The use of General Anaesthetic for Dental Extractions in Children: Researching the complex causal networks and approaches to reducing need

A thesis submitted to the University of Manchester for the degree of Doctor of Philosophy in the Faculty of Medical and Human Sciences

2014

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Total Word Count: 120,840
# Abbreviations

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<th>Abbreviation</th>
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<tr>
<td>BASCD</td>
<td>British Association for the Study of Community Dentistry</td>
</tr>
<tr>
<td>CatPCA</td>
<td>Categorical Principle Components Analysis</td>
</tr>
<tr>
<td>CDS</td>
<td>Community Dental Service</td>
</tr>
<tr>
<td>CT2</td>
<td>Core Training 2 (previously known as SHO)</td>
</tr>
<tr>
<td>CVD</td>
<td>Cardio Vascular Disease</td>
</tr>
<tr>
<td>DBOH</td>
<td>Delivering Better Oral Health</td>
</tr>
<tr>
<td>DES</td>
<td>Dentist with Enhanced Skills</td>
</tr>
<tr>
<td>DGA</td>
<td>Dental General Anaesthetic</td>
</tr>
<tr>
<td>DMFT/dmft</td>
<td>Decayed Missing Filled Teeth</td>
</tr>
<tr>
<td>DoH</td>
<td>Department of Health</td>
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<tr>
<td>ECC</td>
<td>Early Childhood Caries</td>
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<tr>
<td>FT</td>
<td>Foundation Trust</td>
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<tr>
<td>FTA</td>
<td>Fail to Attend</td>
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<tr>
<td>GA</td>
<td>General Anaesthetic</td>
</tr>
<tr>
<td>GDP</td>
<td>General Dental Practitioner</td>
</tr>
<tr>
<td>HES</td>
<td>Hospital Episode Statistics</td>
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<tr>
<td>HSCIC</td>
<td>Health &amp; Social Care Information Centre</td>
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<tr>
<td>IHS</td>
<td>Inhalation Sedation</td>
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<tr>
<td>MCA</td>
<td>Multiple Correspondence Analysis</td>
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<tr>
<td>MRC</td>
<td>Medical Research Council</td>
</tr>
<tr>
<td>NHS</td>
<td>National Health Service</td>
</tr>
<tr>
<td>NICE</td>
<td>National Institute for Health and Care Excellence</td>
</tr>
<tr>
<td>NWPHO</td>
<td>North West Public Health Observatory</td>
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<tr>
<td>OHRQoL</td>
<td>Oral Health Related Quality of Life</td>
</tr>
<tr>
<td>PCA</td>
<td>Principle Components Analysis</td>
</tr>
<tr>
<td>PCO/PCT</td>
<td>Primary Care Organisation/Primary Care Trust</td>
</tr>
<tr>
<td>QoL</td>
<td>Quality of Life</td>
</tr>
<tr>
<td>RCT</td>
<td>Randomised Control Trial</td>
</tr>
<tr>
<td>RR</td>
<td>Relative Risk</td>
</tr>
<tr>
<td>RTT</td>
<td>Referral to Treatment Time</td>
</tr>
<tr>
<td>SPSS</td>
<td>Statistical Package for Social Sciences</td>
</tr>
<tr>
<td>TDO</td>
<td>The Dental Observatory</td>
</tr>
<tr>
<td>UDA</td>
<td>Unit of Dental Activity</td>
</tr>
<tr>
<td>VT</td>
<td>Vocational Training</td>
</tr>
<tr>
<td>X</td>
<td>Extracted</td>
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Abstract


Dental decay remains a global issue but, in the UK, has become concentrated within the most vulnerable section of society, namely young children and the most deprived. When dental decay and subsequent infection become too severe, teeth may need to be extracted under General Anaesthetic. The aim of this work was to develop a greater understanding of the population of young children referred for a Dental General Anaesthetic (DGA) in the North West of England and to explore possible interventions that may positively impact on this group reducing the high number of children undergoing this procedure.

A mixed methods approach was utilised, combining a broad scoping review, quantitative data collection and qualitative interviews. Individually these methods were used to develop a greater understanding of the issue and of the services, processes and patients involved in DGA. The methods were subsequently combined using triangulation to address potential preventative interventions that would be appropriate and acceptable to this group.

Differences were observed between hospitals in treatment experiences of children across the North West of England. These included variations in the environment, hospital setting and time from referral to treatment, all of which were shown to impact on the child. The number of children experiencing a repeat DGA was also high and noted as an area that required further intervention. While DGA could be a distressing experience it was considered necessary and resulted in a positive outcome both in terms of oral health and a child’s quality of life.

Improving oral health in young children who experience severe decay is a complex and challenging area. A number of interventions were identified that could reduce the need for extraction under DGA. These ranged from targeted interventions, linked to information provision and enablement to support those who are more at risk, to policy change with regard to excessive sugar in food and beverages that could have a broader impact across the population.

In addition, DGA service re-designs are discussed including increased provision of prevention that may benefit children referred along this pathway and thereby reduce repeat DGA rates in the future.
Declaration

No portion of the work referred to in the thesis has been submitted in support of an application for another degree or qualification of this or any other university or other institute of learning.

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Acknowledgments

I feel incredibly privileged not only to have been given the opportunity to undertake my PhD at this University but particularly with the people I have worked alongside during my time here. Firstly and foremost I would like to thank my supervisors…

Caroline Sanders whose encouragement, patience and invaluable advice on an area that was relatively new to me was second to none, I always came away from every meeting feeling 10 times better about my work with renewed focus. Your knowledge and considered explanations have been instrumental in completing this PhD.

Iain Pretty for opening doors I had no idea were within my reach and giving me the opportunity to follow this path. You have provided me with incredible support over the years and numerous opportunities that I really can’t begin to thank you for. Your enthusiasm and motivation is contagious and while we often say your mind works 100 times faster than the rest of us the time you take to explain everything, usually with a handy diagram, and again in such a considered and illuminated way is invaluable.

The result of having two supervisors who were able to support and advise in two quite different capacities but both with such dedication and enthusiasm has been priceless and I find it hard to put into a few short words how thankful I am.

In addition I would like to thank all my colleagues and fellow PhD students. To Maureen, Laura, Dave, Brenda, Juliana, and Christian who all made my working day great and understood when I became insular, quiet and lost in a world of writing and analysis. I would particularly like to thank Jo Goldthorpe and Nicola Boothman, Jo again was always on hand for not only work advice, having recently completed her PhD, but also her friendship and support over the years and my irreplaceable Niki who from first interviewing me all those years ago has been my confidant and the first person I go to for guidance. I really don’t know what I would do without you.

Thank you all for making work the kind of place I look forward to come to.

I extend many thanks to Helen Worthington and Tanya Walsh who have helped and given me so much advice and support within my statistical journey not only for the PhD but in many other aspects of work, their guidance has been very much appreciated. I would also like to thank Wendy Olsen who kindly looked over my MCA work, Laura Mackay for her
work on the systematic review and Gill Davies & Mike McGrady who were also kind enough to provide feedback.

My personal thanks to all who took part in this study who must necessarily remain anonymous. I thank you for sharing your time and experiences.

I of course would like to thank my family. My brother and best friend throughout my life, Tom and my wonderful, parents, my role models, I love you both dearly. You have provided me with the encouragement and confidence to follow my passions and belief in me that has made me take on these adventures. I couldn't ask for more. I would like to mention a special thought for my Grandpa who is always in my thoughts.

Finally I need to thank my partner, Matt who has endured so much while I completed this PhD with kindness and patience, from all the little things to helping me return to a state of calm when I had my little melts downs. Without you this would have been much more difficult and life just wouldn’t be as good.

Having (hopefully) thanked everyone, I have to say for any inadequacies or mistakes that remain in this work, of course, the responsibility is my own.
Dedicated to my mum for everything she is and everything she has done for me.
The author

I studied Psychology as an undergraduate and then undertook a Masters in Social Science Research Methods. Following this I worked at a research company specialising in health research and disease programmes. In 2010 I was fortunate to be interviewed and accepted as a Research Assistant at the DHU. Within this role I had the chance to work on a large quantitative data set and was subsequently offered the opportunity to complete a PhD while maintaining my position as an RA. I have been offered numerous opportunities throughout my time at the University to be involved with a number of other studies and occasions to present the unit's work. I feel very privileged within this position.
Introduction to the thesis

This thesis is presented in an alternative format. This allows chapters that are suitable to be submitted for publication or that have already been published as the work progressed to be incorporated into the thesis.

The thesis is divided into three phases or principal components: the background to the area and methodology, understanding the population and services for Dental General Anaesthetic (DGA) and finally the potential solutions to reducing the number of DGA’s carried out in England. These have been presented with the corresponding chapters below.

Chapter 1: Literature Review: A background into dental extraction under GA
Chapter 2: A Scoping Systematic Review: Using a common risk factor approach to map behaviour change interventions, with the potential to impact on caries experience in children
Chapter 3: Methodology: A mixed methods approach
Chapter 4: A study of the provision of hospital based dental general anaesthetic services for children in the Northwest of England. A comparison of service delivery between six hospitals
Chapter 5: A study of the provision of hospital based dental General Anaesthetic services for children in the North West of England: The views and experience of families and dentists regarding service needs, treatment and prevention
Chapter 6: Issues Arising Following a Referral and Subsequent Wait for Extraction under General Anaesthetic: Impact on children
Chapter 7: Subgroups within a Dental General Anaesthetic Cohort: Who makes up this vulnerable group
Chapter 8: A Qualitative Exploration of The Complex Causes of and ways of Reducing DGA in Children
Chapter 9: A Tale of Two Pathways: An evaluation and qualitative exploration of child dental referrals treated along two distinct pathway
Chapter 10: Prevention in Practice: Why are children still undergoing extraction under GA
Chapter 11: Discussion and conclusion
**Background and importance:**

Dental caries is a preventable disease and is by no means a new problem. Despite an improvement in caries prevalence throughout England over the past 30 years (strongly linked to the use of fluoride over this time) there is still a significant part of the young population that suffer this damaging yet preventable condition. The burden of dental disease remains worldwide but is particularly prevalent in underprivileged groups in both developed and developing countries [1].

A survey from the Dental Public Health Intelligence Programme (formally Dental Health Observatory) confirmed that throughout 2008/2009 over 15,000 children in the North West were admitted to hospital for a dental extraction [2]. More recent data from the HSCIC (Heath and Social Care Information Centre) showed children being admitted to hospital for caries treatment rose year on year between 2010 and 2014 [3]. Given the majority of extractions carried out in a hospital setting for children would be for carious teeth and would require General Anaesthetic (GA) [4], there is a significant need (not least due to the morbidity associated with such procedures) to explore why the figures are so high within this region and to determine if there are any interventions which could impact on this challenging area. This issue has been acknowledged not only by academics within the discipline but also by NHS commissioners and consultants. This is evident within Manchester where meetings between relevant dentists, commissioners, specialist in dental public health and the author have taken place over recent years to discuss the problem of GA extractions in the Manchester area, as evidenced by the large waiting list (approximately 400 children and approximately a 6 month wait).

The means of influencing policy to ensure that effective evidence-based prevention is deployed at population and individual levels are central to the research aims. This project articulates a means of identifying populations at risk by using GA referral as the risk factor and, uniquely, aims to understand the populations before commencing a prevention strategy. This is an important feature of health intervention research and has been recognised by the Medical Research Council (MRC) as a fundamental component within developing complex interventions [5]. In order to develop an intervention that is appropriate for this population (receiving GA extractions) it is vital the population needs are understood, and thereby the acceptability of the prevention strategy can be increased.

The research will form the basis of the first two stages of developing a complex intervention according to the MRC framework [5, 6]. The framework has developed over
the years from a linear model to a more cyclical model incorporating a period of
development, feasibility and piloting, informing the interventions and evaluation of the
intervention [6] which can be seen in Figure 1. This change from the original (linear)
guidance was in relation to various criticisms; one particularly relevant to this research
was the recognition that these types of interventions may be best tailored to local contexts
rather than standardised [6]. Context could include the following: wider socioeconomic
background or cultural factors, the system in which the health service operates, the
population and how these factors may change over time [7]. This may be particularly
relevant for the study as the population referred for DGA may include sub groups that will
require modified or differing interventions to impact on the severe decay and subsequent
GA extraction that we are attempting to reduce.

Figure 1: Update of the MRC development and evaluation process [6]

Overall the research involves readdressing the upstream/downstream model with patients
‘downstream’ informing interventions along the entire spectrum from downstream
approaches, looking at individuals and families, to midstream approaches in schools and
communities, to upstream approaches via policy change. It is vital to ensure that the
developed interventions will be the most appropriate for those they are intended to effect.
A common risk factor approach should be incorporated, taking into consideration the idea
of proportionate universalism as it is important to include everyone in societal
improvements but where it may be necessary to have additional resource and support for
those most in need [8, 9]. The aims of this work are therefore:

1) To develop a better understanding of those referred for a DGA and any potential
   subgroups within this particular population.
2) To develop a better understanding of DGA services provided and any differences across regions.
3) To explore potential interventions which may positively impact on this area of reducing DGA extractions.

The chapters are either submitted or in the process of being submitted to the following journals.

**Chapter 1 and 2 combined**

**Chapter 4**

**Chapter 5**

**Chapter 6**

**Chapter 7**
Goodwin, M., Sanders, C., & Pretty, I. (TBC). Subgroups within a Dental General Anaesthetic cohort: Who makes up this vulnerable group. *Community Dent Oral Epidemiol, TBC.*

**Chapter 8**

**Chapter 9**

**Chapter 10**
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Foundation and Summary of Chapter 1

Within any research project it is vital to conduct a background review of the area as a foundation to the enquiry. An understanding of the issues and a justification for the research can then be arrived at. The literature review was the first activity for the PhD. While not a systematic review I attempted to conduct this in a systematic way using lessons learned from both Cochrane and Campbell reviews. Therefore a list of search terms were developed and used within both the Cochrane library and through OVID (an interface for a number of databases). This type of search allowed a compilation of papers that utilised different methods (both quantitative and qualitative), which not only detailed the various determinants and pathways to require a Dental General Anaesthetic (DGA) but also gave a greater understanding of any difference seen and the implications of results spanning the reasons contributing to caries experience in young children.

The literature review considered the various factors thought to have an impact on the development of caries in children, and resulting GA extraction performed. In order to illustrate the various complex causal networks a fan model has been developed (based on the ideas behind Dahlgren and Whitehead’s model of Determinants of Health). The first level of this fan refers to the parent’s of/and the children that undergo Dental General Anaesthetic, followed by the health professionals, community factors and finally national influences. Within this review both the individual and social determinants of oral health, connected throughout the fan levels are explored.

The review concludes that despite the improvement in oral health over the last 30 years, there is still a significant problem in relation to caries and young children. Severe caries can result, in some circumstances, in the extraction of teeth under General Anaesthetic. There are a variety of levels explored throughout the fan model that could have the potential to impact on this area as each has shown to be interconnected to severe caries experience and subsequent GA extraction.

Authors Contributions
MG wrote this chapter, IAP and CS reviewed and contributed to the draft. A reduced version of this chapter will be submitted with Chapter 2 to BMC Public or Oral Health as part of a scoping review on DGA and potential interventions for the future.
Introduction: Caries and Extraction

The negative impact that can arise from oral disease has been established for many years \(^1\). Alongside the damage caused on an individual level, in relation to distress and pain \(^3,4\), it has been argued that dental caries in general is also the most important oral disease from the viewpoint of the NHS \(^5\). It is crucial to consider the impact of oral health beyond simple caries experience. Early tooth decay could result in a variety of problems for children given that developmental factors can interact with many aspects of a child’s oral health. An example is the association of mean dmft (decayed missing filled teeth) with school performance data amongst 5 year olds in the UK \(^6\). The issue of oral disease within children is of particular concern, not only due to the vulnerability of this group, the short and long term effects casting long shadows into later life \(^7\), but also the fact that it is both entirely preventable and one of the most common childhood diseases in the world, with 60-90% of school aged children being affected by caries in most industrialised counties \(^1,2,8\–10\).

“Although dental problems don’t command the instant fears associated with low birth weight, foetal death, or cholera, they do have the consequence of wearing down the stamina of children and defeating their ambitions. Bleeding gums, impacted teeth and rotting teeth are routine matters for the children...Children get used to feeling constant pain. They go to sleep with it. They go to school with it...Children live for months with pain that grown-ups would find unendurable. The gradual attrition of accepted pain erodes their energy and aspirations...To me, most shocking is to see a child with an abscess that has been inflamed for weeks and that he has simply lived with and accepts as part of the routine of life. Many teachers in the urban schools have seen this. It is almost commonplace.”

(p, 114, \(^11\).

While this extract is taken from a reference to children in American schools it illustrates clearly the problem and damage that can be done to children who endure the pain and discomfort that caries can cause and which they may have had to deal with for some time. Caries is one of the key issues when looking at oral health. It is a progressive disease caused by bacteria, which can lead to the destruction of the hard tissues of the tooth structure, if untreated this can be followed by infection and pain \(^12\). Acute cases of caries within young children are often referred to as early childhood caries (EEC), characterised by a distinct pattern of severe tooth decay. This severe tooth decay has also been
referred to as baby bottle caries, nursing caries and night bottle mouth. Early tooth loss caused by caries can result in a number of problems: growth, weight gain, quality of life, communication and cognitive development, often affecting and interfering with nutrition and concentration and at times impacting on other aspects such as, attendance at school.

If caries and subsequent infection become too painful for a child to endure or the teeth are beyond restoration, one treatment option is to extract the teeth to relieve the distress. While extractions on children can be performed within a practice setting, it is apparent that on occasions a dentist will feel unable to carry out this procedure without the use of some form of sedation, i.e. General Anaesthetic (GA), where the patient completely loses consciousness. Dental General Anaesthetic (DGA) is an vital component of dental treatment but is employed, in theory, only in the most extreme or acute cases, due not only to the risks involved, time constraints and distress, but also to the requirement for the procedure to be carried out within a hospital setting. Conversely, DGA can produce immediate benefits to oral health by removing decayed teeth and therefore should be carefully considered against other options. The amendment to restricting the use of GA within a hospital setting developed after the publication of ‘A Conscious Decision’ in 2000 by the Department of Health. This review concluded that Dental General Anaesthetics carried out within a practice meant patients were vulnerable to unexpected death and this needed to be properly regulated. Extractions for caries carried out in hospitals have risen dramatically; over a period of 10 years from 1997 to 2006 they increased by 66%. Although an initial jump would have been expected in 2002 when the change in GA regulations came into place, this increase has continued rather than levelled out or decreased since this time. More recent data from HSCIC (Heath and Social Care Information Centre) has shown a year on year increase from 2010 to 2014 for children attending hospital for caries treatment in England.

There are a number of reasons associated with the decision to refer children for an extraction under GA. These include the number of teeth that need to be extracted, acute pain experienced, the age of the child or the behaviour, i.e. anxiety or needs of the child. Although clinical need is the main factor discussed when looking at the reasons behind GA extraction, some studies have indicated that other factors can also influence this procedure, for example, patient demand and the availability and convenience of GA. Many hospitals state that extractions must not purely be for orthodontic purposes with the majority being performed for caries in the primary dentition followed by caries into mixed dentition in children.
A recent survey on the use of GA for dental extractions in children suggested more than 50,000 children undergo this procedure each year in England. Additionally data from the Dental Health Observatory confirmed that throughout 2008/2009 over 15,000 children in the North West were admitted to hospital for an extraction, the majority of which would be under GA. With the high number of extractions carried out in the North West, as well as this area having among the highest average number of decayed, missing or filled teeth (d3mft) in 5 year old children (see Figure 1.1), there is a significant need, not least due to the morbidity associated with such procedures, to explore why the figures are so high within this region and to determine if there are any interventions which could reduce the number of children having an extraction, particularly under GA. In addition to the social, clinical and education issues associated with these procedures, they also represent a substantial cost to the NHS. A national costing report released in 2010 estimated the cost of dental general anaesthetics for children alone at £36,282,960. These figures must be considered in the context of an entirely preventable disease.

Figure 1.1: Average d3mft in five year old children, 2012

While this research will concentrate on oral health within England and specifically the North West it is important to note the international incidence of DGA. Children undergo this procedure across many other countries including Australia, New Zealand, Canada and the USA. However, countries do utilise DGA differently and it has been noted that many European countries either do not use DGA to the same extent as the UK or it is simply not given for dental surgery. There has also been a difference noted between the UK and USA when dentists from both countries were asked about treatment plans for

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children in pain. A marked difference was seen in the clinical decision; where 39% of UK dentists discussed the use of GA to extract a tooth compared to just 4% of USA dentists.

This review will take into account the determinants of both oral health and conversely the disease, in relation to caries, and the subsequent extractions under GA that occur. The combination of complex causal pathways will then be explored building on each level of factors or networks which could integrate to result in a child being referred and receiving an extraction for caries under GA (see Figure 1.3).

**Determinants of Health**

The health and wellbeing of both the population and individuals are influenced by a number of factors, some within an individual's control and some in the control of the wider community and established policy. A model created by Dahlgren and Whitehead encapsulates the interplay of the various factors that can determine potential health (see Figure 1.2). This ranges between fixed factors such as, age and genetics and factors that can be altered or modified such as lifestyle, environment and general socio-economic and environmental conditions.

A variety of research and intervention studies have shown that the fundamentals of good health in later life are put down in early childhood. The health impact of early development can cast long shadows over health into adult life. This is particularly true in relation to dental health with studies indicating that oral health in adulthood is predicted by both childhood socioeconomic disadvantage as well as oral health in childhood. Oral health is also a good indicator of health in general and in cases of oral disease being persistently left untreated, can indicate a more worrying possibility of child neglect.
Social Determinants (influences) of Disease

For many years attempts to identify the causes of caries in children have concentrated on a few key variables, primarily biological in nature, often referred to as ‘downstream’ factors. Models that have been developed on this basis have resulted in the ability to predict caries development, with a high degree of sensitivity but also identify healthy children as a caries risk (low specificity). However recently there has been an effort to challenge this and develop a comprehensive model of caries development; incorporating the importance of interactions between behavioural, social and biological factors. The psycho-social, economic, political and environmental elements within this can be collectively referred to as the social determinants of health.

The health inequities seen both within and between countries are considered to mainly be attributed to these ‘social determinants of health’. In response to increasing concern on this issue WHO commissioned a report on the social determinants of health to provide advice and recommendations. These included the following factors: improving daily living conditions; tackling the inequality of power and resources; measuring and understanding the problem and assessing the impact of action. The final recommendation has, in part, driven the focus of the following review and consequent research in more deeply understanding the problem of extreme caries experience in young children and the various interventions that may have a positive impact.

Based on the ideas behind Dahlgren and Whitehead’s model of Determinants of Health a fan model has been developed to illustrate the various factors thought to have an impact on the development of caries in children and resulting GA extraction performed (see
Figure 1.3). The first level of this fan refers to the parents and children (who result in having a GA for tooth extraction), followed by the health professionals, community factors and finally national influences; within this both the individual and social determinants of oral health, connected throughout the fan levels will be explored.

*Figure 1.3: Diagram of determining factors associated with or contributing to the administration of GA for extractions of carious teeth*

**Self-care: Parent/Child Related Factors**

*Figure 1.4: Fan Model - Parent and Child factors*

It is acknowledged that despite the strong biological factors that actually cause caries such as cariogenic bacteria, inadequate salivary flow and a lack of fluoride, aspects such as bacteria alone are not entirely sufficient in causing a carious tooth. Other factors must be in place on which these bacteria can act over time on a susceptible tooth or host. These ‘risk factors’ can include: poor oral hygiene, poor diet and inappropriate infant feeding practices elaborated on within this section.
Oral Hygiene and Habits

Poor oral hygiene, for example a lack in adequate tooth brushing, is strongly linked with dental decay as a variety of studies have demonstrated that children who brush their teeth more often have fewer occurrences of caries. Hind and Gregory showed that while only 24% of children who brush more than once a day experienced caries, 48% of children who brushed less than once a day had dental decay. They also found that supervised brushing resulted in a lower prevalence of dental decay compared to when a child brushed their teeth on their own. This was most noticeable in the youngest age group where 7% of children who brushed their teeth unsupervised experienced dental decay, compared to only 1% of children who had supervised brushing. However the value of tooth brushing in relation to caries in fact lies with the regular application of fluoride. It is the use of fluoride at home (mainly within dentifrices) that has been the main factor associated with the decline of caries in most industrialised countries, especially since the 1970s, as it has become more prevalent and used more extensively. A recent study indicated that oral health professionals concentrate on tooth brushing techniques when teaching patients about dental health, rather than fluoride toothpaste use as they believe this knowledge is already familiar to the majority of people. Fluoride interventions such as gels, varnishes and toothpaste were shown in a recent systematic review to have the most consistent benefit in arresting or reversing the development of noncavitated carious lesions.

Regular dental attendance is another area which has been linked with dental health. There is also a secondary relationship when it comes to children and attendance, as associations have also been shown between children’s caries experience and the mothers’ dental attendance pattern.

Diet and Infant Feeding Practices

Poor dietary habits such as the frequent consumption of sugars and refined carbohydrates have been shown to play a major role within the development of caries. There has been a particular relationship established between caries experience in young children and non milk extrinsic sugars consumed one hour before bed.

It is also recognised that early childhood caries are closely associated with infant feeding practices. Putting a young child to bed with a baby bottle or leaving the child with the bottle for some time is thought to be a contributor to childhood caries and was often
referred to as nursing caries. Research has indicated that using a feeder or training cup from the age of 8 to 12 months, instead of a baby bottle can greatly reduce caries within very young children. However in reality most babies are fed with a bottle at some time and therefore the evidence for bottle use is mixed. In relation to both dietary intake and bottle use one issue can be the consumption of fruit juices and fruit flavoured drinks. Many parents believe that these are an important part of their child’s diet as they provide vitamins and nutrition. However they also have the potential to cause damage to the tooth tissue due to the levels sugar and acidity.

**Psychosocial factors: Anxiety, Stress and Control**

Anxiety can be a feature in a range of ways in relation to a GA extraction for caries. Firstly, parental dental anxiety has been positively associated with children’s caries experience. Secondly the anxiety of the child or parent could be an underlying factor in irregular dental attendance as dental anxiety has been shown to be a contributing factor when examining barriers to seeking dental treatment in both adults and children. This can be an important consideration as dental attendance is known to have an association with dental health; whilst non attendance at the Dentist prevents children from receiving the adequate care, advice and treatment needed to prevent the extreme form of caries, which results in DGA.

Thirdly, the level of anxiety that a child may have in requiring a tooth extraction is often cited as a contributing factor in a referral for GA extraction. Anxiety can therefore lead to a vicious cycle as children who are irregular attendees usually only attend with pain and often require an extraction. The extraction is also associated with anxiety which could lead to a continued pattern of poor attendance, extraction and continuing dental anxiety.

Stress has its links to both physical and mental health and has been extensively studied within research. However, in relation to oral health and specifically caries within children there has been significantly less work. In fact studies have reported conflicting results, Quinonez et al., indicated that while higher caries rates were found consistently for children whose caregivers reported stress, the total parent stress score did not maintain a strong relationship amongst other factors present in contributing to childhood caries. However, Finlayson et al., found the opposite, with an significant inverse association between early childhood caries and parenting stress scores. It was hypothesised that this was due to stress levels which reflected greater conscientiousness on the part of the parent or another adaptive quality. This study also indicated no significant association with
caries and self-efficacy but an association with 'fatalistic belief' was apparent nearly tripling the odds of the disease.

Behavioural risk factors can be studied by exploring aspects such as a person’s attitude based on the assumption that behavioural intentions can be measured. Locus of control is one theory which looks at explaining behavioural patterns based on the concept that behaviours are determined by an individual's own ability to control events, i.e. a person may believe they determine their own health or that health is based on luck or fate. Studies have shown that parents' locus of control is associated with their preschool children’s caries experience.

**Socio-demographic and Deprivation**

On top of factors such as oral hygiene, diet and infant feeding practices other factors related to the risk of caries include deprivation and socioeconomic status, including education and income. Inequalities and deprivation have not only been shown to be a factor in relation to the number of children who have caries but also in the care that they receive. A study by Tickle et al., showed that children from deprived backgrounds who regularly attended the dentist were still more likely to have an extraction than their more affluent peers, irrespective of caries experience. Therefore disadvantaged children could be at risk of having inequality on top of inequality if they don’t receive the same standard of care.

**Special Needs, Disability and Medical History**

It is well established that people with learning disabilities, mental health problems or other special needs, experience physical health inequalities throughout the UK. This can include people who have a physical, mental, behavioural, cognitive or chronic medical condition, which may require healthcare that is outside what would be considered ‘routine’. In relation to oral health this may be due to the fact individuals may have more limitations in the ability to carry out good oral hygiene due to potential motor disabilities. There may also be an issue with cooperation or understanding the importance of oral health. Other factors such as xerostomia (dry mouth) can also increase susceptibility to dental caries as the lack of saliva means bacteria activity increases. Studies involving children and young adults who have special health care needs have shown they have a higher prevalence of dental caries and need for restorative care. In relation to General Anaesthesia, studies have found that children referred for GA in relation to dental
treatment who have a chronic illness or disability are significantly older and require a significantly higher number of extractions, indicating these children could benefit from earlier visits to hospitals in order to have restorations and further prevention rather than extractions 80.

**Attitudes to Treatment and Patient Demand**

Morbidity after GA extractions is common and can be distressing for not only the young patients but also their parents or guardians 28. A qualitative study carried out in 2006 indicated two conflicting attitudes to GA extractions, stating while the experience of a child undergoing dental general anaesthesia was ‘troubling in a variety of ways’ for not only the child but also the parents, parents also reported a positive impression of the dental outcome and improved oral hygiene behaviours. A positive reaction may not be too surprising as the dental extractions would have meant their children were no longer suffering from the pain of the decayed tooth 33. Some studies have also reported that dental care under GA is well accepted by parents, with parents reporting more smiling and improved school performance after the operation 81.

Despite parents in some studies indicating a change in oral health behaviour with their children following a DGA, the attendance for repeat GA has been shown to be an area of concern. One study showed that children who received a DGA before their 4th birthday had a high risk of a repeat GA within a relatively short time 82. A separate study indicated that while repeat GA is relatively low it still occurred, with 12% of children at Liverpool Dental Hospital having received a previous GA extraction 23. Patient demand has been shown to play a part within GA referrals, especially in relation to repeat GAs for dental extraction. Albadri 23 established that a quarter of patients were self referred for GA extractions. Furthermore, Harrison [60] found that self referrals rose from 14% to 30% in the second treatment for exodontias under GA, indicating parents may consider this an acceptable or even desirable form of treatment.
Practitioner Related Factors

Figure 1.5: Fan Model - Practitioner factors

In theory a strict set of guidelines should determine whether a child is referred on to have an extraction under GA following an agreed care pathway. However, a number of studies have indicated that a large proportion of referrals may be inappropriate.

Competency and Confidence

A number of studies have indicated dental students may not be equipped with sufficient clinical expertise relating to their paediatric dental skills. This could be due to a lack of competence or confidence in their abilities. A study conducted across three dental schools found that while students appeared to satisfy the requirements of the General Dental Council’s ‘The first five years’, students’ confidence scores were lowest for the ‘management of dental trauma’ and ‘selecting patients for GA, risk and instructions’. In fact the mean score for Manchester students was below average confidence for patient selection for a DGA. However, in relation to carrying out extractions under local anaesthetic the majority of students had had the opportunity to carry out this procedure; ranging from 87% to 98% across the three schools. A separate study conducted in 2008, which examined referrals under local anaesthetic rather than general anaesthetic also found that 7% of GDPs referred based on their lack of expertise.

Contracts and Attitudes

Little research has been conducted looking at the effect of different contracts on referrals out of primary care and onto secondary care involving GA extractions. It is possible that dentists may choose to refer a child for a GA extraction for reasons other than the clinical need. These could be due to the cost and time taken to perform these procedures, the
negative effect it can have on the child and their family and therefore on their potential to return to the dentist in the future, the availability of GA or the facilities and alternative treatments on offer [17, 64]. A study conducted in 2008 indicated that of 110 dentists surveyed 23% cited financial considerations in relation to reasons for referring children from primary care 86.

At the time of writing this review, the method of remunerating dentists is based on “Units of Dental Activity” (UDAs). However there are now plans to introduce different pilot schemes across England to determine which model should be used in the future after it was admitted that the current UDA system was not working. A study is about to begin which will explore the impact on dental disease and oral health related quality of life of a new blended contract model which is incentive driven against the current UDA model 87. A study conducted in 1990, when the process of remunerating dentists was different to the present arrangement of UDAs, compared the dental care of children with either a fee for service or capitation system. This study, although relatively old, showed that under capitation more preventative care was provided and fewer extractions were carried out 88. However, it is also argued that under capitation, as dentists are paid whether they provide treatment or not, this can encourage under-treatment and neglect 89. In fact a second paper connected to the aforementioned 1990 paper looked into whether capitation encouraged 'supervised neglect'. This concluded that while there was no evidence of systematic neglect in children treated under the system of capitation, there was a greater number of untreated decayed teeth and fewer fillings being carried out 90. A further review conducted in 2006 indicated that remuneration can have a large effect on treatment and financial incentives can indeed heavily impact on behaviour 91.

Hastings attributed other non-clinical factors relating to the decision for referral under GA to attitudes and norms of the dentist 21. However while this study also indicated that the dentist had the greatest influence on the decision for GA use in extractions, other studies have recognised the role that patients and their families can play 23.

**Dental Health Education**

Dental and allied professionals have a moral responsibility to instil within patients the importance of preventing disease and how to achieve this. However, this need is not always reflected in the remuneration for dentists, with fees based on treatment rather than on maintaining health. A variety of studies have been conducted looking at both professional and community schemes for improving oral health behaviour while others
looked further at the effects on plaque removal or caries\textsuperscript{92–94}. Some studies have shown that oral health promotion from a trained dentist can produce a positive change in areas such as brushing behaviour and improved knowledge\textsuperscript{92}. Studies looking at pre-school dental health education, professional instruction and practice-based prevention did not show any evidence as to an effect on caries levels according to Kay's systematic review\textsuperscript{93}. The same systematic review did detect an intervention effect on the reduction of plaque accumulation. However it was noted that this area, in general, had been poorly researched, with issues around the use of RCTs\textsuperscript{93}. Other studies looking at non-practitioner related dental health interventions have shown to have some success in affecting caries experience. A randomly selected cohort of children assigned to various health education interventions vs. control showed regular home visits to mothers when deciduous teeth erupted was effective in preventing early childhood caries\textsuperscript{95}. A more recent controlled, longitudinal study has added to previous work showing both home visits and telephone contact conducted every six months reduced child caries at 24 months\textsuperscript{96}.

**Tooth Protection/Prevention**

There are a variety of methods, which can be employed by dentists or other similar health professionals in order to reduce the risk of developing caries. It has been acknowledged that there has been a notable improvement in oral health over the past 30 years. This has not necessarily been down to a change in behaviour or significant change in dentistry but to the introduction of fluoride on a mass scale (mainly in dentifrices)\textsuperscript{45}. Fluoride is a mineral that can prevent tooth decay by encouraging re-mineralisation, improving the structure of the tooth enamel and reducing bacterial growth\textsuperscript{97,98}. Various systematic reviews have been conducted on the use of fluoride both within practice\textsuperscript{99} and for everyday use\textsuperscript{100–102}. One review suggested the use of fluoride varnish within a practice setting, applied professionally two to four times a year, produced a substantial caries inhibiting effect in children’s teeth\textsuperscript{103}. Additionally a recent RCT examining the surface specific efficacy of fluoride varnish on preventing caries indicated that while there was a 25% reduction (RR) in surface level caries risk, the intervention was most effective on surfaces that were sound at baseline\textsuperscript{104}. A recent large scale cluster randomised control trial involving 3133, seven and eight year old children found fluoride varnish application in a *school setting* showed no statistically significant effect on decayed and filled surfaces (DFS) and therefore concluded there was no demonstrable effect as a public health measure within this particular setting\textsuperscript{105}. Further systematic reviews have assessed a variety of fluoride products including fluoridated milk\textsuperscript{106}, fluoride mouth rinse\textsuperscript{102} and fluoride toothpaste\textsuperscript{100,101}. While there was insufficient evidence that fluoridated milk would
prevent tooth decay, the systematic review on both fluoride mouth rinses and toothpastes had a clear association with the reduction in caries in children.

A further preventative measure which can be taken up by practitioners is to apply a fissure sealant on permanent teeth. A sealant is a coating applied to the occlusal surfaces of molar teeth. They can prevent the growth of bacteria that lead to decay within the occlusal anatomy. A number of systematic reviews have established the benefit and effectiveness of sealant use for those with high caries risk. One indicated a reduction of over 50% in decay on biting surfaces for sealants vs. no sealant in children aged between 5 and 10\textsuperscript{107}. Another looked at a number of non-surgical caries preventative methods in relation to caries. It concluded sealants and resin infiltration had the potential to slow the progression of noncavitated carious lesions\textsuperscript{47}.

**Community Related Factors**

*Figure 1.6: Fan Model - Community factors*

**Access Issues**

Despite the increase in the number of regular dental attenders over the past 30 years (from 43% in 1978 to 61% in 2009\textsuperscript{108,109}), access to dentistry remains an issue. There is still a suggestion that some people are unable to access routine or emergency dental care in England today, with varying regional differences in the ability to access services\textsuperscript{110,111}. However alternative theories are that while the option of care is available other barriers such as cost prevent access for some patients\textsuperscript{112}. In theory this should not apply directly to children, as dental care for children is free under the NHS. However it may be a factor affecting parents’ regular attendance, which has been linked to the regular attendance
and caries prevalence in children. While attendance has increased it may still be the case that those who have the greatest need, use the dental services available less often and less effectively than those with the least need. This is referred to as the inverse care law and can be seen not only in treatment of illness and disease but also within health promotion and prevention.

**Training**

(See also Practitioner Related Factors: Competency and Confidence)

Training within Dentistry involves diagnosis, prevention and treatment of disorders and disease related to oral health. After 5 years of undergraduate training, one year vocational training (VT) is also required for all new UK dental graduates. This training throughout Universities is guided by the GDC documents ‘The First Five Years’. Studies examining the undergraduate training have concluded that while treatment and diagnosis training for general practice had been covered well, a large proportion of both undergraduates and trainers felt training in surgical endodontics and extraction had not adequately prepared them for VT. This has been mirrored in the Dental Programme Board of Medical Education England whose review of Oral Surgery training recommended a substantial increase in the number of training posts in Oral Surgery. In a study in 2006, training in Paediatric Dentistry was thought to be poor or very poor in relation to sedation training by over half of the trainers, 13% of GDPs thought training in extractions was poor/very poor whilst other areas such as behavioural management were found to be satisfactory for both GDPs and trainers.

**Referral Process**

There are a variety of ways that children can be referred for a GA extraction. In some areas referrals are paper triaged before appointments are issued, in others children are triaged at a clinic or at hospital before the operation. For most hospitals there are standard forms to use when referring a child for GA extraction (although these are not always utilised). A number of studies have indicated that there is a high incidence of inappropriate referrals, with an apparent lack of understanding from referring dentists as to the appropriate provision of DGA plus little adherence to the GDC guidelines surrounding this pathway. As a result such referrals are often rejected by the triaging dentist. As discussed in the training and competency section referrals may be sent through due to the confidence or skills of the referring dentist, however it has also been suggested in previous research there may be a ‘perverse incentive’ to under prescribe...
and increasingly refer under the present contract with dentists cost shifting and looking to ‘offload patients’ if they were at risk of financial loss under the UDA system. A recent EPOC review was conducted regarding financial incentives (fee-for-service, fixed salary and capitation payments) on dentist clinical activities. The number and quality of studies limited the conclusions that could be drawn. However from the two studies that met the inclusion criteria the authors suggested financial incentives within remuneration system could produce changes to clinical activity but further research in this area was needed.

There has also been debate as to the value of DGA, not only due to the potential risk they impose and the subsequent morbidity, but also due to the long wait that some children have before receiving their treatment. Previous studies have shown waiting times vary for DGA between three and 84 weeks. Given that a child may be in considerable pain during this time it is worrying that wait lists for GA extractions can be lengthy, as children are effectively not receiving the treatment they need while they are in pain. Several PCTs have invested in rapid access schemes, although such schemes are reliant upon appropriate and proportionate referrals. Knowledge of long wait times for treatment may act as a perverse incentive to refer early, often before treatment is needed, with the belief that by time the child is seen they will be ready for treatment. This referral behaviour has also been discussed in relation to orthodontic referrals.

**Alternative Services and Sedation Techniques**

There are three main techniques for the pain and control of anxiety for extraction in paediatric dentistry: General Anaesthetic, Conscious Sedation and Local Anaesthetic. General anaesthetic has been a technique that has been used for over 100 years. It was introduced as a means of carrying out pain free dental work after a successful demonstration by Morton in 1846 whereas local anaesthetic became more commonly used after 1940 with the introduction of lidocaine. GA is defined as "Any technique using equipment or drugs which produces a loss of consciousness in specific situation associated with medical or surgical interventions" (p.8 in 17) and can be administered through inhalation, intravenous (IV) or through intramuscular inductions. Conscious sedation on the other hand is a "technique in which the use of a drug or drugs produces a state of depression of the central nervous system enabling treatment to be carried out, but during which verbal contact with the patient is maintained" (p. 73, 112). Conscious sedation can be administered through Inhalation sedation, IV sedation or orally. Whereas local anaesthesia are used to perform infiltrative techniques and nerve blocks, this can be combined with conscious sedation if thought appropriate.
Conscious sedation is often viewed as an alternative to GA when considering dental care in children, i.e. using inhalation sedation with nitrous oxide (IHS) \(^{123}\). However both of these procedures (GA and IHS) carry the risk of mortality and can be associated with post operative morbidity \(^{124}\). A Cochrane review carried out in 2009 stated that the assessment of studies included, suggested that the need for GA in many children may be prevented with the use of IHS and may also result in better outcomes when looking at morbidity \(^{123}\). It was acknowledged that IHS is not suitable for very young children which is an issue when it is considered the peak age for caries related extraction is 5 years old \(^{18,125}\). In addition to the morbidity features between sedation and GA, Jameson et al., \(^{29}\) also examined the cost of both procedures. They determined GA was 46.6% more expensive than advanced conscious sedation. It was noted that further research involving well designed RCTs would be required to make a direct comparison between GA and other sedation techniques for dental extraction which are also appropriate for young children.

There have been a variety of changes, particularly over the past 20 years, in relation to services offered for children who require dental treatment and specifically under different forms of anaesthetic. A working group led by Professor Poswillo made a variety of recommendations concerning the use of sedation and general anaesthetic in 1990. These proposals included avoiding GA's where possible, that dental surgeries should be inspected/registered and that the same standards should be observed in both surgery and hospital \(^{121,126}\). Despite the Poswillo recommendations a number of deaths occurred throughout the 1990's involving DGA, 5 of which were children \(^{17}\). Therefore the use of general anaesthetics for dental treatment was moved solely into a hospital setting in 2002 after the Department of Health published 'A Conscious Decision'. At this time an increasing number of children were seen through the Community Dental Service (CDS) as sedation was also recommended to be used in preference to GA in the Poswillo report \(^{122,126}\). Historically there is no clear or defined pathway for children who have extensive caries or may require multiple extractions at a young age. It is recognised that there may be geographic differences in services dependent on the commissioners involved, on various providers and on the dental need and demand in the area. A paper by Robertson et al., concluded that the differences seen across DGA referrals in Yorkshire and Humber could be due to not only rates of decay but also access to DGA services and whether alternatives such as inhalation sedation were provided \(^{127}\). Within the Northwest we are aware of a variety of services in other locations all of which are run and provided for in different ways and could have been shaped by historic provision. There are GA services that are provided by the CDS and run through hospital settings. This may be due to a
legacy left over from the changes suggested by the ‘Poswillo’ and ‘A Conscious Decision’ reports. Other GA services are run by Consultants in Paediatric dentistry, within a hospital setting, while some are run by GDPs who have a contract with a hospital provider and even some by Maxillofacial Consultants.

Changes and Variations within the Community

Within certain communities there is a high level of mobility (relocation into other geographic regions). This can affect not only regular dental care and advice acquired but also affect the ability to implement various health care interventions. A prime example of this is the population within Manchester. A study by Davies et al., demonstrated that one of the primary reasons for non involvement in an oral health promotion pilot was the movement in and out of the area, which meant that nearly half of the children had not been able to participate in the intervention 128.

Another aspect to consider when looking at oral health is the dental experiences of minority ethnic children. This population has grown rapidly over the past 50 years. There have been mixed data concerning ethnicity in relation to caries; studies have found some differences between ethnic groups for both caries experience and oral hygiene/dietary practices 129,130. Bedi's survey of children throughout Trafford in 1998 noted the probability of being caries free was greater for Afro-Caribbean groups, compared to white, while the probability of having rampant caries was increased for the South Asian (specifically looking at those with non English speaking mothers) group compared to the white group. This could be a significant factor as language and culture could influence understanding and also parental attitudes. As ethnicity and culture could play a part in effectively delivering oral health advice it would be important to examine these in relation to effective prevention strategies involving parenting and attitudes to oral health and diet.

Social Environments/Social Structures

Social structures and social environments are also considered to have a major influence over health behaviours. As mentioned previously, early life experiences can have a profound effect on later life, for example, low social economic conditions resulting in the negative psychosocial health of an individual can subsequently effect health behaviours and consequently contribute to the formation of health inequalities 8,37. This can be seen as a result of how individuals from different backgrounds with varying vulnerabilities and
capabilities interact with others, their environments and their control over resources and information available to them. Environment and social position can influence opportunities with people who are on the 'lower rungs of the ladder' having a lesser sense of control, increased stress, experiencing prejudice and possible additional risk to both occupational and environmental hazards. All of these factors combine to produce individuals with poorer social support and lower self esteem which shapes their pattern of behaviours to become either more risky or less beneficial to their overall health\textsuperscript{131}.

A number of studies have explored the social structures around both dental caries and dental general anaesthetic. One study looking at DGA children in Scotland found over half of parents would opt for their child to have a DGA again. This was described as predictable given the culture of acceptability and reliance on DGA\textsuperscript{20}. Indeed a paper looking at familial and cultural perceptions and beliefs indicated cultural and ethnic diversity was an important factor in how parental attitudes varied and impacted on behaviour related to good oral health\textsuperscript{132}. This issue has been described in another paper in regards to both acceptability and from where and from whom information is received. Following a DGA, some parents were resistant to doctors giving advice on oral health, as they had 'never experienced it themselves'. It was suggested that information should come from trained parents where a similar cultural background and/or experience could be established\textsuperscript{133}. It is argued that rather than focusing on individual actions alone these should be combined with an understanding of the social environments in which the behaviours are developed in order to effectively tackle health related issues\textsuperscript{39}.

**National Related Factors**

*Figure 1.7: Fan Model - National factors*
The UK dental service is constructed of both NHS and private dentists working in practice. Services are available through practices to attending patients. For other groups who have problems accessing care or have special needs provision is supplied through the ‘Community Dental Service’ (CDS) of the NHS [81]. CDS can also provide GA extractions, although these are carried out in a hospital setting.

**Policy and Healthcare**

In 2005 an Oral Health Plan for England was developed after the Government White Paper *Choosing Health: Making Healthier Choices* was published \(^{134}\). The document, while acknowledging the improvement in child oral health over the last 30 years, indicated that there are still inequalities in dental health associated with social background. This document identified common causes of poor oral health, including oral hygiene, diet and looked at the key roles and responsibilities for improving oral health. Some of the suggestions included the following: encouraging preventative dental care, improving diet and reducing sugar intake, and increasing the use of fluoride, possibly looking at water fluoridation. An integrated working approach was also discussed within the document, after it was recognised that non communicable disease such as obesity, diabetes and oral diseases share a set of common risk factors, such as diet. A targeted population approach is also advocated which involves identifying specific communities which may be at a greater risk of disease and using strategies within these groups. These actions should also be implemented along with complimentary measures such as strengthening community action and promoting oral health by creating supportive environments.

Following the production of ‘Choosing Better Oral Health: An oral health plan for England’ a document was produced to guide dental teams in the actions they should take and advice that should be given in order to promote oral health and prevent disease. This document was called ‘Delivering Better Oral Health: An evidence based toolkit for prevention’ \(^{135}\). It details the advice to be given such as supervising tooth brushing of young children, advice on fluoride use, frequency and times of sugary drinks and snacks and other areas such as sugar free medicines. While this advice provides a comprehensive and detailed guide on caries prevention and may have resulted in changes at a population level, it is apparent that with the number of very young children having extractions under GA that there are still groups who are falling outside of this
practice and policy. It could be argued, particularly due to the inverse care law discussed earlier that DBOH could increase inequalities if steps are not taken to encourage parts of the community to attend, given those in most need often do not utilise the health services available 113.

A programme called Childsmile was initiated in Scotland in 2005, which aimed to improve the oral health of children in Scotland and reduce the health inequalities seen in young children. This was to be achieved by shifting care towards prevention and promoting good oral health in infancy. An element of the programme involved encouraging practitioners to apply fluoride varnish to the teeth of young children that showed signs of decay and provide additional advice to parents. Dental health support workers encouraged families to visit either a dentist or salaried service when their child was approximately six months old. Childsmile nurseries and schools were established to provide clinical prevention activities 136,137. Although this programme has not been completely evaluated at this stage it appears to be on target to establish a model of dental care that has the potential to improve the dental health of children and reduce inequalities 138. There is no direct data about DGA extractions in a hospital setting and whether Childsmile has had an effect on the number seen. The ISD NDIP database does have data on the total number of extractions carried out on children over the last 10 years. These show that in 2004 (before Childsmile) there were 133,744 claims for extraction this dropped to 97,715 in 2014 139.

**Water Fluoridation**

Artificially fluoridated drinking water has been available across a number of regions in England since the 1950's. Deliberately fluoridating drinking water developed following a study conducted in 1944 which noted the different levels of naturally occurring fluoride in the water in North and South Shields (South Shields being 1.4ppm higher than is present in most water supplies) and that the children in South Shields had a much lower caries rate 140. Since then a wealth of evidence has been collected showing the benefits of water fluoridation on caries levels 141. However the area has been fraught with controversy and difficulties given the risk of developing fluorosis and issues around legislation. The arguments against water fluoridation have been recently revisited following the attempt of South Central Strategic Health Authority to introduce a new scheme in Southampton (which Public Health England have recently stated will no longer go ahead). Much of the more reasoned arguments against such schemes are the reduced levels of decay in the UK seen over the last 30 years. However, this ignores the distribution of the disease in the most disadvantaged. While water fluoridation may be beneficial there is still an issue when
considering the ability to align the supply of fluoridated water to the geography of those most in need. Within the UK, approximately 10% of the population live in an area with optimally fluoridated water, including areas of Cumbria, Cheshire, Lincolnshire and Bedfordshire. The majority (5.8 million) live in areas supplied with artificially fluoridated water, predominantly in the West Midlands and parts of the North East \[142\].

**Epidemiology**

Large scale dental surveys conducted by, and in conjunction with, the North West Public Health Observatory (NWPHO), The Dental Observatory (TDO), the Department of Health (DoH), BASCD and other stakeholders were carried out throughout England from 2007 to 2009 for children aged 5 years old and 12 years old \[143,144\]. Both showed a variation across different PCTs for the average number of dentally decayed, missing (due to decay) and filled teeth (d$_3$mft). For children aged 5 years old the North West was shown to have the highest average d$_3$mft, while for children aged 12 the North East had the highest D$_3$MFT, followed by Yorkshire and Humber and then the North West. The level of children who had some form of decay was still relatively high, despite the reduction in caries in children over the past 30 years. In the North West the percentage of 5 year old children with a d$_3$mft of above 0 was 38.1% \[143\] with 12 year old children showing a similar experience at 39.8% \[144\].

Data collected from Hospital Episode Statistics (HES) indicated a disturbing trend in relation to the treatment of dental conditions in England with an increase of 66% from 1997 to 2006 for extractions due to caries. However this is thought to coincide with the change in policy with regard to general anaesthetics being moved to a purely hospital environment \[18\]. Nonetheless it should be noted that worryingly the number of extractions did not purely jump within the year that policy changed but have continued to rise year on year. The data revealed that extraction for carious teeth was highest for children aged 5 and just over 5% of these had received multiple extractions episodes with one child receiving up to seven separate extractions episodes.

**Conclusion: Social Determinants of Health and a Common Risk Factor Approach**

This review has provided a background into the relationship between oral health and the behaviours that lead to the use of general anaesthetics for extraction in relation to caries. It can be seen there are underlying complex casual networks that interplay when looking
at the reasons for referral. However, while this literature review has focused on tooth decay as an issue with young children, given the initial data from the dental observatory which sparked this evaluation. It is recognised that various health problems in childhood share common risk factors. Oral health, obesity and cardiovascular health\textsuperscript{145} can be linked by diet, perceived control, stress, hygiene, etc.\textsuperscript{131,146}. Therefore it is important when looking at improving the health of young children that a 'silver bullet' approach is not taken. It is suggested a holistic approach to interventions should be adopted, positively impacting on a child's wellbeing in order to tackle the complex problems that can lead to preventable poor health.

It is also acknowledged, as mentioned in the beginning of this review, that while individual actions can impact on the health and wellbeing of children these behaviours are highly influenced by social determinants and the focus has shifted to exploring these areas in more detail. It has been discussed in previous papers that there is a tendency to slip back into 'lifestyle', (downstream) rather than upstream approaches, therefore ignoring the broader context in which behaviours are determined and their influences over health. In this respect the 'social determinants' of health have been increasingly studied and discussed. However within the wording of this idea there is an inherent issue, social factors do not determine your health, rather they influence it; they are the potential 'indirect' foundations of the 'direct' causes of poor health. In this respect it is important to not lose sight of the impact of individual behaviours within health research but to continue to incorporate and explore the complex causal networks, with both individually and socially influenced behaviours intertwined revealing a richer picture of how health can be improved. In this way downstream methods can influence upstream models, resulting in the voices of people who have poor oral health being heard and incorporated into the models at policy level to improve this area overall.

\textbf{The second stage of this review will explore the potential interventions that may be beneficial for this group, incorporating a common risk factor approach.}
References


139. Table 1a - SDR Item of service claims by item number and patient age. *ISD Scotland, MIDAS* (2014). at <http://www.isdscotland.org/Health-Topics/Dental-Care/Publications/data-tables.asp?id=590#590>


143. NWPHO. 5-year-old Survey 2007/08 - Primary Care Trust Data. (2008).


Chapter 2

A Scoping Review: Using a common risk factor approach to map behaviour change interventions, with the potential to impact on caries experience in young children
Foundation and Summary of Chapter 2

The purpose of this scoping review is to explore previous research within the area of childhood preventable diseases that are connected under the common risk factor approach to dental health (for example diet, nutrition, diabetes etc.) and postulate a set of interventions that have the potential to be used to reduce the caries burden within a young population. A scoping review rather than systematic review is more appropriate in this case as the research area is so vast it was unsuitable at this stage to narrow the search down to one specific area. It was thought a scoping review in the form of a health matrix could be useful to illustrate the key areas that have worked in the past and gaps in the literature.

A full traditional systematic review, such as those carried out for the Cochrane Collaboration, did not seem appropriate given the wide range of topics and potential outcomes, which would have been difficult to combine in a more conventional review. This scoping review may however, inform a more in-depth systematic review of a particular intervention in the future. The primary purpose is to explore the literature within this domain and identify a variety of interventions that could potentially be implemented and reduce caries burden on young children. This is an innovative approach to conducting a scoping review in oral health and may be useful as a guide to inform commissioners and policymakers as to the most effective use of oral health interventions.

Author’s contributions:
MG and LM conducted the review by completing the review table (See supplementary materials, links to these materials can be found in Appendix 12.2.1). MG wrote this chapter, IAP and CS reviewed and contributed to the draft. A reduced version of this chapter will be submitted with Chapter 1 to BMC Public or Oral Health as part of a scoping review on DGA and potential interventions for the future.
Introduction

The health and well being of a child is vitally important for their growth and development. Additionally poor child health has a lasting impact, casting 'long shadows' over health in later life 1. It is recognized that various health problems in childhood share common risk factors, for example oral health, obesity and cardiovascular health 2 can be linked by diet, perceived control, stress, hygiene, which are themselves connected and are understood to be socially determined 3,4. This has been observed over a number of studies and emphasized by Marshall in 2007:

"The concept of biological plausibility would suggest that neither the hypothesis 'obesity increases risk of caries' nor 'caries increases risk of obesity' is particularly logical. Rather, it is more realistic that a common risk factor increases the likelihood of both diseases, which are then observed in association" [p.449-450, 5]

Being able to prevent rather than treat disease in children through lifestyle or behaviour change could decrease the considerable burden on health systems, budgets and increase the wellbeing and life expectancy of the children involved 6. It is important when looking at changing health behaviours to improve aspects such as the oral health of a child that a 'silver bullet' approach is not taken as aspects such as diet can also impact on as well as dental health. It would be wasteful and ineffective to always tackle each disease individually when they have similar origins 4, not only in relation to time and cost but also given limited resources available. The populations with the greatest burdens of disease are those most deprived 7,8, consequently it would be more efficacious to tackle the multiple problems within these populations, when possible, at the same time. This could be perceived as a high risk approach as discussed by Rose 9 or could be viewed within a population approach with a greater emphasis on populations that require additional support referred to as proportionate universalism 10. It is suggested if possible a holistic approach to interventions should be adopted, positively impacting on a child's wellbeing in order to tackle the complex problems that can lead to preventable poor health. The potential benefits of this approach would be greater than focusing on isolated individualistic interventions.

Childhood health can have a lasting impact into adulthood, however researchers have shown the earlier interventions are started, whether they are health, education or social, the bigger impact they can have 11. For example, considering dental decay, it is suggested effective interventions should start in the first 2 years of a child’s life (earlier than they
would normally have their first dental visit) 12. There is also strong evidence that gains made in early childhood could be continued and aided when they are supported by on-going efforts as the child grows 11. However while some studies have indicated interventions started earlier could make a greater impact on childhood health and education, it would be unwise to infer that all interventions started later are not necessarily as effective. Therefore while health interventions of most interest will be for children between the ages of 0 to 5, it is still important to include interventions ranging up to children of 16 years old as well.

Methods and Materials

Inclusion and exclusion criteria were determined before the literature search began. Eligible participants included children and adolescents aged up to, and including 16 years at the commencement of the study. Interventions included those aimed at impacting on children and the family as a whole.

There are various levels of interventions that may work with children who face preventable general health related issues such as, obesity, oral health, diabetes and cardiovascular disease (CVD) 4. These interventions can fall under a variety of levels including population level, community level, geographic targeting or targeting families and individuals. While population level interventions are popular within public health, given the skewed distribution of issues relating to oral health to certain populations in high income countries it may be more appropriate to focus on geographic targets (such as schools), proportions of the population or even family centred interventions through community projects such as Sure Start 13,14. Interventions will therefore cover any activity to reduce preventable childhood health related issues including obesity, tooth decay, diabetes and CVD problems. These could include education, change in diet, oral hygiene, motivation or control and self regulation theory in various forms that tackle either targeted groups or targeted geographic locations. In this respect comparisons will be made with either no intervention or an alternative intervention.

The research objective is not only to assess what effective interventions are available but also to examine which factors and underlying social / psychological guide the success of these interventions.

Outcomes

What are the intended effects of the intervention?
To be included, studies must have reported one or more of the following primary outcomes, presenting a baseline and a post-intervention measurement, or change in score compared to a control. Included studies have no minimum intervention or follow-up duration.

Health outcomes
- Measurement of dental caries (dmft/dmfs/BASCD).
- Measurement of diet change.
- Oral hygiene measurement (debris, plaque, gingival health).
- BMI (or weight by age/height, body fat).
- Cardiovascular metrics (blood pressure, cholesterol).

Social outcomes
- Quality of life – OHRQOL/QOL.
- Change in attitude or motivation, understanding e.g. accepting new foods, understanding food labels.
- Social influence e.g. change in public support for water fluoridation.
- Episodes of pain (toothache).
- Self-reported/ parent report dental health, diet, general health.

Intermediate health outcomes
- Healthy lifestyle practices e.g. measurement of early feeding practices, bottle use (juice, sugar drinks) or brushing, toothpaste use, activity level.
- Dental health services e.g. increased preventative techniques used.
- Change in use of or engagement with health services, visiting GDP or GP.
- Attendance at secondary care facility.
- Need for hospitalisation/General Anaesthetic for tooth extraction.

Intervention examples include:
- Interventions to increase availability and use of fluoride, including:
  - Provision of free toothpaste.
  - Supervised brushing with fluoride toothpaste at child care sites and schools.
  - Encouraging the use of fluoride (and the appropriate concentration) including supplements (such as fluoride drops, mouth rinse, etc.).
• Interventions to improve oral health such as, access to affordable tooth-brushes and to promote effective tooth-brushing.

• Interventions to improve diet, including:
  o Discouraging the use of sugary drinks for babies and very young children, supporting breastfeeding and encouraging the use of trainer cups.
  o Support to adopt healthy food policies across a range of settings for babies, children, young people and adults including those that offer healthy and nutritious food and drink to people living on a low or very low income.

• Interventions to encourage people to attend general dental practices or other health care settings, where they can receive preventative treatment and advice or increase preventative treatment within a community setting (as per ‘Delivering Better Oral Health’, DH 2009).

• Interventions that change the environment or policy which would impact on oral health, cardiovascular disease (CVD) or weight.

**Objectives**

The objectives of this review are to

• Evaluate studies that investigate the effectiveness of health interventions designed to improve a child’s oral health, diet, CVD problems or similar health related issues through a change in behaviour.

• To determine if there is evidence that such interventions are of benefit to children in improving their health and wellbeing.

• To understand the functions that guide the interventions and whether there is a common thread amongst interventions that are efficacious.

**Methodology**

Inclusion criteria:
Quasi-experimental, Randomised Control Trial (RCT), controlled before and after studies and interrupted time series studies will be included. Studies with ‘no’ intervention (data gained from the group before the intervention was introduced) or any other intervention will be used for comparison.
Single case studies, qualitative work/interviews and observational quantitative studies that provide an indication of the effectiveness of an intervention may be included to look further at the underlying connections between successful studies.

Exclusion criteria:
Studies will be excluded: if the primary purpose is not to evaluate an intervention or policy change i.e. if the research only looks at existing policy or future policy without any indication of its impact, if the predominate element was physical exercise (not nutrition or diet), those studies predating 1990 (given the change in health and knowledge of behaviour change over the last 20 to 30 years a judgement was made to exclude studies before this period). Studies will also be excluded if the abstract relates to a discussion or conference abstract with no further connecting paper giving a full outline of the study, if there is no outcome measured, if they cannot be accessed in English, if they tackle specific conditions not connected to dental or the general population e.g. work in children with chronic diseases, purely disabled and if they are only descriptive articles about potential effective changes and prevention.

Description of a scoping review:
Scoping reviews have previously been poorly defined and are a relatively new type of research tool that can summarise literature in a topic area and are now seen as a research outcome in their own right 15. In traditional systematic reviews there is a specific process to define a research question, search for studies to answer that question and synthesise the findings after assessing their quality. In order to be able to define the scope of the research question, a scoping review could be conducted in order to understand the gaps in the literature and clarify definitions 15. In this instance a scoping review is being used to explore the area of behavioural and social interventions. As this area is so broad, initially the review will be used to establish what interventions have previously been examined, the theory that underpins these areas and whether (on a basic level) the interventions have been successful. However, unlike a systematic review, the information will not be synthesised to give an over-all statistical value for whether a type of intervention works. This work could be used however, to identify potential sets of interventions that could be explored further. It could also provide an indication as to the size of the literature surrounding each area, in order to budget both for time and staff in order to complete these reviews.
Arksey and O’Malley \cite{Arksey2005} developed a framework in order to strengthen the rigour for conducting scoping reviews. This involved 5 stages (listed below):

1. Identifying the research question
2. Identifying relevant studies
3. Study selection
4. Charting the data
5. Collating, summarising and reporting the results.

**Search Strategy**

While these stages are important to follow the authors also decided to add additional stages in order to strengthen the review and develop the most appropriate key words list to use. This involved a preliminary rapid scoping exercise in order to identify a number of key studies within the area. These were used to pilot and refine the search strategy for the actual scoping systematic review in order to maximise the number of successful studies (that met the inclusion criteria). Key words were identified and searches were carried out in Ovid Medline, Embase and further literature searches were made in Google Scholar. Following this over 2400 papers were identified. After a review of the titles, 5 papers were selected that would have been essential to find in any search for this area. A pilot of various combinations of key words were then trialled through databases in order to produce a set of key words that not only would always find these 5 papers identified but produced the most manageable output in terms of papers found (see Appendix 12.2.1 for rapid scoping exercise).

**Study Selection**

After removing duplicates the remaining records were manually screened to remove studies that were clearly inappropriate. Abstracts were then reviewed, and a decision was made to save the full article, leaving 88 full text articles for assessment (see Figure 2.1). Two reviewers carried out the review and periodically duplicated the assessment of articles to check for agreement (Reviewers were not blinded to authors or institution as this has been shown to be of limited value \cite{Ehlers2013}). This duplication occurred as both reviewers entered the assessment separately into an excel sheet under a variety of headers for each section i.e. study title, outcome, population etc. Both reviewers assessed a number of studies and a comparison was made between the two entries for consistency.
Data Extraction

A table was constructed for data extraction based on examples from previous reviews and guidance from Cochrane and Campbell reports. There were a variety of data that could be collected from each study however there were key elements required for the evidence synthesis which were crucial to record within the data extraction toolkit. Firstly the type of intervention was recorded i.e. whether it was focused at the individual and therefore a downstream approach, at the community, a midstream approach or policy or regulation as an upstream approach. Secondly the type of behavioural change or policy the intervention was based upon was recorded. The categorisation used was built on Michie's Behavioural Change Wheel (Figure 2.2). This behavioural intervention framework links an overarching model of behaviour change and covers topics previously missed in other work. Additionally the quality of the study was assessed. There are a variety of quality assessment tools within the area of reviews. For this particular scoping review guidance was taken from the GRADE system which was designed to provide methodological guidance in reviewing intervention research. GRADE can be broken down into four categories, see Table 2.1.
Figure 2.1: Search Strategy and Study Selection

Identification
- Embase 1464
- Medline 1113
- Additional records (Grey literature - 35)
  Records after duplicates removed 1482

Screening
- Records screened by abstract 288
  Records excluded 1194

Eligibility
- Full text articles assessed for eligibility 288
  Records excluded 200

Include
- Studies included in evidence based matrix 88
Other recorded attributes of the studies were the population of interest, details of the intervention, details of the outcomes recorded and whether these were successful. Notes were also made on a number of the possible biases or issues within the study that also fed into the quality level assigned (from 1 to 4).

Table 2.1: GRADE definitions of the four quality categories

<table>
<thead>
<tr>
<th>Quality Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>High quality</td>
<td>We are very confident that the true effect lies close to that of the estimate of the effect</td>
</tr>
<tr>
<td>Moderate quality</td>
<td>We are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different</td>
</tr>
<tr>
<td>Low quality</td>
<td>Our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect</td>
</tr>
<tr>
<td>Very low quality</td>
<td>We have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect</td>
</tr>
</tbody>
</table>
**Method of Synthesis**

Within traditional systematic reviews there are a number of ways to synthesise data in a meta-analysis. Analysis can either be quantitative or qualitative. Systematic reviews by organisations, such as Cochrane traditionally pool quantitative data and utilise forest plots to detail if a specific intervention is effective. This type of meta analysis was not appropriate for the scoping review, primarily as it was not the objective of this review to determine if one intervention worked most effectively but also as the outcomes were so broad analysis in this way would have been problematic. The review took direction from an evidence based policing matrix originally developed by Lum. This moves away from creating a list of simply what studies have worked and produces a user friendly display which can help inform strategies and translate research into real world application. The matrix involves breaking down studies by the type of intervention or by the function of that intervention. This is an innovative approach which has not previously been used within this area of research.

**Results**

Eighty-eight studies were included in the final synthesis, which were then plotted onto the health intervention, evidence based matrix. This matrix demonstrates the spread of the studies that were successful in achieving a change in the specified outcomes across the spectrum of action from upstream policy change to downstream interventions targeting the individual. Each study was plotted onto the matrix and assigned a colour based on the type of intervention defined by Michie's Behavioural Wheel and a shape based on a grade of 1 (lowest) to 4 (highest) for the quality of the study and resulting confidence in the true effect of the outcome. The full citation for each article is in Table 2.2. The breakdown and review of each study appears in the supplemental files, which can be found in Appendix 12.2.2.
### Key for Health Intervention Matrix

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Colour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education – Blue</td>
<td></td>
</tr>
<tr>
<td>Enablement – Red</td>
<td></td>
</tr>
<tr>
<td>Environmental - Purple</td>
<td></td>
</tr>
<tr>
<td>Training – green</td>
<td></td>
</tr>
<tr>
<td>Role Modelling – Yellow</td>
<td></td>
</tr>
<tr>
<td>Incentivisation – Orange</td>
<td></td>
</tr>
<tr>
<td>Regulation – Black</td>
<td></td>
</tr>
<tr>
<td>Persuasion – Pink</td>
<td></td>
</tr>
<tr>
<td>Restriction - Turquoise</td>
<td></td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Quality Grade</th>
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</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>![Symbol 1]</td>
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<tr>
<td>2</td>
<td>![Symbol 2]</td>
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<tr>
<td>3</td>
<td>![Symbol 3]</td>
</tr>
<tr>
<td>4</td>
<td>![Symbol 4]</td>
</tr>
</tbody>
</table>

### Figure 2.3: Health Intervention Matrix

<table>
<thead>
<tr>
<th>Intervention - Succesful</th>
<th>No</th>
<th>Yes</th>
<th>Mixed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>![Intervention Matrix]</td>
<td>![Intervention Matrix]</td>
<td>![Intervention Matrix]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Quality Grade</th>
<th>Symbol</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>![Symbol 1]</td>
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<tr>
<td>2</td>
<td>![Symbol 2]</td>
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<td>3</td>
<td>![Symbol 3]</td>
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<tr>
<td>4</td>
<td>![Symbol 4]</td>
</tr>
</tbody>
</table>
Discussion

This scoping review examines interventions, which could be applied to reduce the proportion of young children experiencing severe decay by exploring this issue using a common risk factor approach. This involved incorporating studies whose outcome may not have been reduction in caries, but the intervention could either impact on this area, by proxy or be modified to apply to a dental population or population as a whole, tackling a number of issues connected to caries under the common risk factor approach.\(^3\)

The clustering of studies that emerged, presented in Figure 2.3, is a powerful visual. The matrix shows what a single study cannot achieve alone. The first notable observation is that studies that utilise education alone as a function for change by either targeting individuals or throughout the community appear to be relatively ineffective. The matrix also indicates many of the individual targeted approaches rely mainly on education as a behavioural change component. Education was the most utilised intervention throughout the studies examined, either on its own or in conjunction with other interventions. Looking purely at the studies where the intervention was a success in its primary outcome this educational component was active in 34 (out of the 51) studies. Education was often combined with another behaviour change function such as environmental restructuring, training or enablement. Studies, which utilised this mixture of functions, appear to be more successful i.e. involving an element of ‘training’ such as how to manage day to day routines or specific parental training (based on social interaction theory instructing parents on self control and healthier lifestyles) or ‘enablement’ by providing toolkits to encourage behaviour which may benefit oral health e.g. training cups for children and appropriate strength fluoride toothpaste and reducing barriers and increasing opportunities such as registering children with a dentist from birth.

Exploring studies that were successful for both individuals and communities in more detail revealed repetition within the intervention also played an important part. Studies such as those by Mohebbi et al., 2009\(^{24}\) (Matrix Number ‘22’. Figure 2.3) showed that those who received information about their baby’s oral health only at vaccinations did not demonstrate an improvement in the percentage of caries incidence compared to a control group. However for those who received this information at vaccination combined with reminders at two monthly intervals a significant decrease in caries experience compared to a control was observed. A study exploring dental education given on just one occasion\(^{25}\) (Matrix Number ‘17’. Figure 2.3) and a separate paper which detailed an intervention
involving just one class on bottle use \textsuperscript{26} (Matrix Number ‘18’. Figure 2.3) also showed no effect within these types of singular educational intervention.

Studies also appeared to be successful when they incorporated the views of the population they were looking to target. Harrison et al., \textsuperscript{27} (Matrix number ‘10’. Figure 2.3) identified gaps in the knowledge of their targeted community before developing an intervention and counselling based on feedback. This intervention was therefore sensitive to the known cultural differences, utilising a Vietnamese Health Counsellor to address this particular part of population in Canada.

Interventions that take a community or ‘midstream’ approach utilised a greater mix of intervention functions. It can be observed within the matrix that community interventions that again were only made up of educational components tended to fail in providing a significant improvement compared to a control or other intervention. The studies that proved successful utilised a variety of intervention functions. One of the main features within these clusters (along with education) is environmental restructuring which looks at changing the physical or social environment. This type of intervention is indicated as producing successful results throughout different scenarios with interventions including increased opportunities for exercise \textsuperscript{28,29} (Matrix Number ‘46/72’. Figure 2.3) and changing the school canteen menu to encourage healthy eating \textsuperscript{29–31} (Matrix Number ‘51/72/77’. Figure 2.3). Training and enablement (often combined with education) were also utilised in a number of studies. These could include providing toolkits to support or promote healthy behaviours such as oral health toolkits to impact on caries \textsuperscript{32,33} (Matrix Number ‘42/53’. Figure 2.3) or providing training in tooth brushing with active demonstrations \textsuperscript{34} (Matrix Number ‘41’. Figure 2.3) other studies which made accessing the dentist (or health care provider) easier by allowing health providers to attend school sessions impacted positively on oral health \textsuperscript{35} (Matrix Number ‘38’. Figure 2.3).

Finally studies revolving around more upstream models were much fewer in number. This could be expected as researching areas such as national or region wide policy change can be difficult. Issues include gaining a relevant control group and effectively measuring outcomes over such a large area, with other potential confounders contributing to the outcome. However interventions within this upstream approach were proven to be successful with changes across dental health, diet and controlling weight. Environmental restructuring and enablement were the main functions utilised in upstream interventions. Distinct studies also looked at restriction and incentivisation. As with interventions that targeted individuals or sections of the community, interventions, which utilised a
combination of behavioural change functions, appeared more successful in recording a
significant change in the primary outcome. Studies which saw a policy change within, for
example, school nutrition, which went onto restrict food consumption showed successful
results (Matrix Number ‘84’ - Figure 2.3) \(^{36}\). Similarly a program that enabled dental care
to be provided at medical visits and ‘well-child’ visits by reimbursing providers for
preventive oral health services for children under 3 (i.e. fluoride varnish) saw a significant
increase in oral health visits (Matrix Number ‘85’ - Figure 2.3). \(^{37}\). While this study does not
demonstrate a direct health benefit, as it is a ‘process’ outcome or ‘intermediate’ change it
is important to note this type of study as these health behaviours and processes are
linked with dental health \(^{38,39}\).

Limitations
While scoping reviews can provide a rigorous and transparent method for mapping areas,
such as health research, there are also a number of limitations that should be
acknowledged. Despite two reviewers being involved there was an inevitable subjectivity
in the decision making process as to what was relevant and the quality of the research
 reviewer bias) \(^{40}\). It is also possible that the review may not have identified all papers in
the area and grey literature. This is despite the attempts to be comprehensive and use of
a pilot study to ensure success in terms of the number of key studies returned but also
balanced with the total number of studies to review (sensitivity and specificity). Even
though the pilot review reduced the total number of papers returned, the quantity of data
generated was considerable and therefore it could be argued there was more breadth
than depth, however this is one of the reasons a scoping rather than traditional systematic
review was chosen.

The findings from a number of studies were dependent on the context of the research. For
example the country where the research took place and its impact on that population may
not be applicable to other regions. One limitation of the search is that it relies on a
combination of the health matrix and data extraction table to determine if these contexts
impact on the outcome and could be valid in a UK setting for example.

Conclusion

It is apparent that there are a number of functions which can positively affect behaviour
(either of a child or parent perspective, or health care provider perspective). The studies
that seem to have a higher level of success are those that combine behaviour functions
such as enablement and education over a period of time. When looking at targeted
interventions the focus should be on certain environments such as schools, hospitals and care organisations to develop support to maintain good oral health. Importantly, given the young age of children referred for DGA (See Chapter 4), preschool settings such as nurseries and sure start centres should be a main point of focus.

The most successful interventions are those aimed upstream looking at policy change. Indeed it has been argued that concentrating on interventions at an individual level can create wider disparities in health 3. Upstream interventions still effect behaviour but in a different way to targeting individuals as they look at a population effect using aspects such as legislative, fiscal change and regulation policies to promote good oral health. Changing aspects of the environment to enable healthy choices is also a key aspect of upstream interventions. Using a combination of both targeted interventions through preschool settings such as sure start centres and wider policy change, a mixture sometimes referred to as proportionate universality 3,10, is likely to be the most effective way of improving the oral health (and overall health) of young children.

This scoping review has taken a novel approach to exploring various interventions appropriate for child oral health. This is a promising methodology, which could be utilised across a variety of research areas. It has already been previously employed within police research and practice and currently, within this work, looking at behaviour change impacting on oral health. Therefore the potential for the matrix to be utilised within other research areas is high; further exploring dental health related interventions across various ages and differing levels of need and more broadly across health behaviours including, smoking cessation and alcohol use.
References


Appendix 2.1: Full Citation of studies relating to Health Behaviour Matrix

Table 2.2: Studies relating to Health Behaviour Matrix (Figure 2.3)

<table>
<thead>
<tr>
<th>Study Description</th>
<th>Authors</th>
</tr>
</thead>
</table>

|                                                                                  | Antonio AG, Kelly A, Valle DD, Vianna RBC, Quintanilha LELP: Long-term effect of an oral health promotion program for schoolchildren after the interruption of educational activities. 2007, 32:37–41. |


Johnson BA, Kremer PJ, Swinburn BA, de Silva-Sanigorski AM,: **Multilevel analysis of the Be Active Eat Well intervention: environmental and behavioural influences on reductions in child obesity risk.** *International journal*
<table>
<thead>
<tr>
<th></th>
<th>Reference</th>
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<tbody>
<tr>
<td>64</td>
<td>Slade GD, Bailie RS, Roberts-Thomson K, Leach AJ, Raye I, Endean C, Simmons</td>
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<tr>
<td>Number</td>
<td>Reference</td>
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<tr>
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<td>------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>78</td>
<td>Yin Z, Parra-Medina D, Cordova A, He M, Trummer V, Sosa E, Gallion KJ, Sintes-</td>
</tr>
<tr>
<td>ID</td>
<td>Author(s)</td>
</tr>
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<td>----</td>
<td>-----------</td>
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<tr>
<td>1</td>
<td>Yallen A, Huang Y, Wu X, Acosta D, Kibbe D, Ramirez A</td>
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<td>3</td>
<td>Yusof ZYM, Jaafar N</td>
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<td>Hystad HT, Steinsbekk S, Ødegård R, Wichstrøm L, Gudbrandsen OA, Odegard</td>
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<td>Author(s)</td>
<td>Title of the Study/Article</td>
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<tr>
<td>-----------</td>
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</tr>
<tr>
<td>No.</td>
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</tr>
<tr>
<td>-----</td>
<td>-----------</td>
</tr>
<tr>
<td>28</td>
<td>Sharma, Hebbal, Ankola, Murugabupathy</td>
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<td>31</td>
<td>Strippel, H</td>
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Chapter 3

Methodology
Foundation and Summary of Chapter 3

The methodology chapter outlines the various approaches adopted within this thesis. This work employs a mixed methods design, utilising both quantitative and qualitative methods and combining these in a number of different ways. The rationale for choosing a mixed methods design is discussed and how various combinations of quantitative and qualitative methodology have been used to answer the research questions posed.

As this thesis naturally broke down into the following seven chapters, the various methods discussed logically connected to each of these manuscripts. Across the entire thesis triangulation was employed to draw the main conclusions and address the key research aims.

Authors Contributions
This section was written by MG and was reviewed with contributions by IAP and CS.
Mixed Methods Approach

Mixed methods research looks to utilise the qualities of both quantitative and qualitative research [1]. Quantitative research looks to quantify and understand what factors influence an outcome, for example trialling potential interventions by introducing a different factor in a treatment group vs. control and determining whether it has a statistically significant effect on the outcome in question. Quantitative research also usually looks to generalize outcomes to a wider population [1]. This type of research is often underpinned by the philosophy of post positivism where science is deemed to require precision, deductive reasoning and attention to evidence but is not always confined to that which can be directly perceived [2]. Claims surrounding this type of research are based on the idea of cause and effect, detailed observations, measuring variables and continually testing and refining theories [3]. However this type of research fails to understand the mechanisms of how problems are solved or how certain interventions work and are not always appropriate when the variables and theory base are unknown. Qualitative research on the other hand works from a different worldview and is concerned with understanding the meaning of phenomena through participants and their subjective views. Qualitative inquiry is typically associated with worldviews which include constructivism and interpretative approaches [4]. This form of inquiry often begins with inductive thinking and is useful in exploring new phenomena and concepts and looking in depth at factors, which may be associated with issues being studied. This can be from individual perspectives in the case of interviews although some qualitative research can also be observation based. Given that the problems addressed within health science research are usually complex, it is becoming more accepted that the use of only one research paradigm is inadequate to address these areas. Being able to triangulate results to give a more complete picture provides a greater insight and is the best of way generating and expanding understanding around a given research area.

There are various ways of combing qualitative and quantitative research together and the advantages of each have been explored by a variety of researchers. Roseman and Wilson [5] discussed three distinct ways for mixed methods to be advantageously used (see Table 3.1).
Table 3.1: Mixed method design from Roseman and Wilson, (1985)

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corroboration (Triangulation)</td>
<td>Seeking to converge findings with either quantitative converging with qualitative or vice versa. This in has been described as <em>Triangulation</em> in other work (Greene, 1989).</td>
</tr>
<tr>
<td>Elaboration (Complimentary)</td>
<td>Seeks to elaborate and enhance understanding. Typically using qualitative research to 'put the meat on the bones' of quantitative data. However quantitative data can also be used to explore how often the theories and themes from qualitative findings occur and to make decision on how findings can be applied in a more wide spread way. This has been described as <em>Complementarity</em> in other work (Greene, 1989).</td>
</tr>
<tr>
<td>Initiation</td>
<td>Initiation looks to explore ideas from another angle and find new interpretations, contradictions or rediscover the research question in a new way. This can be achieved by recasting the question or results from one method with results from another method.</td>
</tr>
</tbody>
</table>

Greene Caracelli and Graham [6] discussed two more mixed method designs in addition to the breakdown given in Table 3.1, these include 'development' and 'expansion' (see Table 3.2).

Table 3.2: Mixed method designs from Greene, Caracelli and Graham, (1989).

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Development</td>
<td>Looks to utilise one methods result in order to inform another, this usually includes knowledge about sampling and implementation.</td>
</tr>
<tr>
<td>Expansion</td>
<td>The purpose of this method is to expand the scope of the research question by looking at different components to the question with differing methods.</td>
</tr>
</tbody>
</table>

Creswell and Plano Clarke [3] broke down the mixed methodology design into six main models: Convergent, Explanatory, Exploratory, Embedded, Transformative and Multiphase (Table 3.3).
Table 3.3: Mixed method designs from Creswell and Plano Clark, (2011)

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Convergent design</td>
<td>Similarly to triangulation discussed in Table 3.1, Convergent design looks to understand the research problem by gaining different data on the same topic, and develops an overall understanding by using both quantitative and qualitative data as each provides a partial view.</td>
</tr>
<tr>
<td>Explanatory</td>
<td>This design takes place over two phases where quantitative data is conducted first and qualitative data is used to expand or explain these results. For example using quantitative data to form groups, which are followed up with subsequent qualitative data giving detailed voices and perspectives behind the trends seen.</td>
</tr>
<tr>
<td>Exploratory</td>
<td>Similarly to the explanatory design the exploratory design is a two-phase approach. The difference is that with this approach the qualitative data is conducted first which builds into the second quantitative phase. Given the variables are unknown it can also be used to assess if detailed results from a small number of participants can generalize to a population.</td>
</tr>
<tr>
<td>Embedded</td>
<td>This process uses one data type as the main focus with the 'other' data type in a supporting role i.e. obtaining detailed views through qualitative data to examine various outcomes of experimental methods.</td>
</tr>
<tr>
<td>Transformative</td>
<td>This design looks at research that aims at challenging social injustices by framing the collection of data within a transformative framework that guides the methods section.</td>
</tr>
<tr>
<td>Multi-phase</td>
<td>This combines quantitative and qualitative data sets over multiple phases of a study potentially over long periods of time for example developing a program or intervention and evaluating it at the end.</td>
</tr>
</tbody>
</table>

There are a number of considerations in determining the most appropriate mixed methods approach for this study including; the level of interaction between the data, the priority of the quantitative and qualitative strands and the timing of the various aspects of the study [3]. The main approach adopted was that of sequential explanatory design as this distributed the significance of both quantitative and qualitative data evenly and followed the timing of the proposed data collection with quantitative proceeding qualitative. Other
designs such as exploratory or embedded were not as appropriate as they didn’t follow the timing of quantitative to qualitative and models such as embedded gave too much weight to one type of data collection.

The research in this thesis included; a scoping review to provide information on interventions connected under the common risk factor approach to caries in young children, a service evaluation on two existing but different pathways for children referred from their own dentist for dental decay, a large quantitative survey to gain a broad understanding of Dental General Anaesthetic (DGA) referral and need and finally a qualitative phase interviewing; parents, children and those involved within paediatric dentistry to provide a more in-depth understanding to this area. These methodologies, the timing they were implemented and the corresponding use in each chapter is illustrated in Table 3.4

Given the various phases in this thesis a variety of methods were used to analyse the data collected. In the first instance, examining research objectives individually, data were combined in a sequential explanatory or complimentary fashion. This meant quantitative data could firstly be examined in order to develop a general understanding of the DGA population. This was then followed by a qualitative phase, a pragmatic means of understanding the views of those involved throughout this pathway or those experiencing the service. This followed the identification of specific quantitative outcomes requiring additional explanation and in certain chapters using these to guide qualitative data collection [3]. This break down can be seen in Figure 3.1 where exploring alternative services (Chapter 9), service design and organisation (Chapters 4 and 5) and exploring if differing groups would require different interventions or support and what this may entail (Chapters 7 and 8) utilised quantitative results to give general knowledge of the area and qualitative interpretation to give further in-depth understanding.

Overall this thesis has used triangulation to bring together information gained from the scoping review on interventions, connected under the common risk factor approach, quantitative data collection through hospitals and qualitative interviews conducted with those throughout the process of dental GA. Convergence of the analysis from each method allowed further interpretations of the findings and a greater depth of understanding of the problems faced within this population and solutions to reduce the rate of DGA or reduce repeat DGAs in the future.
<table>
<thead>
<tr>
<th>Method</th>
<th>Time</th>
<th>Chapter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scoping review</td>
<td>Completed in 2014</td>
<td>2</td>
<td>A scoping review was conducted on interventions, which have the potential to impact on reducing severe caries seen in young children.</td>
</tr>
<tr>
<td>Quantitative data collection</td>
<td>Over a period of 12 months from 2013 to 2014 (One researcher attend 6 hospital consecutively for a period of 2 months each)</td>
<td>4 5 7 10</td>
<td>Data were collected from clinical records from the hospital, referral letters from the referring dentist and a self-complete questionnaire from the parent (see appendix 12.3.2 and 12.3.3 for all variables included). Parents were approached on the day of the operation at the hospital while they were waiting (parents were usually at the hospital for approximately 3 hours). They completed the consent form and questionnaire on the day of the operation; clinical notes were obtained on the same day.</td>
</tr>
<tr>
<td>Qualitative data collection</td>
<td>Data were collected over a period of 9 months from 2013 to 2014 (data were collected throughout this period but lasted 9 months given the length of time between triage and operation for one participant)</td>
<td>6 8 9</td>
<td>Parents were approached at triage clinics in order to explain the study, give out the information sheet and if parents agreed sign the consent form to be contacted in the future. Parents were then contacted within the next month to take part in the first qualitative interview (before the operation). A date was recorded for the operation and parents were then contacted within 2 weeks after the operation to organise the second interview. Due to the length of time a child waited between triage and operation the interviews could be up to 8 months apart but were usually within 5 months of each other (see appendix 12.3.1 for interview schedule).</td>
</tr>
<tr>
<td>Service Evaluation</td>
<td>Over a period of 5 months in 2013</td>
<td>9</td>
<td>Minimums of 96 consecutive anonymised records over a period of time were obtained from two different pathways. The data was analysed and presented to determine treatment outcomes along these pathways (see appendix 12.3.3 for data collection tool).</td>
</tr>
</tbody>
</table>
Figure 3.1: Phases and Combination of Research Methods

**Triangulation/Convergent design**

**Phase**
- Generate evidence of potential interventions
- Accurate up to date information on hospital referrals
- Evaluation of alternative pathways
- Service design and organisation
- Explore population of attending GA and potential interventions

**Quantitative Element**
- Scoping Systematic Review
- Hospital Episode Statistics
- Explore referral notes and triage/treatment notes from two pathways for children referred for treatment out of primary care
- Questionnaire & Consultation notes 456 participants and observational notes taken during research, Descriptive Statistics
- Questionnaire & Consultation notes 456 participants. Explore background and potential subgroups within population, Multiple Correspondence Analysis

**Qualitative Element**
- Not Applicable
- Not Applicable
- Interview Patients, Dentists and Key Stakeholders/players in this process
- Interview Patients, Dentists and Key Stakeholders/players in this process
- In depth qualitative interviews with subgroups to explore potential interventions

**Process**
- Not Applicable
- Complementary Explanatory
- Complementary Explanatory
- Complementary Explanatory
Advantages and Disadvantages of Mixed methods

The advantages of using a mixed method design and in particular the explanatory approach, is that it matches the research question in a relatively straightforward way given the two distinct phases utilised. In addition data analysis and interpretation could either be undertaken individually and merged in the discussion of the thesis or incorporated within the same paper when appropriate [7]. The collection of quantitative data facilitated purposive sampling for the qualitative work in approaching dentists.

One disadvantage of this design is the possibility of conflicting results from the quantitative and qualitative data collection [7]. If disparate data were uncovered there are numerous recommendations, including; to continue to collect further data, treat the methods as fundamentally different or use this to inform future research [8]. This is less of an issue with this particular research as the combination of methods is not used to confirm the findings from two different methods but used for completeness and development within this area [9].

A quantitative study conducted individually and not as part of a mixed methods piece would have given a broad understanding of this area but only at a one dimensional level [10]. As it was decided that a more in-depth level of information was needed to draw conclusions not only about dental general anaesthetic but ways of reducing the need for this procedure in the future, it was decided more in-depth information from both families and dentists were required. Therefore the different methods utilised were suited to address the different types of questions within this research.

Quantitative Research

Introduction
This section describes the methods undertaken to conduct the quantitative aspect of the mixed methods design. This was an observational study and was conducted as one portion, contributing to this larger piece of work. This section looked to understand the population attending GA sessions and contribute to the development of interventions, which may work for this population. Quantitative research looks to explain phenomena by analysing numerical data. As discussed, this way of collecting and exploring data can give a comprehensive understanding to the area in question, an important aspect in the first stage of developing complex interventions [11].
Purpose of quantitative study
There were two purposes of carrying out quantitative data collection; firstly data was gathered to give a greater understanding of the referred population in a generalizable sense. This involved considering the impact of the need for GA extraction, the difference between services provided to patients and the potential areas of improvement not only around the GA service but to explore interventions, which could reduce the need for a GA extraction. The second purpose was to assess if any subgroups within the patients referred could be established. This could be achieved using a variety of methods, the main methods will be examined later in this chapter and the decisions regarding the chosen analysis will be elaborated on. It should be noted analysis was conducted to understand the DGA population and potential interventions which have a benefit and not to distinguish DGA attenders from the rest of the population, as this research is not primarily looking to determine causal factors in relation to requiring a GA for extraction. If this were the primary outcome a different method such as a prospective cohort study would have been more appropriate.

Development of quantitative study
The questionnaire was developed utilising questions previously described in oral health or child related questionnaires such as the Olley et al study on child DGA carried out in London and the child dental health survey [12]. Specific question such as anxiety were developed from a modified version of anxiety scales including MCAS and CFSS-DS [13–15]. A simplified version was required therefore authors based this on just one question, taking into account the age of children involved. This does mean that the anxiety question cannot be compared at this stage to other anxiety measures as it is not validated but was considered appropriate given the aim of the questionnaire and research to gain a broad understanding of the population referred for DGA in the North West England. In addition the questionnaire was developed and refined following Patient and Public Involvement (PPI) at three separate sure start centres spread throughout the Greater Manchester area throughout 2012 (Rusholme, Wythenshawe and Chorlton). From these meetings a number of decisions regarding the research were made including; approaching parents individually rather than in a group setting to answer questions, approaching parents at a hospital or places parents had to be, such as clinics, was also mentioned by many as the best way to go about interacting and engaging with families. Parents stated that very young children would not be able to take part and questions should be directed at parents therefore the questionnaire was designed this way. Certain questions were discussed around where parents had previously received support or felt it was lacking and therefore questions were included regarding this area.
This public engagement also fed into the qualitative piece in designing the interview schedule for example some parents expressed that a change of behaviour needed to occur for the child (such as instilling good practice in school that would be brought home). Other parents discussed the problems they had at home and that for many the issue revolved around breaking the pattern of behaviour (as generations of behaviour had been passed down from parent to child) but also mentioned the lack of support (specifically health care workers). From this public engagement it was thought that children would still be involved but depending on how the qualitative work progressed the inclusion of young children may have to be altered. It was also decided that approaching parents in hospitals with a short questionnaire was also appropriate given the responses from this work.

The data gathered from clinical and referral notes was developed following discussions with both a Commissioner and Specialist in Dental Public Health and refined following the service evaluation as to what data could be gained from these notes (see appendix 12.3.3 for breakdown of variables).

**Limitations of questionnaire**
While the questionnaire was developed using PPI it was only piloted on a small number of parents (5 parents) and the majority had not been through a DGA. Therefore one limitation of the questionnaire was the lack of piloting and refining questions following this. This can affect the validity of the research, although as many questions were taken from previous research surveys the content of the questionnaire was considered appropriate. It can be seen in appendix 12.3.7 participants answered the majority of questions, with 98/99% of questions completed. The one question that was answered by fewer parents was the question on household income. Income can be an area that many people either feel uncomfortable with or feel it is not necessary to the research being carried out. This limits the confidence we have regarding data looked at when income is involved as we cannot know if the proportion of people who didn’t answer this question are different from the rest of the group.

Additional feedback following qualitative interviews regarding how often the child attended the dentist revealed that this question (given the timing of the questionnaire) might have provided misleading information on regular attendance. As many parents stated their children regularly attended the dentist. However on further exploration many parents confirmed that regular attendance only started within the last year, after children had experienced dental problems. Therefore they may not always had the opportunity from a
young age for early prevention within practice from what could be classed as ’regular attenders’ from the survey.

Definition of study group
Participants for the main quantitative element were comprised of patients and their parent/guardian who attended the six randomly selected hospitals (see sample strategy for elaboration on random sampling) during the 2-month period the researcher was present. Participants were approached on the day of operation, therefore only attending patients were included in the study. The strength of this design, collecting data at the event allowed DGA rates to be determined and provided a representational sample of the population attending from each area, i.e. those hospitals that saw a larger referral rate would also be represented by a larger sample in our study. Additionally given face to face contact rather than using a postal questionnaire meant a reasonably high consent rate was expected, giving additional confidence in the generalizability of the data collected. One negative aspect of approaching families at this time was the potential stress and anxiety felt by parents and children about the operation which may impact on taking part or responding to questionnaires.

Additionally to these participants who consented for their consultation and referral notes to be accessed along with completed questionnaires, two service evaluations were carried out where data was provided to the researcher on patients who attended a GA clinic and alternative primary care clinic over similar period of time. From this data collection, information on referring dentists was also acquired to aid qualitative sampling.

Inclusion Criteria
A patient should be 16 years old or less and referred for 'Outpatient GA' extraction i.e. not primarily for special needs or restorative work under DGA.

Exclusion Criteria
Those referred over the age of 17 years old and those referred primarily for trauma or injury.

Quantitative sample strategy and sample size
Data were gained from Hospital Episode Statistics (HES) for all hospitals in the Northwest who perform extractions under DGA; this was combined with the data from the Dental
Observatory who had collected data on extractions carried out in Primary Care Trusts (PCTs) through the Community Dental Service (CDS). Of the 32 hospitals (across the North West) in the HES statistics where numbers were presented, 21 were chosen to be included in the random sample. The criterion was that a hospital had to carry out more than 200 operations for an extraction per year (Information was also included from data from CDS which is why Arrow Park is included, although it only appears from the HES data that 162 admissions took place, data from CDS showed a further 642 were conducted). This was to ensure any hospitals picked would have enough respondents for data collection to be carried out (some had only 7 extractions performed a year and this would make it unviable to carry out work here).

Each of the 21 hospitals included were assigned a number; a random generator was then run using an online randomiser. This produced the randomly generated sequence of numbers; 18, 2, 11, 15, 13, 14, 10, 21, 12, 20, 3, 6, 16, 19, 5, 8, 17, 1, 9, 4, 7 (corresponding to each eligible hospital) each hospital was approached in turn in this sequence and data collected for 2 months (hospital numbers have not been included in the data table to preserve anonymity). Given that only one researcher was involved in data collection this meant each hospital had to be visited consecutively rather than all hospitals visited for the same 2 months. While this did not appear to produce seasonal changes it is thought that fail to attend rates may be higher in winter when children may experience more colds or flu like symptoms which would prevent them from attending their operation.
<table>
<thead>
<tr>
<th>Hospital site</th>
<th>Total seen at hospital site exclude CDS</th>
<th>Total with CDS</th>
<th>PCT of Hospital</th>
</tr>
</thead>
<tbody>
<tr>
<td>Furness General Hospital</td>
<td>231</td>
<td>231</td>
<td>Cumbria</td>
</tr>
<tr>
<td>Trafford General Hospital</td>
<td>276</td>
<td>276</td>
<td>Trafford PCT</td>
</tr>
<tr>
<td>Burnley General Hospital</td>
<td>331</td>
<td>331</td>
<td>East Lancashire PCT</td>
</tr>
<tr>
<td>Rochdale Infirmary</td>
<td>350</td>
<td>350</td>
<td>Heywood, Middleton &amp; Rochdale PCT</td>
</tr>
<tr>
<td>Warrington Hospital</td>
<td>62</td>
<td>357</td>
<td>Warrington PCT</td>
</tr>
<tr>
<td>Salford PCT</td>
<td>363</td>
<td>363</td>
<td>Salford PCT</td>
</tr>
<tr>
<td>Halton Hospital</td>
<td>7</td>
<td>507</td>
<td>Halton And St Helens PCT</td>
</tr>
<tr>
<td>Blackpool Victoria Hospital</td>
<td>520</td>
<td>520</td>
<td>Blackpool PCT</td>
</tr>
<tr>
<td>Stockport NHS Foundation Trust</td>
<td>553</td>
<td>553</td>
<td>Stockport PCT</td>
</tr>
<tr>
<td>Liverpool University Dental Hospital</td>
<td>616</td>
<td>616</td>
<td>Liverpool PCT</td>
</tr>
<tr>
<td>Royal Manchester Children's Hospital</td>
<td>622</td>
<td>622</td>
<td>Manchester PCT CMFT</td>
</tr>
<tr>
<td>Royal Blackburn Hospital</td>
<td>663</td>
<td>663</td>
<td>Blackburn With Darwen PCT</td>
</tr>
<tr>
<td>Royal Albert Edward Infirmary</td>
<td>665</td>
<td>665</td>
<td>Ashton, Leigh And Wigan PCT</td>
</tr>
<tr>
<td>Royal Bolton Hospital</td>
<td>726</td>
<td>726</td>
<td>Bolton PCT</td>
</tr>
<tr>
<td>Knowsley PCT - Whiston Hospital</td>
<td>-</td>
<td>759</td>
<td>Knowlsey PCT</td>
</tr>
<tr>
<td>Arrow Park Hospital</td>
<td>162</td>
<td>804</td>
<td>Wirral PCT</td>
</tr>
<tr>
<td>Fairfield General Hospital</td>
<td>556</td>
<td>815</td>
<td>Bury PCT</td>
</tr>
<tr>
<td>Manchester University Dental Hospital</td>
<td>848</td>
<td>848</td>
<td>Manchester PCT CMFT</td>
</tr>
<tr>
<td>Lancashire Teaching Hospital</td>
<td>821</td>
<td>1240</td>
<td>Lancashire PCT</td>
</tr>
<tr>
<td>Countess of Chester Hospital</td>
<td>227</td>
<td>1325</td>
<td>Cheshire PCT</td>
</tr>
<tr>
<td>Alder Hey Children's Hospital</td>
<td>1435</td>
<td>1575</td>
<td>Liverpool PCT</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>10034</strong></td>
<td><strong>14146</strong></td>
<td></td>
</tr>
</tbody>
</table>
Quantitative Sample Size Calculations

Three separate sample size calculation were performed in order to determine the number of participants to approach.

**Sample size calculation 1:**
Sample size calculation based on the ratio of patient gender from the original service evaluation. Sample size formula taken from Adequacy of Sample Size in Health Studies [16]

Estimating P to within ‘d’ percentage points

\[ n = \frac{z^2_{1-a/2} P(1-P)N}{d^2 (N-1) + z^2_{1-a/2} P (1-P)} \]

where:

- \( n \) = sample size
- \( N \) = Population size, taken from combined HES and CDS data
- \( Z \) = Z statistic for a level of confidence, (1.960)
- \( P \) = Expected proportion (based on HES data of 54%:46% male female split), and
- \( d \) = Precision (number of percentage points), (0.05 = 5 percent points i.e. if anticipated population proportion is 20% then absolute precision with 5 percent points would give between 15-25%).

\[ n = \frac{1.96^2 (0.54)(0.46)14146}{0.05^2 (14146-1) + 1.96^2 x 0.49 x 0.51} = 374 \text{ participants (based on gender split from service evaluation and absolute precision of 5%)} \]

**Sample size calculation 2:**
Using the same formula as Sample size 1 but using proportions taken from HES data split between proportions of children seen less than 5 years old and over 5 years old (27%/73%). Sample size formula taken from Adequacy of sample size in Health Studies [16]

\[ n = \frac{1.96^2 (0.27)(0.73)14146}{0.05^2 (14146 − 1) + 1.96^2 (0.27)(0.73)} = 297 \text{ (based on age split from HES and absolute precision of 5%)} \]
Sample size calculation 3:
Given the Multiple Correspondence Analysis (see quantitative methodology) used to establish subgroups within the dataset, sample size calculations were also performed in order to determine if the overall sample size would be adequate to run this analysis. Multiple correspondence analysis may be seen as the counterpart of Principal Component Analysis for categorical data and is part of the family of descriptive methods that reveal patterning in complex datasets (such as clustering, factor analysis, etc.) [17]. The general method of sample size calculation for this type of analysis is based on either absolute minimum sample sizes or the ratio of subjects to variables. If one were to take either set of guidelines e.g. 10:1 subjects to variables ratio (Nunnally, 1978, cited by Osborne) [18] or that a sample N = 200 would be fair and 300 would be good [19] then a sample size of 370 would be adequate and allow for both ratio of subject to variables to be at a maximum of 37 and also satisfies the minimum sample size required from other guidelines.

This study aimed to achieve a sample size of 374 given this was the highest of the three sample size calculations. Given a non response rate of 30% a maximum of 540 participants were expected to need to be approached (this response rate is based on various observations from authors who state “a response rate of at least 50 percent is considered adequate for analysis and reporting. A response of 60 percent is good; a response rate of 70 percent is very good.” Grove [20] citing Babbie (2007, p. 262).

Descriptive Methods that Reveal Patterns in Datasets

One of the objectives within this thesis was to determine if any subgroups could be established within those receiving extraction under general anaesthetic to explore if a variety of interventions and prevention techniques would need to be utilised or if a 'one size fits all' approach could be employed. In order to explore this there were several types of analysis, which appeared to be suitable. The next section explores each of these before concluding as to the most appropriate technique to identify subgroups for this research, these will be presented in table format and include; Path Analysis, Multiple Correspondence Analysis, Principle Components analysis, Factor Analysis and Cluster Analysis.
<table>
<thead>
<tr>
<th>Description of Analysis</th>
<th>Is the analysis applicable to this research?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Factor Analysis (FA)</strong></td>
<td>Factor analysis is used to group variables according to their shared variance. It is most commonly used to develop questionnaires [52]. Factor analysis can reduce a large number of variables into a smaller set or be used to establish underlying dimensions between measured variables and latent constructs which can allow theory to be developed and refined, this process is also called ‘identifying latent variables’ [53]. This technique is mainly used for understanding latent variables i.e. un-measurable constructs such as depression by reducing down many questions into factors. This is therefore not quite appropriate for this research, which aims to group or cluster respondents based on their answers rather than trying to group questions as to their underlying construct. Factor analysis also requires data to be interval level and normally distributed [51] which the majority of the study data is not.</td>
</tr>
<tr>
<td><strong>Path Analysis (PA)</strong></td>
<td>Path analysis (PA) can be used to test theoretical models that have directional relationships with a number of variables being examined. This analysis determines if the model is able to account for the relationship observed in the sample data [51]. PA is a structured equation model technique for analysing structural models with observed variables. It is well known that correlation does not equal causation. PA attempts to identify or create a model that can explain directional correlation, the main goal is then to estimate both the causal and non-casual aspects of observed relations. Predominantly applied to metric scaled and normally distributed data which again would not be appropriate for this analysis given the nominal data used.</td>
</tr>
<tr>
<td><strong>Cluster Analysis (CA)</strong></td>
<td>Cluster analysis is similar in some ways to factor analysis described above but whereas factor analysis tries to group variables together, cluster analysis attempts to group cases. Therefore cluster analysis groups people based on their response to several questions [49]. Cluster analysis assumes no prior knowledge about which elements belong to which clusters. The clusters are defined by analysis of the data but to understand what differentiates the clusters subsequent multi-variate analyses must be performed (i.e. ANOVA) [50]. This technique is potentially applicable to this research and the aim of the analysis as it looks to group individuals rather than reduce variables. However it does not provide the same visual representations as MCA (see below) or have the ability to implement supplementary variables such as exploring the hospital attended grouping with defined clusters without influencing the outcome.</td>
</tr>
</tbody>
</table>
Principle components analysis considers the total variance in the data (it extracts all factors underlying a set of variables therefore the number of factors is equivalent to the number of variables) and reduces the original variables so there are fewer contributions. PCA aims to create summary variables (principle components) that capture most of the information from the original dataset PCA therefore aims to: [48]

1) extract the most important information from the data table
2) compress the size of the data set by keeping only this important information;
3) simplify the description of the data set; and
4) analyse the structure of the observations and the variables.

MCA is flexible in terms of the data requirements (i.e. it can incorporate likert scales or nominal data), makes no distributional assumptions and is able to simplify complex data from a potentially large table into a clearer display of variables while preserving all of the valuable information in the data set.

MCA is distinct in being able to describe patterns geometrically and can map both variables and individuals allowing a complex visual map to be interpreted. MCA can also incorporate supplementary variables to aid in analysis. This type of analysis is therefore applicable to this research particularly given its flexibility in regards to data requirements.

PCA can be used to examine the relationship among a set of variables in order to identify the underlying structure. It assumes the dataset to have linear combinations of the variables and therefore requires numeric (interval) data, again as data within this study will be nominal, PCA is not as an appropriate analysis as other tests which are suitable for nominal variables as this will make up the majority of this studies output.
The preferred Quantitative Methodology: In-depth discussion and steps to analysis

Multiple Correspondence Analysis has (MCA) been chosen as the statistical technique to use in exploring potential subgroups within those referred for GA, namely if there are certain factors which group together that may illuminate the need or support required for those referred along a GA pathway.

**Interpretation**

MCA quantifies categorical data which is then clustered together, constructing ‘clouds’ using collected data [17]. A cloud can incorporate various categories, where responses are represented and can be visually grouped together. It is also possible to show the location of an individual on the plot and how the responses of that individual are reflected in relation to the responses of other individuals. These clouds of points are not just a graphical display but are also a geographic map with the same distance scale in all directions. The interpretation is based on the distance of the point to the origin of the axis (centroid) and on the weight of the point. Interpretation of MCA also lies within the location of category points to each other and which side of the axis they fall on [21].

An example of MCA can be seen below in figure 3.2, if for instance you asked people about the food and film type they like you could map this using MCA to determine if the certain foods and films were grouped together. From the example we could suggest those who like fish and chips also watch comedies and those who eat pizza watch thrillers. This could be used for marketing when people buy either of these commodities.

*Figure 3.2: MCA diagrammatic example*
Aids to interpretation

The construction of clouds is based on the active individuals and active variables. Once the cloud is constructed, supplementary individuals and variables may be placed in the cloud, these can be used to enrich the interpretation of data, however the contributions of points to axes are the main aid to interpretation [21].

The following steps to analysis are taken from Le Roux and Rouanet [21], beneath each step the actual data analysis for this study is described (See chapter 7 for actual analysis and interpretation):

1) Prepare data for MCA: active individuals and categories are chosen and coded
The following variables were included in the first MCA analysis (variables were dichotomized where possible); Medical history, attendance, prevention advice, anxiety, previous GA, relocation, bottle use, language spoken, pain experienced, impact on school attendance, age, deprivation.

2) Elementary statistical analysis
Frequencies run on variables included.

3) Basic analysis includes, coordinates and contributions and clouds first examination of these contributions will be made.
Certain variables appeared to contribute little to the MCA graph and on reflection were impacts of the disease on the child rather than elements of the individual, which could be used to describe why and how they needed GA and what varying interventions could be beneficial. Additionally it has been noted that where possible variables should contain the same breakdown of categories, as for the majority of variables a dichotomous breakdown was used other variables such as age were also dichotomized (using 4 years old as a split given pre and post school and the age some hospitals referred on for specialist treatment into tertiary care).

4) Informal inspection of Clouds: possible revision of analysis if appropriate (feedback loop)
Following inspection of the cloud coordinates etc. the following variables were included in final analysis: Medical history, attendance, prevention advice, previous GA, relocation, language spoken, age (dichotomized), deprivation (income dichotomized).

5) Interpretation: how many axes need to be interpreted
There are no definitive set guidelines as to how many axes need to be interpreted, this can be dependent on the research question and interpretation by the researcher, however one author describing MCA within market research suggested axis inertia should account for 100/number of items included. For this analysis there were 8 items therefore at least
12.5% inertia should be interpreted by the axis included. This meant for our analysis three axes would be plotted (see Chapter 7 Table 7.2).

6) Inspect and shape and landmark patterns

The mass, coordinates and contribution of each category to the cloud were explored using the tables and graphical display. Points that were located close together on the map meant these features shared similar profiles. The interpretation of these groupings revealed three distinct profiles.

7) Supplementary elements included both individuals and variables

The hospital attended was added as a supplementary variable, as it would not affect the MCA solution but aid further in interpreting the data.

It should be noted the cross-plots of dimensions within the data are suggestive, but not decisive and that while interesting and enlightening interpretation can only produce general statements about this area and not draw precise conclusions [22].

Qualitative Research

Introduction

This section describes the methods undertaken for the qualitative aspect of the mixed methods research. Qualitative research can be defined as “...the interpretive study of a specified issue or problem in which the researcher is central to the sense that is made” ([23] p, 2). These research techniques can be complex and require a certain amount of flexibility and pragmatism in order to address the questions being asked. Even so research should always be grounded in sound background and adequate theory in order for both the reader and researcher to understand and make a judgment on the quality and usefulness of the work [4, 24]. Therefore, methods will be based on the frameworks and techniques developed to not only build on in-depth descriptions of experience, but also to go further and develop interventions based on principles relating to this experience and understanding.

The following section will outline the study purpose, design, participants and sampling as well the various philosophical positions and methods of analysis available and the resulting standpoints taken.

Purpose

The goal for this research is to achieve the deepest possible understanding of the need for GA extractions, the process that leads to it and the ways in which it can effectively be
prevented, using in-depth interviews with those involved. Qualitative research was also be used to elaborate on quantitative findings both within the services provided and experiences of those referred into this pathway.

**Qualitative Data Collection**

*Consideration of interviews*

When research is centred on answers and responses given by the participants themselves it is vital to construct a situation where participants feel able to express their views easily and to direct the outcomes of the research rather than trying to prove a certain hypothesis and directing participants towards certain responses. This is based on inductive thinking, which can be summarised in a flow diagram [25] (see Figure 3.2)

*Figure 3.3: Inductive thinking*

There are many different kinds of qualitative methodology. A number of methods were discounted immediately for this research given the ability to answer the research questions proposed, such as ethnographic and certain observational research. It would be difficult to observe a family over a period of months before a GA referral would be made or for the researcher to immerse himself or herself within the patient's lifestyle. Observations within clinics or at the time of a referral could have been conducted however the pragmatics constrained this type of research and therefore it was deemed not appropriate for this study.

The most appropriate and information generating methodology regarding the perspective of participants themselves is to conduct interviews. This allows an understanding of their experiences and the meaning they assign to events leading up to referral and subsequent tooth extraction. Interviewing participants is the most common approach of qualitative research and can be conducted in various forms, including: face to face interviews, focus groups and interviews by telephone. Each type of interview can be useful and appropriate in different settings. Interviews can also be broken down through a spectrum of structure; from those which are narrowly defined and have a very specific set of questions that need to be addressed, to those which are un-structured and rely on data to be generated.
spontaneously with no pre defined interview guide [4]. The usual structure of interviews lies somewhere in the middle of this, referred to as semi-structured interviews [26].

It has been decided that individual interviews with parents, conducted along with their children (if appropriate) would be the best option. This followed on from PPI discussed earlier with parents at various sure start centres in Manchester. Certain questions in the interview guide also came from these discussions. The setting of face-to-face interviews can impact on the data elicited. Consideration was given as to the most appropriate place for an interview from the participant’s perspective, this could have been either at their home or in a convenient location, such as a coffee shop or library. If the setting resulted in meeting in a place surrounded by the general public it was important to consider that sensitive topics could be discussed. These options would allow parents to freely discuss different aspects that lead to their child’s need for a GA extraction face to face and for the researcher to ask the same broad questions at each interview [27]. Face to face interviews could also allow the researcher to respond to other cues such as body language and their surrounding and if appropriate take additional field notes which may aid analysis or interpretation [4]. It is possible in some circumstance interviews may need to be conducted by remote means.

For those who feel unable to meet face to face or would prefer to have an interview by another means, telephone interviews were also offered as it was important to gain as many appropriate respondents as possible, therefore methodology was reasonably flexible. Telephone interviews are one way of interviewing participants while maintaining a level of anonymity for participants. These types of interviews can be useful for sensitive topics, when groups are hard to reach or where interviewer safety is of a concern [28]. While face-to-face interviews are more usual within qualitative research, telephone interviews have been shown to be an acceptable and valuable method of data collection [29] and the relative anonymity for some may increase data quality [28].

These individual qualitative interviews with the family/caregiver and child, took place if possible both before and after the operation, in order to record any significant changes in the thoughts and reasoning, given the serious operation being experienced. All interviews were tape recorded and transcribed at a later date. There were no apparent differences before and after the operation in the responses therefore all themes are presented together rather than presenting information gained separately before and after the operation.
**Participants and recruitment**

In deciding who should participate in the qualitative interviews it is important to consider who is involved in the process of children receiving a DGA and who is affected by it.

Dental professionals have an important role in the referral and dental procedure carried out, as they are the gatekeepers and ultimate decision makers in regards to treatment. If a GDP decides to attempt extraction or restoration and is successful then a GA operation is not required. If a dentist who is performing the procedure decides this is not appropriate and rejects the referral or performs under another means such as Inhalation Sedation (IHS) then the GA operation is also avoided. It is therefore important to involve these individuals within the qualitative interviews, as they are the gatekeepers and referrers of DGA. Individuals could include: Consultants, GDPs, Specialist dentists, etc. By interviewing these individuals it is not to say that GA operations are not necessary, if children’s teeth are decayed to an extent where multiple teeth need to be extracted or the child is too young to cooperate, GA may be most appropriate solution.

Referred participants could include both the parents and child if appropriate. It is known that parents and guardians play an essential role in their children’s health and wellbeing, particularly when they are very young and at their most vulnerable. Parents can be in turn affected by the experiences of their children and their reaction to the procedure. Children referred for GA extraction will obviously be affected by the operation, however, up until a certain level of maturity they are very dependent on their parents or guardians to provide the correct environment to facilitate a healthy lifestyle and well-being and have limited control over their own health.

In the past, involving children within research and specifically as active participants has been scarce throughout most disciplines and for more than a century was the territory of developmental psychology. Over the past few decades this has changed and the theory and methods developed are now well established within sociology of childhood [30].

Previous research specifically in this area has focused purely on the parents, and it is felt that the child’s view and opinions could be an important factor within this study if possible.

Given the likelihood of children requiring an extraction under GA for varied reasons, these varied perspectives should be considered and the sampling should reflect this to allow insight into these potentially different aspects and needs. This is important as within qualitative research the sample should “produce the type of knowledge necessary to understand the structure and process within which the individual or situations are located”
The original plan was based on purposive sampling, where properties could be selected depending on who can represent certain groups identified and develop understanding of this area to a greater degree [5, 12]. Due to pragmatic reasons a convenience sample was ultimately employed given parents willingness to take part in interviews, this is elaborated on further within the discussion (Chapter 11).

While parents and guardians could be approached through various hospitals and referral centres, Dentists were approached from those who work at the clinics or refer into the centres following data collection. All participants had to sign a consent form before taking part in the qualitative interview as well as parents completing the same questionnaire distributed to the quantitative cohort.

**Qualitative Sample Size**

Sample size is always difficult to ascertain, sample size should be determined by the analysis and stopped when saturation has occurred [4]. When no new information comes from each new participant and redundant information remerges. Therefore sampling was based on this iterative approach. However to begin with an estimate of sample size need, it was thought 10 participants per group (i.e. parents and dentists) should be sought.

**Sample Information**

The participants who took part in the final interviews are shown in Tables 3.5 and 3.6. Participants were recruited from 3 different geographic locations.

<table>
<thead>
<tr>
<th>Dentists treating referred children</th>
<th>Referring/non operating dentists</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ID</strong></td>
<td><strong>Dentist</strong></td>
</tr>
<tr>
<td>1</td>
<td>Operating dentist</td>
</tr>
<tr>
<td>3</td>
<td>Operating dentist</td>
</tr>
<tr>
<td>13</td>
<td>Primary care dentist</td>
</tr>
<tr>
<td>14</td>
<td>Primary care therapist</td>
</tr>
<tr>
<td>15</td>
<td>Primary care therapist</td>
</tr>
<tr>
<td>5</td>
<td>Commissioner</td>
</tr>
</tbody>
</table>
Table 3.7: Participant’s details (Parents and children)

<table>
<thead>
<tr>
<th>ID</th>
<th>Mother/ father</th>
<th>Child included in interview</th>
<th>Child Male/ female</th>
<th>Area</th>
<th>Age of child at op/treatment (years)</th>
<th>Teeth extracted</th>
</tr>
</thead>
<tbody>
<tr>
<td>259</td>
<td>Mother</td>
<td>Yes</td>
<td>Male</td>
<td>2</td>
<td>7.10</td>
<td>1</td>
</tr>
<tr>
<td>328</td>
<td>Father</td>
<td>No</td>
<td>Male</td>
<td>2</td>
<td>8.83</td>
<td>5</td>
</tr>
<tr>
<td>326</td>
<td>Father</td>
<td>No</td>
<td>Male</td>
<td>2</td>
<td>9.33</td>
<td>4</td>
</tr>
<tr>
<td>648</td>
<td>Mother</td>
<td>No</td>
<td>Male</td>
<td>4</td>
<td>7.58</td>
<td></td>
</tr>
<tr>
<td>901</td>
<td>Mother</td>
<td>No</td>
<td>Female</td>
<td>3</td>
<td>6.00</td>
<td>Restoration</td>
</tr>
<tr>
<td>920</td>
<td>Mother</td>
<td>Yes</td>
<td>Male</td>
<td>3</td>
<td>7.78</td>
<td>Restoration</td>
</tr>
<tr>
<td>918</td>
<td>Mother</td>
<td>Yes</td>
<td>Male</td>
<td>3</td>
<td>8.92</td>
<td>Restoration</td>
</tr>
<tr>
<td>912</td>
<td>Mother</td>
<td>Yes</td>
<td>Male</td>
<td>3</td>
<td>10.03</td>
<td>Restoration</td>
</tr>
<tr>
<td>924</td>
<td>Father</td>
<td>Yes</td>
<td>Male</td>
<td>3</td>
<td>6.20</td>
<td>Restoration</td>
</tr>
<tr>
<td>810</td>
<td>Mother</td>
<td>Yes</td>
<td>Male</td>
<td>1</td>
<td>3.75</td>
<td>5</td>
</tr>
<tr>
<td>818</td>
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<td>Yes</td>
<td>Female</td>
<td>1</td>
<td>6.00</td>
<td>12</td>
</tr>
<tr>
<td>811</td>
<td>Mother</td>
<td>No</td>
<td>Female</td>
<td>1</td>
<td>2.42</td>
<td>10</td>
</tr>
<tr>
<td>806</td>
<td>Mother</td>
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<tr>
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</tr>
<tr>
<td>800</td>
<td>Father</td>
<td>No</td>
<td>Male</td>
<td>1</td>
<td>6.25</td>
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</tr>
</tbody>
</table>

Development of the interview schedule

It was expected interviews could last up to 60 minutes with discussions to include: previous problems with oral health, issues during development, support and information available and dental history. These discussion guides were developed following PPI at sure start centres and after results from questionnaires revealed patterns in oral health advice and care and other aspects identified in both self report and clinical notes. Initially a narrative approach was employed asking participants to discuss a typical day and elaborate on any positive or difficult aspects, the discussion also focused on whether oral health and related activities were routine and the challenges that were faced. The discussion considered the referral into the GA pathway and the experience of attending and undergoing the GA operation. The researcher acted as a facilitator and drew out from these discussion topics, health interventions that have worked or may work in this semi structured interview, with the direction and influence coming from the participants (child and parent/guardian). In order to involve the child in this process as much as possible
certain props or guides were used, for example, pictures to describe dental pain, toys and replica toothbrush in order to gain young and older children’s understanding and experiences of their own dental health and what could be changed or improved. All parents gave full informed consent and children over the age of 11 were also be asked if they agree to participate (for children under 11 parents had to give full consent for both as it is thought children under this age are not be able to fully consent for themselves).

In relation to children, interviews were not necessarily about unearthing new ideas but rather are about constructing an account with that child [30]. When interviewing both children and adults it is important to build up a positive rapport. However there are some similarities and differences in the basis of questioning in a qualitative interview between adults and children. With both groups open-ended question should be utilised while closed questions that would give a yes or no response should be avoided and leading questions should not be asked. A specific issue with interviewing children could be to repeat questions in exactly the same way as children may give different responses each time as they may assume their initial response was incorrect [30].

It has been suggested that different children may respond well to different types of questions, therefore it was pragmatic to have questions posed in these different ways to use within the interview in order to respond to what a child may feel comfortable answering. There are three different types of question that are proposed by Freeman [31], these are:

1. Direct and personal questions i.e. what do you feel when going to dentist, how did you deal with that challenge?
2. Indirect and concrete i.e. how does your dentist act when you go into clinic, does your dentist give you advice when going to for consultation? (further questions discussing diet and tooth brushing)
3. Indirect, personal, concrete and connected to emotions i.e. what do you think happens to people who don’t brush their teeth, what do you think is good and bad food to eat for your teeth?

A research diary was used in order to track all activities, decisions made, instrument development and revisions so an adequate audit trail could be established for other researchers to see how the methods have progressed, altered, and why [32]. After each interview the researcher (MG) recorded their thoughts and initial ideas about the interview and any additional information they thought was relevant.
Interviewer considerations

Reflexivity is a key element to the research process, as a researcher it is important to be aware of your own experiences, circumstances and perspectives and how these can influence the collection and interpretation of data. Interviewer bias can occur in all types of interviews and despite an effort to address this issue within qualitative research it is acknowledged that the researcher was entering the research with a preconception of some of the issues within caries in young children and the impact parents and dentists could have on this area. While being aware of this it has been noted through various frameworks that researchers beliefs, knowledge and experience should not necessarily equate bias [33]. Therefore reflexive techniques should be employed while acknowledging that understanding requires interpretation and this is encompassed within the researcher’s beliefs and standpoint. With this in mind it is important to establish the researchers (MG) circumstances and perspectives and how these were reiterated to participants. The researcher stated they were not part of the dental team and worked for the University of Manchester and that none of participant’s responses would affect their treatment. As participants included both parents and dentists they could have been approached face to face at clinics or in the case of referring dentists through email and telephone calls to the practice, It was important that there was consistency through the interviews, therefore at the start of each interview the purpose of the interview was reiterated and obviously participants were informed they could withdraw at any time and didn’t have to answer questions if they did not wish.

As the researcher (MG) was from a non-clinical background it was felt this was important to reiterate to both dentists and participants. It was believed this meant that certain topics could be addressed without parents or dentists feeling they were being judged or scrutinised by someone within the profession and that there was a genuine interest in their individual views and how they perceived the impact of GA without a predefined assumption of what this should entail. This was discussed as the main focus of these interviews with participants. However, having said this, there is in any interview recognition that information gained is in part directed by the line of questioning and given the research was looking at an area which we wished to prevent (caries in young children and the resulting DGA), parents and to some extent dentists may have felt certain responses were required of them (responder bias). They may have wanted to present themselves in a certain way, which they may have felt was more acceptable. This was evident when looking back through transcripts and field notes where on occasion a parent’s description of their behaviour did not match what was seen during the interview.
for example one parent discussing that no sugary things were within the house while her
daughter drank a large bottle of cola. These insights were however an important part of
the research and show the difficulties around this area of responsibility and blame as
people obviously want to present themselves as good and responsible parents but
challenges and other issues can get in the way. This is not believed to be a failure of the
methodology but a positive and indicates the importance in the process of not only the
recorded transcripts but also making field notes during or shortly after the interviews which
would otherwise not have been picked up. The notes were also important in relation to
interviewer bias and reflexivity and it served as a log of influences for each interview and
could allow for a paper trail to search for subjectivity or prejudices within the interviews.

**Qualitative Data Analysis**

A thematic analysis was conducted using some techniques of a grounded theory
approach [34] to code and compare data across cases in order to look for recurring
themes, and also negative or unusual cases. Grounded theory looks to uncover basic
social processes and can be used to explore the behaviour of groups which affect
individuals lives and where there has been little exploration in the past [35]. The approach
to analysis is iterative so that initial analysis informs subsequent interviews and analysis
[4]. In a pure grounded theory approach, there is an emphasis on generating theory which
emerges inductively from the data through careful analysis. The emphasis for this study
was to understand a specific dental health service problem and how key perspectives
might contribute to that. A purely inductive approach to theory building would be less
useful for that purpose. Instead, useful elements were combined from grounded theory
such as constant comparison and open coding to begin to reduce data, with recoding
allowing further categories to emerge.

After Interviews were completed they were recorded and transcribed. In order, to gain the
richest insights and aid theory generation as well to allow for sample saturation to be
determined an iterative approach was employed. Where approximately 3 interviews were
coded and analysed, followed by a second batch of 3 interviews, this continued until the
researcher was satisfied no new themes were emerging [5].

Atlas (ti. Version 6.2 2010 Berlin) was used to support organisation of the data, to locate,
code and annotate findings of the qualitative data. Thematic analysis is commonly used
as a basic type of analysis [4], and is useful in identifying typical responses and for
identifying important issues within specific groups. The typical use of thematic analysis is
to establish the main themes from interviewee’s accounts from notes and transcripts. It is a flexible way of analysing data and means a range of research questions can be addressed [36]. Like other methods of analysis, thematic can incorporate constant comparison and other coding techniques adapted from a grounded theory approach. Theoretical frameworks underpinning thematic analysis vary [36], and it is commonly applied in health related research. In this research the author adopts a theoretical stance consistent with post positivism, and assumes that science is applicable in the social world, just as it is with the physical world (natural science). However, different strategies are required for effective study, given that society is in continuous state of change. In this way the theory is not attempting to predict but is used for explanatory benefits and assumes as measurement is fallible it is important to take multiple measures and observations and triangulate this across sources in order to have the best understanding possible of what and why phenomena occurs [37].

Other analysis such as framework analysis and Interpretative Phenomenological Analysis (IPA) were considered but were not as suited to this type of research for various reasons. IPA involves the use of thick description of lived experiences and is useful for developing explanations in the form of models and narratives from the data collected [33, 38]. Various types of analysis share common processes and it was considered that the coding and development described by Fade [33] and Smith [38] relating to IPA could be utilised to aid analysis with this research. Although IPA is not commonly used in mixed methods studies, as the researcher should become immersed in the phenomena studied in order to gain a satisfactory view of the experience. Therefore the time needed to utilise this method effectively was compromised and consequently not used as the primary qualitative analysis [39]. Framework Analysis is often used within policy orientation and tends to have specific objectives set to be included within interviews i.e. to inform the design of a survey looking to develop a valid measure [4]. In this way it did not sit well in this mixed methods research, as the sequence of data collection starts with quantitative, which qualitative results will elaborate on. However framework analysis maybe of value for future research in this area in the next stage of intervention development according to the MRC guidelines [40].

Major steps in the analysis process comprised: familiarising oneself with the data, generating initial codes, searching for themes, taking extracts and re-examining and coding in more detail, looking for connections between themes to create new sub-themes in a meaningful way, reviewing themes and defining and naming themes [33, 36]. This type of analysis can also be seen to broadly follow a grounded theory approach which
involves open coding, by segmenting the text into labelled sections, axial coding that looks at the relationship between codes and then selective coding by developing the overarching key themes [34]. In addition, while reading through transcripts memos and notes were made on ideas and potential themes that were then explored further throughout the other transcripts. Analysis was therefore conducted by well-developed themes being linked together through accounts of association or connections. An example of these have been presented in Figure 3.3 and 3.4 where codes were developed recoded and themes were linked through associations. Figure 3.5 illustrates how recoding and extracts were broken down, these quotes were then looked at in terms of broader themes and connections. The explanations arrived at continuously evolved and were compared with incoming data and projects being conducted on similar areas.
Figure 3.4: Illustration of coding development and defining themes - 1
Anxiety and fear of the dentists

Looking beyond the dental practice

Anxiety and fear of the dentists

Challenges with routines and independence

The influence of the wider social context on dental health

Policy and advertising within and outside the UK

The need for and value of a public health approach?

Behaviour change

Initial recoding

Further recoding (with extracts)

Reviewing and defining themes

Challenges with treating children - the parents

Challenges - responsibility

Challenges in making parents understand - oral health

Anxiety

Tooth brushing

General Oral health routines

Dental visits

Changes over age

Dental perspective

Challenges with diet

Advice brushing/diet

Public message

Fluoride prevention (dentist)

Family/cultural influence

Continuous care

Messages from other areas

Positive changes to behaviour

Feelings towards dentists

Open Coding

Initial recoding

Further recoding (with extracts)

Reviewing and defining themes

Challenges with parents

Challenges with children

Routines

Prevention

Changes following referral

Figure 3.5: Illustration of coding development and defining themes - 2

119
It is, and it’s very difficult because you can’t...in the past you could bluntly tell the parent to leave. It’s hard to do that these days because of...there’s child safeguarding issues and things like that. In a way you have to have the parent, or a parent with you, and it’s very difficult; you end up managing both at the same time (Dentist 2)

Don’t be scared,’ they tell them as they walk in. We haven’t done anything yet, there’s nothing to be scared of, but they’ve already planted that in their brain, and the kid’s already… ‘If you don’t sit there, the dentist is going to take out all of your teeth!’ A lot of parents say that, and it’s just...oh gosh, here we go. (Dentist 7)

One of the biggest problems is, we can see kids for the first time, it’s too late to prevent the problem happening, because it’s happened. (Dentist 16)

So had a IHS extraction for a child and the mum is there rubbing his leg as if he is about to give birth and then as a six comes out instead of just keeping quiet she gets off the chair and comes to the chair, comes to the dental chair where the child is sitting and says “oh my God, look at the size of that” [laughter]. Thanks, mum. (Dentist 2)

We have to kind of like deal with the parents as well in a way don’t we (break) Sometimes we have had to take them out and explain that you need to remain calm otherwise the child is not going to remain calm. (Dentist 14)

I get stressed more with the parents because they’ll say to me, “he’s always sweets, he doesn’t stop” and I say, “right, who’s buying them?” and that’s what makes me - they blame the children. “Do you brush their teeth before they go to bed?”; ”no, we don’t, they don’t let us”, ”what do you mean? You’re the parents. What do you mean they don’t let you?”. It’s just that basic level. (Dentist 17)

So to have seven teeth out due to neglect, you know, it’s not only mother’s guilt, but you just think what on earth was going on in that dental practice (648)

At the end of the day, she’s a child and they all have different ways of...it’s a comfort. And it’s like taking something off them and like a smoker, taking their cigarettes off them, do you know? (811)

He did explain, obviously, does she have lots of sugary things, does she have lots of cakes and biscuits, and sweets and things like that? No, because she’s hyper, as we well can see, I’ve not had sugary things in the house since she was about two and a half. (818 – researcher field note child was drinking large bottle of coke at the time)

Parents have a got a clue about it, they just don’t understand, they think it’s entirely tooth brushing, or they brush their teeth really well. Well, the diet is even more important than that when it comes to decay (Dentist 7)

Most of my patients aren’t aware that drinks have such a major effect. Their diet’s like… ‘Oh but they eat this,’ and the diet could be all well and good, but their drinks, because they’re having it in their school packed lunches, and the Fruit Shoots, constantly, all the time, they’re just not aware. And then when you tell them, it’s like, ‘Oh, okay.’ Yes, in some children you see the difference from just 12 months of understanding, completely, I’ve had quite a few, but then other ones they’ll not come back in for 12 months, they’ll come back in, in pain again. (7)

"I thought these were okay, were healthy. I thought a yoghurt was okay because it was healthy. I thought orange juice was okay because it’s healthy. I thought apple juice was okay because it’s healthy”. Well, thank you, I didn’t realise this”. (Dentist 16)
Quality, Rigour and Validity

While there is no absolute and definitive list of criteria to assess qualitative research there are areas and guidelines that are agreed upon that address rigour and quality. Aspects such as generalizability, reliability and credibility have been described by qualitative researchers as important to tackle [4] and guidelines such as COREQ [41] have been developed to address quality. It is important to describe how these areas have been protected within the research.

Reliability or dependability should be considered with the research being able to establish work has been conducted with due attention. This was achieved with accurate transcripts produced using a transcription service but checked by the researcher (MG). Analysis of the data was then undertaken by coding and examining the themes described within this chapter and illustrated in part by Figures 3.4 and 3.5. A second researcher was also involved in order to have consensual validation. As Sandelowski and Barroso [42] discuss this does not necessarily mean the degree of agreement but rather the reasons behind the point of view offered for coding in a certain way. The codes were discussed between researchers to alleviate bias (specifically biased reporting) and come to a consensus in this sense. In order to address respondent validation and credibility, member checks were employed by inviting a selection of the interviewees to give their views on the conclusions reached [43]. This occurred for dentists but was not possible for participants, a Consultant, Referring GDP and those performing the operations or treatment (Alternative pathway and GA pathway) were sent the themes and conclusions for certain areas and asked for feedback either by email or telephone. The only changes came back from the first round of feedback when one dentist suggested his voice felt more prominent in the themes and there might be others who had similar or differing views, the authors agreed and continued with interviews until it was felt that the views and opinions had begun to be repeated within interviews (saturation).

As discussed previously a clear audit trail of the work through a research diary and notes from the researcher were recorded in order to be able to appraise the design and evolution of the research in relationship to its outcomes addressing issues of reliability [32]. The research diary was useful in not only being able to document the work as it continued but also to note ideas and conversations that could be reflected upon in recorded interviews. For example differences in how the hospitals were run and issues mentioned such as staffing were noted and could be incorporated into the discussion within interviews to elaborate on these aspects. This can be seen in the different use of
play specialists throughout the hospitals that became a reoccurring point with parent’s thought-out discussions. They were also used as observational data and combined with information gained from consultation notes and questionnaires for descriptions of services and patients in Chapter 5 and 6. The research diary also noted aspects of interviews, which would have been missed from a simple transcripts, one example of this is from the interview conversation below

*He did explain, obviously, does she have lots of sugary things, does she have lots of cakes and biscuits, and sweets and things like that? No, because she’s hyper, as we well can see, I’ve not had sugary things in the house since she was about two and a half.* (Participant 818) Researcher notes; at the time of the interview the child was drinking a one-litre bottle of cola.

Without the researcher notes and observations the difference between actual behaviour and what the parent was saying would not have been captured, an important aspect within this particular topic within qualitative analysis.

Finally, generalizability is an interesting concept as it could be said that qualitative research is generalizable only to those who took part. However given the mixed methods element to this research, if findings are shown to be plausible and reliable the ability to generalise more widely is possible [27]. It is important enough information is given for the reader to determine if the research can also be applied to other settings, The COREQ suggestions clarity of major and minor themes and consistency, which have been shown through Chapters 5,8 and 9 [41]

Methods within this thesis have been employed to benefit the research, addressing the proposed problem and constructing a way of producing research of quality and rigor. Resulting in methods which have been merged not simply to satisfy a tick box set of guidelines, as this can negatively impact on research looking to generate new theories, [44] but with these guidelines in mind, create research which logically allows for the most important, diverse and vital information to be extracted. It is also important to remember that the trademark of a good methodology is the way it is used to adapt in response to circumstances as they exist [45] which was also the approach of the study.

This flexible, reflexive and iterative process of data collection and analysis should allow a rich insight into this area and aid in developing theory in relation to complex interventions to tackle the issue of severe caries and the resultant GA extraction.
References


Chapter 4

**Foundation and Summary of Chapter 4**

Chapters 1, 2 and 3 have provided the background to this thesis and identified issues concerning the number of Dental General Anaesthetic (DGA) extractions carried out in the North West of England. The data gained from Hospital Episode Statistics (HES), detailed in the methodology, demonstrated different services saw a substantially different number of patients throughout the year. It was hypothesised that there may be significant differences not only in the population attending these services but also in the service delivery and organisation of the DGA treatment.

Therefore it was the purpose of this chapter to explore the potential differences in services and treatment provided at the six hospitals attended. This was achieved using data collected via questionnaires completed by parents or guardians, dental consultation and referral notes and also observational data collected while at the hospital. In this sense Chapter 4 sets the scene for DGA extractions carried out in the North-West of England and provided grounding for further qualitative work in this area. Chapter 4 is closely linked with Chapter 5. Chapter 4 presents a broad quantitative look at the data collected while Chapter 5 uses qualitative interviews and analysis to give a more in-depth picture.

This paper was submitted for publication to BMC Oral Health in November 2014

**Authors Contributions**

IAP and CS contributed to the protocol, design and manuscript. GD contributed to the design of the data collection tool. MG contributed to the design, acquisition of data, analysis, interpretation and manuscript.
Abstract

Background
Extensive caries in children can result in a referral for tooth extraction under General Anaesthesia (GA). While there are guidelines for the use of GA within paediatric dentistry this process is ultimately dependent upon the decision making of the treating dentist. This decision can be influenced locally by the availability of services and their waiting list. GA services for paediatric extractions (DGA) have developed from different historical positions, including community dental services, maxillofacial services and paediatric led specialist services.

Method
This article explores the differences between DGA services provided by 6 randomly selected hospitals across the North West of England. 456 patients who attended a routine DGA appointment in each hospital over a period of two months from 2012 to 2013 gave consent to allow access to their clinical notes and completed a questionnaire (93% consent rate). Data were entered onto SPSS and appropriate statistical tests undertaken.

Results
Differences between hospitals included the clinic structure, patient characteristics and the treatment provided. There was a significant difference in the number of previous child DGAs experienced within the family, ranging from 33% to 59% across hospitals. Hospital 1 attendees differed in a number of ways to other areas but notably in the stability of lifetime residency with 20% of patients having previously lived in another area and with just 58% of parents stating their child regularly attended the dentist (compared to an average of 9% and 81% respectively across other hospitals).

Conclusion
Findings suggest services throughout the region face different obstacles in providing support and treatment for young children referred for DGA. There are, however common practices such as preventative treatment, which could impact on caries experience and subsequent DGA referral, a particular issue given the high DGA repeat rate observed. For many children a DGA may be their first dental experience. It is therefore vital to engage with both child and family at this stage, attempt to initiate a pattern of dental attendance and to ensure this experience does not create an on-going cycle of poor dental behaviour and health.
**Introduction**

Despite the fall in caries prevalence over the last 30 years, strongly linked to the widespread use of fluoride toothpaste [1], tooth decay is still a significant problem. Dental decay is a global issue but has become concentrated in the most vulnerable section of society; namely young children and the most deprived [2]. Caries is a multi-factorial disease and its effects can range from mild discomfort, to on-going pain that affects quality of life [3]. If dental decay and subsequent infection or pain become too severe a dentist may elect to refer a child for tooth extraction under General Anaesthetic (GA). This should be reserved for the most severe cases, given the associated morbidity of the procedure and due to limits of service provision i.e. wait times within a hospital setting [4].

During the early 20th Century, extraction under general anaesthetic was a routine treatment option for managing decay in young children. Following a decrease in caries, levels of the number of dental general anaesthetics (DGA) in the UK also decreased [5]. In 2002, following a report entitled 'A Conscious Decision', general anaesthetics could only be provided within a secondary care setting. This was largely due to a number of fatalities following administration of GA within primary care settings [5, 6]. The most recent report on hospital extractions by the Dental Health Observatory (now the Dental Public Health Intelligence Programme) produced data showing an alarming rise in the number of extractions being carried out in a hospital setting throughout the North West of England, the majority of which under GA [7]. Additional data were released by the HSCIC (Heath and Social Care Information Centre) which showed a year on year increase of children attending hospital for caries treatment throughout England from 2010 to 2014 [8].

There are a variety of additional reasons, beyond the severity of dental caries, why children may be referred for a GA extraction that may explain this rise against the context of falling disease levels. These range from the referring dentists’ skill and confidence in treating young children, to the services available in that area. One study, examining the experience and self assessed confidence of students at 3 dental schools, found confidence lowest for ‘selecting patients for GA’ [9]. Additionally, a number of studies have indicated there is an apparent lack of understanding from referring dentists as to the appropriate provision of DGA plus little adherence to the GDC guidelines surrounding this pathway [10]. The overall fall in disease on a population level, but with its concentration in the most deprived communities, appears not to have impacted on the level of DGA required i.e. prevalence has decreased but severe caries remains a significant public health issue.
Historically there is no clear defined pathway for young children with multiple decayed teeth although in recent years various care pathways have been suggested and guidelines for the use of GA in paediatric patients have been published [11, 12]. It is recognised that due to differences in providers, commissioners and dental need/demand across geographic areas, a varied DGA service landscape and utilisation is seen [13].

As many of the services are provider led, and historical in nature, they may not have been commissioned based on a formal health needs assessment or have a clear service specification, unlike many contemporary services. Much of this reflects the legacy of these services, however, understanding the differences between them, and impact on children and families, is important. Such differences may also reveal elements of best practice that can form part of a service specification and commissioning.

**Aim:**

To explore differences in the DGA population and services provided for children admitted to six selected hospital sites for a dental extraction under GA in the North West of England and detail certain qualities that can be replicated across these services.

**Objectives:**

- To collect hospital data (wait times, etc.)
- To collect data gained from service users on their dental treatment (preventative treatment, previous GA) and certain features of this population (attendance, IMD, translator required).
- To observe the process of treatment under GA on the day of the operation.
- To observe any prevention or assessment that occurs before treatment under GA.

**Hypothesis:**

- There will be a significant difference between those attending different hospitals in key variables relating to both the population (IMD, language and attendance) and in treatment (number of teeth extracted and prevention advice given).
- There will be ‘best practice’ qualities of services, which should be replicated across other hospitals in relation to quality of care and the positive impact on children.

**Methods**

Data were collected following recruitment of patients from six randomly selected hospitals (using a random number generator) across the North West. The criterion for a hospital to
be included in the random sample was it had to carry out more than 200 operations for an extraction per year, 21 conformed to this criterion. Each hospital was visited for a period of two months on a series of rolling visits over a period of a year and a half during which the researcher (MG) attended every session scheduled for GA extraction, commonly known as 'outpatient' GA, i.e. those not limited to individuals with special treatment needs or requiring complex procedures. This permitted the research team to gain a representative sample from each hospital. The sample size was calculated from information gained both from the Dental Health Observatory (now the Dental Public Health Intelligence Programme) and from a previous service evaluation completed based on the ratio of male to female participants, an absolute precision of 5% and given a 95% Confidence. Other proportions with known data were calculated i.e. proportion of children seen who were 5 years and younger but as the ratio for male/female was almost 50:50 this yielded the largest, minimum sample size required.

\[
n = \frac{1.96^2 (0.54)(0.46)}{0.05^2 (14146-1) +1.96^2 \times 0.49 \times 0.51} = 374 \text{ participants}
\]

Given the final sample size of 456 participants in this study there was deemed sufficient numbers for further analysis. Data were gained from a variety of sources including a questionnaire completed by the parent, which contained questions on dental history, sociodemographics and whether previous information or preventative treatment had been given. Additionally information was collected from clinical and referral notes which comprised of teeth requested and planned for extraction, recorded pain, anxiety, medical history, dates of referral as well as notes on any additional information recorded. Researcher notes were also made at each session regarding the process and delivery of the service these were framed around patient arrival and departure times, hospital setting/layout, staff available during the GA sessions and child friendly activities within the waiting area or equivalent. These were primarily recorded to assist with further questions during the qualitative interviews, which explored experiences of DGA. Information gained during these note taking have been described in Table 4.1 to elaborate on the difference and similarities between services. Data were entered into SPSS (IBM, Version 20) and the data was analysed using appropriate methods taking into account parametric assumptions.

Ethical approval for this study was obtained from the NRES Committee North West Preston (11/NW/0503) and all participants gave informed consent before taking part (copies can be found in supplementary materials in Appendix 12.3.4).
Results and Hospital Descriptions

In assessing DGA services it is important to note both the differences and similarities between the ways the hospitals are organised and the way care is provided. All hospitals were attended for a period of two months during which time clinics were operating as usual i.e. no long-term staff sickness or estate issues. Information about these hospitals is taken from the time the researcher attended and may have changed since (Table 4.1).

It should be noted that during the two month research period theatre sessions were cancelled at hospitals for various reasons (illness, no anaesthetist available, etc.) therefore patient sessions may not add up to the total anticipated if every session had occurred as planned. Due to the high consent rate (93%) out of those who attended the clinic days there is a high degree of confidence in the relative values shown despite not all patients being included. When including those who failed to attend (who the researcher could not have approached and as they did not receive treatment on that day) the consent rate is 75%. All tables in the results section are based on the number of children seen and consented at the hospital site (n).

Assumptions

Before analysis was completed assumptions required for parametric tests were explored. Index of multiple deprivation failed assumptions of normality (Kurtosis 2.977 p <0.05) and homogeneity of variance (F(5,430) = 2.654 p = 0.022). Therefore the variable was transformed using natural log F (5,430) = 1.829, p = 1.06.

Data for Referral to Treatment Time (RTT) in days, number of teeth extracted and age were also skewed and homogeneity of variance assumption not met. However, transforming these did not have an effect on normality and homogeneity of variance and therefore all further analysis on all other variables utilised non-parametric tests.

Analysis

A one-way ANOVA was conducted (Table 4.2) on the transformed IMD score (natural log transformation). There was a significant difference detected between hospitals for the IMD given for each participant F (5,421) = 6.272, p = 0.0001. To determine where possible difference between each hospital lay, a Games Howell post hoc procedure was performed
(Table 4.3). This was chosen over Bonferroni as the sample sizes between hospitals were different and this provides the best performance on such data [14]. Significant differences were observed between a number of hospitals. Hospital 2 and 3 had, on average, lower deprivation scores, with the remainder scoring similarly higher deprivation scores. While this indicates the hospitals, included in the study, covered varying regions with a variety of deprivation backgrounds based on IMD, these data should be linked back to the population of the surrounding area, i.e. if the average deprivation score of those attending for GA extraction were significantly different to the overall population of each hospital region. This was calculated using the same IMD generator but using the whole population postcode data. Analysis indicated Hospital 3 and 4 had a significantly higher IMD than the general population of the region served by the hospital, following correction for multiple comparisons (Table 4.4). However for all hospitals, patients who attend had on average higher IMD scores (and hence higher levels of deprivation) than the general population of that area with the majority showing moderate evidence of a difference. No significant difference was observed between hospitals and age at operation using Kruskal-Wallis $H(5) = 7.614$, $p = 0.179$. 
<table>
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<tr>
<td><strong>Service delivery</strong></td>
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<tr>
<td><strong>Clinics/ patients per month</strong></td>
</tr>
<tr>
<td><strong>Wait from referral to operation Mean (95% CI)</strong></td>
</tr>
<tr>
<td><strong>Pre assessment</strong></td>
</tr>
<tr>
<td><strong>Clinic structure</strong></td>
</tr>
<tr>
<td><strong>Clinic layout</strong></td>
</tr>
<tr>
<td><strong>Entertainment</strong></td>
</tr>
<tr>
<td><strong>Method of induction</strong></td>
</tr>
<tr>
<td><strong>Bed assigned</strong></td>
</tr>
<tr>
<td><strong>Play specialist</strong></td>
</tr>
<tr>
<td><strong>Additional elements to referral or service</strong></td>
</tr>
<tr>
<td><strong>Failed to Attend</strong></td>
</tr>
</tbody>
</table>
FT = Foundation Trust, CT2 – Core training 2 previously known as SHO, CDS = Community Dental Service.

Staffing issues refer to staff leaving due to retirement, maternity or other personal reasons and a delay in implementing new staff or finding appropriate replacements.

Descriptive statistics (Table 4.5) indicated there were few children who were born in another country and there was no statistically significant difference between those attending different hospitals. However, there did seem to be a great level of relocation for those attending Hospital 1 with almost a fifth of the children having moved into this area after they were born. Additionally, there was a difference in main/first language spoken by attendees with Hospital 1 having a fifth of attendees stating English was not their main or first language and 7% requiring a translator at the hospital (Table 4.3).

Treatment provided throughout the six hospitals varied (Table 4.5). The majority of patients underwent extraction of deciduous teeth. However, two hospitals also provided some form of restorative procedure under General Anaesthetic (either alone or with additional extractions). Only one of these hospitals carried this out on a sizable proportion of patients. Hospital 6 treated just over a quarter of patients (26%) using some form of restorative procedure. No other hospital noted they performed any restorative work under General Anaesthetic, only extraction of teeth. Reasons for this are explored further in the discussion.

To explore any difference between the hospitals and the number of teeth extracted, Kruskal Wallis was performed given the non-normal distribution and violation of homogeneity of variance. A significant difference was detected 88.588 (5) \( p = 0.0001 \) therefore the null hypothesis was rejected and pairwise multiple comparisons computed. The pairwise comparisons (Table 4.6) generated through SPSS compare pairs of groups based on rankings created using data from all groups, as opposed to just the two groups being compared, these tests are known as Dunn-Bonferroni tests [15]. Hospital 1 had on average a higher number of extractions compared to other hospitals in the study which ranged up to a full clearance with all 20 teeth being removed (Table 4.3).

Examining the rates of previous DGAs for the participating child or any other children within their household was remarkably high ranging from 33% to 59% throughout the hospitals (Table 4.5).
<table>
<thead>
<tr>
<th>Hospitals (number of children consented)</th>
<th>1 (117)</th>
<th>2 (48)</th>
<th>3 (36)</th>
<th>4 (76)</th>
<th>5 (49)</th>
<th>6 (130)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hospital</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Born in another country</td>
<td>10 (9%)</td>
<td>1 (2%)</td>
<td>2 (6%)</td>
<td>1 (1%)</td>
<td>1 (8%)</td>
<td>5 (4%)</td>
</tr>
<tr>
<td>Relocated within UK</td>
<td>21 (19%)</td>
<td>4 (10%)</td>
<td>5 (15%)</td>
<td>3 (4%)</td>
<td>3 (7%)</td>
<td>8 (10%)</td>
</tr>
<tr>
<td>Main language not English</td>
<td>24 (21%)</td>
<td>3 (6%)</td>
<td>3 (8%)</td>
<td>1 (1%)</td>
<td>0</td>
<td>5 (4%)</td>
</tr>
<tr>
<td>Translator required</td>
<td>8 (7%)*</td>
<td>1 (2%)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1 (1%)</td>
</tr>
<tr>
<td>Extract only</td>
<td>8 (7%)/93</td>
<td>1 (2%)/42 (88%)</td>
<td>6 (17%)/28 (78%)</td>
<td>3 (4%)/69 (92%)</td>
<td>2 (4%)/44 (92%)</td>
<td>13 (10%)/77 (60%)</td>
</tr>
<tr>
<td>P / D / P&amp;D</td>
<td>(80%)/11 (10%)</td>
<td>/5 (10%)/2 (6%)</td>
<td>/3 (4%)/2 (4%)</td>
<td>/3 (2%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Restore/Extract</td>
<td>4 (3%)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>35 (28%)</td>
</tr>
<tr>
<td>Teeth extracted</td>
<td>8 (1-20)</td>
<td>7 (1-15)</td>
<td>4 (1-7)</td>
<td>4 (1-12)</td>
<td>5 (1-13)</td>
<td>4 (1-18)</td>
</tr>
<tr>
<td>Median (min-max)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Previous DGA</td>
<td>40 (34%)</td>
<td>17 (35%)</td>
<td>17 (47%)*</td>
<td>25 (33%)</td>
<td>29 (59%)*</td>
<td>62 (48%)*</td>
</tr>
<tr>
<td>any child in household</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relevant Medical History reported</td>
<td>8 (9%)</td>
<td>7 (16%)</td>
<td>4 (14%)</td>
<td>5 (17%)</td>
<td>6 (19%)</td>
<td>39 (40%)*</td>
</tr>
<tr>
<td>Irregular attender</td>
<td>48 (41%)*</td>
<td>13 (27%)</td>
<td>1 (3%)</td>
<td>13 (17%)</td>
<td>10 (20%)</td>
<td>26 (20%)</td>
</tr>
</tbody>
</table>
P = Permanent teeth, D = Deciduous Teeth, P&D Permanent and Deciduous teeth. 25%\(^7\)/50%\(^6\) of cells have expected count of less than 5. * indicates where statistical differences occur.

Medical history % out of those who had accurately reported records

Further variables were explored to determine if there were differences between those attending the six hospitals in (data were gained from self reported parent questionnaires); regular dental attendance (child attending at least once a year), relevant medical issues or preventative treatment discussed with the parent (it should be noted preventative treatment such as fissure sealants, may have only been discussed with parents and not necessarily applied by the dentist or other health professional outside of the hospital) in order to potentially account for the differences seen in repeat DGAs and number of teeth needed to be extracted (Table 4.5). Hospital 1 had a higher percentage of irregular dental attenders, while Hospital 6 had a higher percentage of children with reported medical issues.

Attendees within certain geographic locations had fewer GDP related preventative measures discussed (Figure 4.1). Evidence of a difference was detected between regions (defined by hospital attendance) in relation to; fissure sealant discussed with parents (any) \(x^2 = 20.255\) (5), \(p = 0.025\), Fissure sealant discussed with regular attending parents \(x^2 = 13.090\) (5), \(p = 0.023\) and fluoride varnish discussed with parents (any) \(x^2 = 15.895\) (5), \(p = 0.007\) (corrected for multiple comparison \(p <0.025\)).

**Figure 4.1: Percentage of GDP preventative measures discussed across Hospitals**

![Graph showing percentage of GDP preventative measures discussed across Hospitals](image)

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Fluoride Varnish Discussed with parent</th>
<th>Fluoride Varnish Discussed with parent if regular attender</th>
<th>Fissure Sealant Discussed with parent</th>
<th>Fissure Sealant Discussed with parent if regular attender</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>31%</td>
<td>27%</td>
<td>10%</td>
<td>19%</td>
</tr>
<tr>
<td>2</td>
<td>23%</td>
<td>23%</td>
<td>13%</td>
<td>24%</td>
</tr>
<tr>
<td>3</td>
<td>31%</td>
<td>14%</td>
<td>8%</td>
<td>15%</td>
</tr>
<tr>
<td>4</td>
<td>39%</td>
<td>39%</td>
<td>14%</td>
<td>14%</td>
</tr>
<tr>
<td>5</td>
<td>40%</td>
<td>20%</td>
<td>10%</td>
<td>14%</td>
</tr>
<tr>
<td>6</td>
<td>32%</td>
<td>28%</td>
<td>14%</td>
<td>19%</td>
</tr>
</tbody>
</table>

*Individual difference detected for hospital 2 and 5 comparing against the collective group, which were
significant for both preventative treatments and for hospital 3 for fluoride varnish and hospital 4 for fissure sealant.

Failure to attend was an issue at all hospitals, with three having almost a fifth of children failing to attend on the day of their operation (Table 4.1) no significant difference was observed between hospitals $\chi^2 = 6.398 \ (5), \ p = 0.269$

Discussion

This study aimed to explore services where children were scheduled to receive dental extractions under GA. This was achieved by randomly selecting 6 hospitals throughout the North West England. In addition, the pre-assessment procedure and use of services before children were referred for this operation were considered using information from both a questionnaire to parents and access to referral and consultation notes. This enabled a deeper understanding of the various influences and determinants that may result in the need for a DGA from a service perspective (this issue is being explored further from both a patient and dental perspective in a Chapter 5). Additionally, with the disbanded PCTs merging over wider geographic footprints (NHS England Area Teams) it was proposed an opportunity to establish commissioned services that reflected best practice and enabled referring practitioners to understand the offer more clearly than at present.

In order to address the differences observed between hospitals the variables described in the results section were clustered into themes. Each one of these will be addressed throughout the discussion in order to establish the differences and similarities between service design and organisation within the assessed hospitals.

Estate issues:

Hospital setting

A child or families’ experience would have been quite different in each hospital. These differences ranged from children being assigned a bed, recovering in an area with other children, to the structure of the service delivery and wait time during the day. Some hospitals (Hospital 1,3,6) saw children all together for their pre-assessment, which meant all children arrived at the same time with the last child potentially waiting for their operation for over 5 hours. Other hospitals (2,4,5) saw children one by one or in smaller cohorts, which reduced their time at the hospital. These could all have varying impacts on the family for example waiting for a considerable amount of time whilst being starved could be troubling for young children [16], additionally recovery with others could cause
further anxiety and add to an already stressful situation. The reason for a collective appointment time vs. individual times was largely due to the physical layout and capacity of the hospitals. Those hospitals with small waiting areas would typically offer individual patient appointment/start times and those with larger facilities, or waiting and pre-assessment facilities at some distance from operating theatres would offer the same appointment start time to all patients.

**Child friendly environment:**
The nature of the clinics was often dictated by their setting; for example clinics could be on children's or adult wards, or be mixed with children waiting for various other procedures or be exclusively for those attending DGA. The majority of hospitals had entertainment in the form of television, games and toys, and such activities have been shown to be invaluable in creating the opportunity to support children's psychological wellbeing and a positive hospital experience [17]. Two hospitals had play specialists throughout the time the observer was present. These individuals talked children through the procedure using props, books and toys in a manner they could understand. Research has suggested children provided with information about their care in a hospital setting consequently felt more prepared and less anxious about their operation and treatment [18].

**Population issues:**
It was apparent a greater proportion of children who attended Hospital 1, compared to other hospitals, had previously lived in another geographic area and had a fifth of parents whose main language was not English. Additionally patients attending Hospital 1 required significantly more teeth extracted (on average 8). There were also significant wait times with a large number of children referred into this service requiring treatment. Therefore Hospital 1 appears to be in an area, which not only experiences a significant oral health problem in children but also has additional barriers to prevention and information being distributed.

The difficulty in providing regular support and information with frequent movement and a variety of languages spoken could impact on a continuous and consistent preventative message being successful [19]. It also indicates any interventions to reduce the number of DGAs would need to take into account language barriers and increased population mobility. This would become problematic if, for example, there was an attempt to establish a Public Health measure such as the implementation of water fluoridation or a school
based varnish scheme, which only serves a local or specific area where families may not reside for sufficient time to gain benefit.

**Referral and Treatment Issues:**

**Wait Time:**
The impact of a prolonged wait time is explored in Chapter 6, which discussed the negative effects that could be experienced during the wait for DGA, such as pain, sleepless nights, and missed school time. Wait time varied between hospitals, with, on average, an 8-month wait. These differences could be due to a number of factors, hospitals with high referrals but fewer clinics to treat children and those with various long term staffing issues resulting in reduced capacity. Such services found themselves in a vicious circle of continuous referrals into the service with little means of addressing the wait list. As such wait lists become permanent features of such services. Wait list initiative programmes may be of little value given the timing that such initiatives take place (evening and weekend), the need for theatres, complex staffing and the high rate of FTA seen. DGA services should also be held to the national 18-week referral to treatment target. Some services fall outside of this target as they are non Consultant led, however, there is little justification for an exception to this and the DoH clearly stated this:

> “Dental care provided under general anaesthesia in secondary care (even where the treatment is carried out by a primary care dentist) is covered by RTT. For these dental pathways, the decision to include them within the scope of RTT was taken on the basis that these patients are typically from vulnerable groups (mainly children but also some adults with learning disabilities etc.) and it would be appropriate for them to be included in RTT. The rationale is that there has to be a consultant involved in their care as by law, general anaesthesia must be carried out in a hospital setting under the care of a consultant anaesthetist. This approach has received support from dental colleagues within the NHS.” [20]

**Prevention and previous treatment:**
 Certain hospitals had a higher number of repeat DGAs or more than one DGA occurring within a family unit than others. Figures indicated two thirds might attend again for a further DGA or have a sibling attend for the same procedure. This suggests more needs to be done with those actually being seen/referred into the hospital to prevent such occurrences. Previous research has shown those who are referred for DGA have not always responded to simple preventative messages, therefore a more active intervention with these families may be needed [21, 22]. Staff at one hospital acknowledged the high
number of repeat DGA's and required parents to attend a preventative clinic before their child could have their teeth extracted, at this time it is not known if this intervention has impacted on repeat DGA or future caries experience given its recent introduction. A difference was also seen in the prevention and advice given to parents by their own dentists or other healthcare professionals before the operation, particularly for those seen at Hospital 5, potentially contributing to the need for additional DGAs with a much smaller percentage having discussed preventative advice with their GDP. It could be referral into the DGA pathway is an opportunity to attempt to encourage good oral health not only for the child being seen but also for the family, particularly given the NHS strategy of ‘Making every contact count’ [23]. Previous studies have shown that a child undergoing DGA may motivate parents to improve their child’s oral health, at least in the short term and parents indicated they would welcome a variety of health care interventions at this stage [24, 25]. Without any effective advice or prevention families could be doomed to repeat negative behaviours, that will require future DGA within the family unit.

Hospital 6 was a tertiary service and also saw a greater proportion of children referred with medical or behavioural problems or who were unable to receive DGA through other facilities. This may be one of the reasons for the inflated repeat DGA rate seen at this hospital, given these issues may contribute to difficulties in both maintaining good oral health and being able to treat a patient in primary care. This is an important point; as in theory, severe caries resulting in a child attending purely for ‘outpatient DGA’ (therefore not incorporating additional medical indicators) should be a preventable situation. However this may not be the case for certain children with special needs where one of the main reasons for requiring a GA cannot be removed. It was also noted that Hospital 6 was the only hospital, which routinely both restored and extracted teeth with all other hospitals extracting teeth under GA in the majority of cases. Additionally, the sessions were mixed with some children attending for more complex procedures that were not necessarily limited to extraction (when this was the case these children were not included). This offers one reason why restorations were a part of treatment plans. However, it may have also been a factor in the number of repeat DGA’s seen, as other hospitals take a more radical treatment approach. Alternatively, it could be a factor of the referred population where restoration is more appropriate than extraction.

There are a number of limitations regarding the study which should be acknowledged and taken into account in relation to conclusions drawn. Data collected from participant questionnaires were based on parental (and at times child) self-report and should be
treated with caution, given responder bias. It was originally thought that parent responses could be validated against dental referral notes, however in the majority of cases an adequate dental history was not recorded. Self-report data can be skewed either by what a participant remembers or if they feel they should answer a question in a certain way therefore while data gives an indication of aspects such as dental attendance and prevention advice being administered these data may be either under or over reported. In addition given each hospital was visited for a period of two months it is acknowledged that services may have changed after data collection or new protocols put in place. Despite the limitations discussed, the use of triangulation allows a number of methods to be utilised for completeness in exploring this area combining data from both participant questionnaires, dental referral and clinical notes and qualitative interviews (which are explored in Part 2 of this work).

**Conclusion**

It was observed that DGA services are defined by the processes and estate issues within each hospital, rather than by formal service specifications. However, given these current constraints, there are aspects of the services that can be modified to improve patient experience. These include treatment from children's GDPs during the wait for their DGA procedure (for example pain management), and prevention advice to reduce the likelihood of a repeat DGA. It appears that advice or preventative treatment possibilities are not discussed with parents/guardians in a consistent fashion. Discussions occur before the operation with their own GDP, in preventative clinics or during pre-assessment with those who will be operating on their children later. In addition, preventative work can be carried out at the time of the operation, for example, fissure sealing teeth. This was undertaken at Hospital 6; possibly due to the high level of children referred with various behavioural or related issues meaning this may be the only opportunity to administer this type of treatment. However, the fact fissure sealants can be delivered in this environment is something that should be considered for all DGA services. Other reports have discussed the possibility of tooth extractions performed in this way may not always allow prophylaxis at the same time [26] therefore a separate session may be needed to carry out this preventative treatment.
A 'one size fits all' approach may not be possible across all DGA services given: the diverse reasons for referral, numbers of patients treated and the dental treatment required, however best practice could be shared with certain qualities and processes incorporated throughout. The differences between dental services carried out in hospital settings have been observed in various areas of the England. A study looking at DGA in Yorkshire and Humber [27] indicated variation in how DGA assessment and lists were organised could potentially impact on the number of DGA operations [28]. Additionally, elements such as an individual’s relocation to another region, first/main language spoken and pattern of dental attendance can make the ability to address the problems that lead severe decay in young children more complicated. In certain cases the first time a child engages with a dentist and has any form of dental treatment may be via a referral for DGA, and this is discussed further in Chapter 8. Therefore it is vital to engage with both the child and family at this stage and attempt to start a pattern of dental attendance and to ensure this experience does not create persistent dental anxiety.

Although both hospitals and patients have differing obstacles, which may require additional assistance and interventions, services across England could look to share best practice and adopt processes that have been shown to work well. DGA services should be based on informed and intelligence led commissioning practices at the heart of which should be a robust health needs assessment. Following the assessment of need, service specifications should reflect the local position with respect to the individual hospitals but key elements of the service should always be included, these are described in Figure 4.2.

Figure 4.2: Key features that should be included within a DGA service

- Reducing wait times (increase clinics or utilise alternative assessment and pathway opportunities)
- Policy and plans in place to cover maternity, retirement and other absences from core team
- Increase preventative measure both pre and post GA extraction
- Utilise play specialists
- Appropriate surroundings and technology to support psychological wellbeing of child
- Starving throughout the day
- Interventions in certain locations tailored to population i.e. movement in and out of area using coordinated interventions across the UK (change in Policy) or utilising technology such as text message and information/s support online in order to provide messages which aren’t restricted to one location.
- Language barriers accounted for by using appropriate translations
These areas are explored further in Part 2 of this work which utilises qualitative interviews with parents and key players throughout the GA pathway to elicit a greater understanding of these factors and their impact.

This paper has demonstrated a DGA landscape of disparate services many of them reflecting legacy approaches to commissioning. There is a clear need to reform these services so they are centred on patient needs, include elements of prevention, are held to performance targets with respect to wait times (18 week RTT) and reduction in repeat attendance. This work has identified elements of best practice that should be incorporated into service specifications in the future.

List of Abbreviations
GA - General Anaesthetic / DGA - Dental General Anaesthetic
GDP - General Dental Practitioner
RTT - Referral to Treatment Time
FT - Foundation Trust
FTA – Fail to Attend
CT2 - Core Training 2 (previously known as SHO)
CDS - Community Dental Service
References


7. Davies G: Production of Data about Admission of Children to Hospital for Dental Extractions in the North West Region in 2008/09. The Dental Observatory. The Dental Observatory; 2010.


Appendix 4.1: Additional tables for Chapter 4

Table 4.2: Summary statistics - Transformed (natural log) Index of Multiple Deprivation by hospitals attended and age by hospital attended.

<table>
<thead>
<tr>
<th>Hospital</th>
<th>IMD transformed</th>
<th>95% CI</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (s.d.)</td>
<td>Lower Bound</td>
<td>Upper Bound</td>
</tr>
<tr>
<td>1 (115)</td>
<td>1.628 (.2392)</td>
<td>1.5840</td>
<td>1.6724</td>
</tr>
<tr>
<td>2 (46)</td>
<td>1.537 (.2268)</td>
<td>1.4698</td>
<td>1.6045</td>
</tr>
<tr>
<td>3 (30)</td>
<td>1.401 (.2846)</td>
<td>1.2942</td>
<td>1.5068</td>
</tr>
<tr>
<td>4 (73)</td>
<td>1.656 (.1996)</td>
<td>1.6096</td>
<td>1.7027</td>
</tr>
<tr>
<td>5 (43)</td>
<td>1.644 (.2390)</td>
<td>1.5705</td>
<td>1.7181</td>
</tr>
<tr>
<td>6 (120)</td>
<td>1.560 (.2506)</td>
<td>1.5516</td>
<td>1.6422</td>
</tr>
<tr>
<td>Total</td>
<td>1.600 (.2457)</td>
<td>1.5766</td>
<td>1.6234</td>
</tr>
</tbody>
</table>

Table 4.3: ANOVA Multiple Comparison of hospital by IMD - Games Howell correction

<table>
<thead>
<tr>
<th>(I) Hospital</th>
<th>(J) Hospital</th>
<th>Mean Difference</th>
<th>Std. Error</th>
<th>Sig.</th>
<th>Lower Bound</th>
<th>Upper Bound</th>
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</tbody>
</table>

*Significantly different following Games Howell
A t test was carried out given the only available data for area IMD was the mean IMD score meaning a t-test was the most appropriate statistical test to use. Area IMD score was based on information gained from PCO/PCT data from Public Health England, 2010 information (http://www.apho.org.uk/resource/item.aspx?RID=110540)

Table 4.4: One sample T test for IMD - Study (study) mean and Population (pop) mean

<table>
<thead>
<tr>
<th>Area</th>
<th>N</th>
<th>Study Sample IMD</th>
<th>95% CI</th>
<th>Pop IMD</th>
<th>One sample T test</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>115</td>
<td>45.776</td>
<td>42.205</td>
<td>49.347</td>
<td>4.46 95%CI 1.075-8.217</td>
</tr>
<tr>
<td>2</td>
<td>46</td>
<td>36.831</td>
<td>31.581</td>
<td>42.082</td>
<td>6.880 95%CI 1.645-12.116</td>
</tr>
<tr>
<td>3</td>
<td>30</td>
<td>28.129</td>
<td>21.912</td>
<td>34.346</td>
<td>11.079 95%CI 4.862-17.296*</td>
</tr>
<tr>
<td>4</td>
<td>73</td>
<td>47.696</td>
<td>43.173</td>
<td>52.220</td>
<td>7.091 95%CI 2.558-11.624*</td>
</tr>
<tr>
<td>5 &amp; 6</td>
<td>163</td>
<td>44.647</td>
<td>41.339</td>
<td>47.954</td>
<td>1.19663 95%CI -2.110-4.504</td>
</tr>
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</table>

*Significantly different (Bonferroni correction p<0.008). Area 5 & 6 combined as served the same population

Table 4.6: Dunn-Bonferroni tests between hospital and number of teeth extracted

<table>
<thead>
<tr>
<th>Pairwise multiple comparison</th>
<th>Hospital (I)</th>
<th>Hospital (J)</th>
<th>Test statistics</th>
<th>Std. Error</th>
<th>Sig</th>
<th>Adjusted Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>19.381</td>
<td>21.794</td>
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<td>4</td>
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<tr>
<td>4</td>
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<td>2</td>
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<tr>
<td>3</td>
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<tr>
<td>4</td>
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<tr>
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<td>6</td>
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<td>5</td>
<td>29.527</td>
<td>21.688</td>
<td>0.173</td>
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</tbody>
</table>
Chapter 5

A study of the provision of hospital based dental General Anaesthetic services for children in the North West of England: The views and experience of families and dentists regarding service needs, treatment and prevention
Foundation and Summary of Chapter 5

This Chapter (5) can be considered complimentary to Chapter 4, as the two are essentially connected. Chapter 4 demonstrated certain differences between the hospitals and services provided for a variety of reasons. This chapter looks at the services across hospitals attended for this thesis from the perspective of the parents, referring dentists and operating dentists working within these facilities. In this way Chapter 5 is the ‘meat on the bones’ when looking at service provision and the actual general anaesthetic service experience. This Chapter uses information from qualitative interviews and the themes developed from these which correspond with the issues reflected in Chapter 4. This work identifies aspects within those categories which could potentially improve or modify processes for the better and concludes with an illustration of a ‘references standard’ dental general anaesthetic service which incorporates the best practice from the hospitals visited.

This paper was submitted to BMC oral health in November 2014

Authors Contributions
MG contributed to the design, conducted the interviews, analysis, interpretation and manuscript. IAP contributed to the protocol and manuscript. CS contributed to the protocol, manuscript and supported analysis and interpretation
Abstract

Background
Patterns of service delivery and the organisation of Dental General Anaesthesia (DGA) have been found to differ across hospitals. This paper reports on qualitative research aimed to understand the impact of such variation by exploring views and experiences of children and their families receiving care in different hospital sites, as well as dentists involved in referral and delivery of care.

Method
Qualitative semi-structured interviews were conducted with 26 people comprising parents (n=15), dentists working in primary care (n=6) and operating dentists (n=5) in relation to DGA. Participants were recruited from areas across the North West of England to ensure a variety referral and treatment experiences were captured. Field notes were made during visits to all settings included in the study and explored alongside interview transcripts to elicit key themes.

Results
A variety of positive and negative impacts on children and parents throughout the referral process and operation day were apparent. Key themes established reflected issues identified in Chapter 4 and were clustered around three key topics:

1. Organisational and professional concerns regarding referrals, delivery of treatment and prevention
2. The role of hospital environment and routine on the emotional experiences of children
3. The influence of the wider social context on dental health

Conclusion
These findings suggest the need and perceived value of: tailored services for children (such as play specialists) and improved information, such as clear guidance regarding wait times and what is to be expected on the day of the procedure. These features were viewed to be helpful in alleviating the stress and anxiety often associated with DGA. While some elements will always be restricted in part to the hospital setting in which they occur, there are several aspects where best practice could be shared amongst hospitals and, where issues such as wait times have been acknowledged, alternative pathways can be explored in order to address areas which can negatively impact on children.
Introduction

Extensive dental decay in young children and subsequent referral for a General Anaesthetic (GA) extraction is a troubling issue within the UK given the numbers referred and the varying wait times that exist for this procedure [1]. Following the requirement that all dental general anaesthesia (DGA) be performed in a hospital setting, DGA services were established throughout England. Although there are general guidelines as to the suitability of a child for DGA and clinical guidelines for the use of GA in paediatric dentistry [2], these services have developed independently of such guidelines and present differing offers to patients. This could be for a variety of reasons; different workforce, for example, Consultants (in either paediatric, special care or oral surgery), Community Dental Service and General Dental Practitioners (GDPs) work within the service with different approaches and commissioners may have procured certain aspects of particular services. Hospital restrictions (such as estate provision and theatre allocation) could also impact on development, additionally the population served could also have dictated provision based on demand. Previous research has indicated there is a variation in the organisation of DGA services, for example, some services have an “absence of agreed referral protocols and lack of, or unstructured approach to, pre-operative treatment planning consultation and assessment” [p. 4, 2].

Chapter 4 highlighted the background to this area and showed differences in the provision of DGA between multiple hospital sites in the North West of England. It is important to note while broad data collection from referral notes, consultations, observational notes and questionnaires offer an overview of services, they cannot provide the impressions of parents and children, and of those working within and referring into this service. Therefore, while quantitative data can give us an indication of the different services, qualitative analysis is vital in understanding the actual impact on individuals and the difficulties facing those who run these operations in instigating changes [3]. This current paper draws on qualitative research to understand the impact of these differences on service users and their families.

Previous research has suggested parents generally view DGA as an accepted form of treatment, with a positive impact on their child, given the reduction of pain and ability to interact socially soon after the operation [4]. However, qualitative analysis has not been applied to the examination of the differences between services or to explore whether anything, beyond the removal of dental decay, could positively (or negatively) impact on the parent or child. This includes their viewpoint on the treatment and operation day, and
their subsequent perspectives on dental health and service provision. Additionally, it is important to consider the opinions of the dentists who refer children into these services and those who carry out these procedures.

This study was therefore a qualitative exploration of the experiences and opinions on the service delivery and organisation of children’s dental treatment from the perspective of parents, dentists and key stakeholders connected to the DGA service.

**Methods**

Participants were recruited from what could be considered three different groups (see Table 5.1 and 5.2). Firstly, parents of children referred and if possible the children themselves were recruited from 3 distinct settings (although not all children necessarily received DGA extraction as some were treated under an alternative pathway) (Table 5.1). These sites were part of a larger observational study run across North West England. This study involved data collected from both referral notes and questionnaires and was run in parallel to this qualitative element (see Chapter 4). Secondly, a number of dentists and Consultants who ran the DGA sessions attended by the research team were interviewed; this group also included dentists who ran an alternative pathway, treating child referrals in primary care (without the use of GA) (Table 5.2). Thirdly, dentists who referred into the system were interviewed following preliminary analysis on the observational data collected on high and low referrers (Table 5.2). Additionally a commissioner was interviewed who had recently implemented changes to tackle the DGA wait list in an area of the North West England. Parents and children were approached during pre-assessment or treatment planning sessions, in order to determine if they would be willing to take part in the interview. All participants were given the option of a face-to-face interview (either at a community/dental setting, at their home or in another convenient location), or they could participate in an interview over the phone. There was a mixture of participants meeting at home, community settings and some over the phone (although each participant actually met with the researcher at least once). At the start of the interview consent, confidentiality and the purpose of the interview were explained again. Interviews lasted up to 55 minutes.
Table 5.1: Participant’s details (Parents and children)

<table>
<thead>
<tr>
<th>ID</th>
<th>Mother/ father</th>
<th>Child included in interview</th>
<th>Child Male/ female</th>
<th>Area</th>
<th>Age child at op / treatment (years)</th>
<th>Teeth extracted</th>
</tr>
</thead>
<tbody>
<tr>
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</table>

Table 5.2: Participant’s details (Dentists)

<table>
<thead>
<tr>
<th>Dentists treating referred children</th>
<th>Referring/ non operating dentists</th>
</tr>
</thead>
<tbody>
<tr>
<td>ID</td>
<td>Dentist</td>
</tr>
<tr>
<td>----</td>
<td>---------</td>
</tr>
<tr>
<td>1</td>
<td>Operating dentist</td>
</tr>
<tr>
<td>3</td>
<td>Operating dentist</td>
</tr>
<tr>
<td>13</td>
<td>Primary care dentist</td>
</tr>
<tr>
<td>14</td>
<td>Primary care therapist</td>
</tr>
<tr>
<td>15</td>
<td>Primary care therapist</td>
</tr>
<tr>
<td>5</td>
<td>Commissioner</td>
</tr>
</tbody>
</table>

The original aim was to sample purposively and then as interviews were coded to continue to explore further cases until saturation of data was reached. This was achieved with respect to the dental professionals by selecting both consultants and dentists involved in DGA delivery, and both high and low referrers. However, recruiting parents and children proved to be difficult with the majority approached unwilling to take part in an interview. When declining, participants often cited; time difficulties, hectic or chaotic lives, or they were often with a number of children and said it would be difficult to even read through the information at the time let alone find an opportunity to take part in an interview. Parents also seemed uneasy about what they would be asked and it is possible
some declined if they were worried they may either be made to feel responsible for the DGA outcome or felt guilt associated with the outcome. A number of parents who agreed to take part when questioned further were actually referred for reasons other than caries, such as teeth needing surgical extraction due to hyperdontia (a condition characterised by having an excess number of teeth). Therefore, we adopted a more pragmatic approach by recruiting opportunistically, and continued with this until saturation of themes had been reached.

Those who agreed to be interviewed signed a consent form when they were approached at clinics or treatment centres and were interviewed a few weeks after consenting (but before the operation) and then again approximately two weeks after the operation was complete. Participants came from three different areas of the North West ensuring differences in experience between settings would be captured. Despite the initial problems with recruitment, a wide variation of participants was achieved in the final sample. As data collection was based on an iterative approach, analysis of early interviews guided additional questions in subsequent interviews with initial brief codes constructed and expanded upon as interviews progressed.

Interviews were conducted by MG and included topics such as the parents’ own health, oral health and related day to day activities, challenges associated with stage of development, influences of diet and infant feeding practices. In addition, assessment, treatment planning, prevention clinics, experience at the hospital, previous and future dental visits, and interventions to improve oral health were explored (interview schedule is presented in Supplemental files, Appendix 12.3.1). All interviews were recorded and transcribed, and field notes were taken during the interviews. These were organised with the aid of the software package Atlas (ti. Version 6.2 2010 Berlin) and analysis involved a variety of techniques including constant comparison to elicit common themes and look for unusual cases [5, 6].

MG also carried out observational work while attending the hospitals on clinic days for recruitment and questionnaire completion. These results have been presented in a chapter 4 and also prompted additional questions and themes during interviews. It was envisaged that children would be involved in the interview as their voice is an important factor of the DGA experience and previous studies have not usually included this element. This proved very difficult, and although all parents were asked if they would be happy for their child to be involved, the majority declined. They cited various reasons for this including, the age of the child or fear they may be upset talking about the experience. Of
those who agreed, the child was often too young to actively take part, or needed heavy prompting by parents to provide even limited answers. Therefore for this work, children’s responses have not been included.

Full ethical approval for this study was obtained from the NRES Committee North West Preston (11/NW/0503) and all participants gave informed consent before taking part (copies are available in Supplemental Files, Appendix 12.3.4).

Results

Analysis revealed a number of themes running throughout responses from both parent and dental providers. Three overarching themes correspond with issues reflected in the observational and quantitative data collection in Chapter 4. Chapter 4 detailed three key areas that differed throughout hospitals and identified aspects within those categories, which could potentially improve or modify processes for the better. These themes from Chapter 4 are presented in Figure 5.1.

Figure 5.1: Themes established in Chapter 4

- Social Context and population
  - Interventions in certain locations tailored to population i.e. movement in and out of area using coordinated interventions across the UK (change in Policy) or utilising technology such as text message and information/ support online in order to provide messages which aren’t restricted to one location.
  - Language barriers accounted for by using appropriate translations

- Hospital Environment
  - Reduce wait times (increase clinics or utilise alternative assessment and pathway opportunities)
  - Policy and plans in place to cover maternity, retirement and other absences from core team
  - Increase preventative measure both pre and post GA extraction
  - Utilise play specialists
  - Appropriate surroundings and technology to support psychological wellbeing of child
  - Starving throughout the day

The issues described in Figure 5.1 corresponded to themes that emerged from qualitative analysis, and therefore these themes from the quantitative paper could be expanded upon using qualitative analysis. Each theme will be addressed below with ensuing qualitative
quotes, which either corroborate or refute the established themes; Figure 5.2 illustrates each developed theme with a contributing quote.

*Figure 5.2: Main themes established which influence service delivery and organisation*

**Organisational and professional concerns in referrals, delivery of treatment and prevention:**

Many respondents discussed the wait time for their child’s DGA. This was both in a positive and negative light. When parents had been advised there would be a long wait they seemed pleasantly surprised their operation was sooner than expected:

*I’m fine with that because at first at the hospital he told me the waiting list would probably be five or six months. So I just had in my mind that it’s going to be Christmas, New Year. So yeah I was really surprised with these appointments actually. (Hospital 1; 802)*

*I was expecting the referral to be 6 months so I was shocked at that (Area; 806)*

However others expressed concern over the wait and the negative effect it had on their child. They not only related the pain and discomfort their child endured during their wait but also on how they felt this was out of their control and all they could do was await the appointment. This was particularly apparent through discussions with parents, to whom dentists intimated they were not able to provide anything additional for the child until the DGA was performed. Several participants expressed their frustration at waiting,
particularly when they felt it had directly resulted in pain or infection. This is an important factor, which needs to be fed back into the referral process. While it is not always possible to reduce the wait time immediately, referring dentists must be encouraged to continue treatment for any pain or infection during the wait. This links strongly to payment mechanisms and prevention discussed later. If additional treatment is provided outside of the hospital by the regular GDP or equivalent alongside discussion of wait times, the frustration and lack of control felt by parents may be alleviated to some degree. As it would allow them to seek alternative treatment if required rather than waiting for the appointment. However, there appears to be a sense that, once referred, the child was no longer the responsibility of the dentist.

At one point, I was looking for the post every single day, is the letter here yet, because she kept complaining about her teeth, and every time I took her back to my dentist, he was like, well there’s nothing I can do, it’s in the hospital’s hands now, so it was kind of like, well what do you do? (Area 1; Parent 818)

We went back to the dentist because it was a long wait …and there was no surgery in sight, he says he’s now got a Buccal abscess, he’s been complaining he’s got a bit of gum soreness (break) It was just shocking service that he gets referred by the dentist in March time, it takes eight months to get it done (Area 1; Parent 800)

And he was in real, real pain so we just wanted to try and get this done as soon as possible, so I can’t really remember how that happened, but he had lots and lots of antibiotics and eventually we were sent to (Area X) (Parent 648)

Those working in the field were also aware of wait and the negative effects it could have on children referred. A number of dentists, consultants and commissioners in the area had looked to alternative pathways, involving treatment in primary care, in order to alleviate the wait.

So many children, young children who were in pain were apparently waiting for months and in fact we were told there were 400 on the list at one point. So therefore something had to be done (Dentist 5)

Staffing issues were a factor discussed in Chapter 4 as they affected wait times and had been mentioned as an issue to the authors by members of staff at various hospitals. This
was echoed by certain parents who discussed concern over staffing and the effect on the ability to see and treat children in a timely fashion.

*Their trouble was they couldn’t find surgeons to do the lists, and therefore they would have the slots to do the lists, because the slots wouldn’t be available at the children’s hospital, they’d have no surgeons. And they were just being done on an ad-hoc basis; it was absolutely rubbish (break) they need to be getting their arse into gear and getting more dentists (Area 1; Parent 800)*

**Reasons for referral:**

Common reasons for DGA referral include; non-compliance, age, number of teeth needing to be removed etc. [2]. Another aspect outlined by both parents and dentists was the benefit in keeping the regular dentists separate from treatment, which might ether, induce anxiety or cause distress in order to avoid potential issues with dental attendance in the future.

*Because it’s quite beneficial from our side because we’re the nice guys, and then we send you to that place to have teeth out and then you come back to us and it’s all alright [Laughter]. So having that distance is actually quite helpful (Dentist 6)*

*(talking about her dentist referring her child for GA) He didn’t want them to be, he said he had children the same age as xxx and xxx despite being a dentist he knew how they felt about going so that way he would rather not do it there (Area 2; Parent 256)*

*No I think he’s fine with it and I wanted to keep it that way - I didn’t want him stuck in a chair with someone with a foot up against his head tugging at his teeth with a pair of pliers while he was conscious (Area 2; Parent 326)*

**Prevention and previous treatment:**

This section describes prevention and previous treatment given by dentists; a more in-depth analysis of additional interventions is the subject of another paper. Data collection from 456 patients attending hospitals throughout the North West indicated there were differences in the preventative advice and treatment being given by dentists across districts. While the majority mentioned their dentist had discussed the use of adult fluoride
toothpaste and low sugar, there were those who stated they had not received this advice. This was reiterated by a small number of parents within the interviews.

*I just think…I think we weren’t told anything about the content of fluoride in toothpaste, at all, at a previous Dentist. We’ve only found that out through going to our recent Dentist, which obviously when he goes to when he’s six, you know, it’s too late by the time he’s six. (Area 4; Parent 648)*

*It’s helpful, you know, when you don’t know anything you just brush, but when they tell you, like, this, and it’s helpful. (Area 3; Parent 918)*

Additionally repeat dental general anaesthetics for either that child or another child in the family was worryingly high throughout participating hospitals but particularly for two in the North West. Several of the parents interviewed commented their child had already experienced a dental general anaesthetic or a sibling had teeth extracted under GA. When the researcher asked if any prevention such as fluoride varnish or fissure sealants had been applied to that child or any other siblings following a previous DGA one parent responded “No, none of them have ever had anything like that… he’s never gone over anything like varnishing or anything like that.” (Area 1; 811). Fluoride based treatment such as fluoride varnish was also mentioned as an element of pre-emptive treatment which was lacking. “The issue really is that I don’t think there is a lot of prevention going on in primary care” (Dentist 2). Other dentists expressed apprehension over the use of these types of treatment (which might go part way to explaining the infrequent use). There were concerns it did not tackle the primary cause of caries and also unease over the reasons behind it being pushed as a preventative measure especially in comparison to fissure sealants that have a sound evidence base and require less frequent application.

*The rule says you put the fluoride on, so that’s how we prevent problems. Well hang on, why is this? I mean, and I think I was alluding to it, suddenly after Colgate bought Duraphat or what have you, and the Government decided on a preventative agenda that needed to be pushed, (break) So, one strategy involves twenty applications of topical fluoride and the other strategy is a one off fissure seal, which has been shown to be more effective …but why don’t they get us to do that? “Oh, we'd have to give you some UDAs for that”. And it’s unbelievable. The beauty of the UDA system is it would have been very easy to modify (Dentist 16)*
A number of the dentists working in the area of GA extraction commented that repeat GAs were a definite concern. One of the ways to counteract this was to remove not only teeth that cannot be restored but also any teeth that have signs of decay once a child is referred. This would result in a child being returned to a caries free state and given the best opportunity to continue in good oral health.

One of the things I try and say to the parents is that if there are any other carious teeth then we get rid of them all of those and you start from base again and hopefully the prevention will then kick in from then and we don’t get repeat episodes (Dentist 1)

If they go for a general anaesthetic, then we tend, once that decision is made, then we tend to be quite radical about it, so what we don’t want to do is leave anything behind with a hole in it which is going to flare up and cause trouble in the future or warrant another general anaesthetic (Dentist 3)

While prevention advice was provided at some hospitals this was not a standard procedure throughout the different locations visited. While few parents discussed prevention from referral to a hospital setting those that did were encouraged by advice and techniques to improve their child’s oral health.

She’s given her these purple plaque detector things, that you put in your mouth (break). And you can see…it’s like a guide basically, so you can work on the areas that you’ve not been cleaning properly. And she loves it. (Area 1; Parent 818)

The role of hospital environment and routine on emotional experiences of children:
As stated in Chapter 4, a family’s experience of GA could differ significantly, partly due to the restrictions of each clinical setting. Observational information collected illustrated the different processes and procedures used. One most frequently mentioned by parents was the communal recovery stage for a particular hospital that impacted on privacy and dignity. The distress caused both to the parent and their child of recovering in a shared area was apparent. Parents reflected on the panic induced in their own child from seeing others in distress and the additional impact on their anxiety and barrier to recovery with this lack of privacy. Dentists also discussed the restrictions of bed space, which also feeds back to the previous topic of wait times.

They take you to recovery, but they’re not even properly awake, when you go, they’re just screaming. And they’re not private neither, so every time one was coming up, you
could see…and it was horrible because one of them was just like ripping wires out and I was like, oh! (break) You could hear them screaming, it was horrible. And they’d just wheel them round and there was like, six beds, all just close together and no privacy. (Area 1; Parent 811)

The other children, you can hear them all distressed and stuff like that, and that panics them anyway, and I don’t think it helped in that respect (Area 1; Parent 818)

Because we have a limited number of beds and have to go through the whole protocol of being admitted into hospital so it limits the numbers quite dramatically it also takes away that scope of being able to offer urgent appointments (Dentist 1)

Observational work also noted administration and assessment on the day in each hospital differed. Some clinics asked all parents to arrive at the same time to be assessed by the dentist, anaesthetist and nurse in one period, followed by operations occurring one after the other over a few hours later. Other clinics saw patients individually for their assessment and operation in one slot. Both dentists and parents commented on the long wait for children when they were seen in groups and again the negative effect, particularly for young children.

They come in at 12.30- but if they were to be seen at 2 o’clock the would have to have been starved so consequently there all starved from 8 o’clock - to keep them waiting till 5 o’clock before they go into theatre particularly if they are only 5,6,7 years olds it’s a long time (Dentist 1)

I think they’d be better off making the dental sessions in the morning because then the child’s been basically starved for the night, you could wake them up at five to give him some…well, the lists wouldn't start till nine, so he could have some fluids at seven, and he wouldn't have to spend the whole day being starved. I think that's a big thing, was that he starved all day for a four o'clock list. It's much better if you just had the lists in the morning and it's a lot less stressful. (Area 1; Parent 800)

Despite the issues of starving during the day many of the parents were positive about their experience, the staff at the hospitals and the ultimate outcome. While certain factors such as recovery were a traumatic aspect to the process many parents were optimistic about the treatment as a whole and acknowledged the necessity of going through the procedure.
The staff were fantastic, at (hospital 2) I have to say. I mean it's a long day as he was the oldest he was the last on the list, but, and it was a hungry day wasn't it (to child) we were starving, had nothing since 7 o clock that morning and he didn't have it done until half four (Area 2; Parent 259)

And then literally, it was over and done with, within seconds she was under, quite quick, which was fine, and then like one of the nurses came out with me, and she was like, you alright, you okay? And I was like, well yes. Absolutely fine. But obviously some parents they get quite upset, and there were quite a few other parents there who were really, really upset, obviously seeing your child going through something like that, it's not nice (Area 1; Parent 818)

I mean it, as a parent, I, myself, I actually had a terrible time having teeth out when I was younger, so they were absolutely brilliant with me. (child) was fine because I was putting on bravado with him, but as soon as he went to sleep I was in floods of tears, and I have to say the staff were excellent- and they were just brilliant; I couldn’t fault the service there. (Area 4; Parent 648)

Yeah, I think it’s been a positive one, so I don’t think he’d be as scared now. I think they’ve obviously relaxed him a lot more now. (Area 2; Parent 328)

She’s actually been better, she’s not choking as much on her food for some reason, so it must have been the pain in her teeth that was making her swallow. (Area 1; Parent 811)

She was still bleeding quite a lot when she came out of hospital, and she was very, very docile, and then it was the nightmare of going into the massive multi-storey car park, while she’s still coming out with loads of blood…it wasn’t the nicest of experiences, but having said that, it was necessary. (Area 1; Parent 818)

Child friendly environment:

Given the young age of many of the children referred for DGA, parents were asked specifically about the hospital environment and any positives or negatives that fed into the experience. Again hospitals differed in their approach to involving children. One notable difference in some hospitals was the presence of play specialists. These were individuals
brought in specifically to talk children through the procedure and, as commented by one
parent, spoke 'at the right level for kids to understand'. Often the play specialist was also
available at the pre assessment and therefore continuity was kept with whom the child
saw and what they expected on the day. Parents commented these specialists made
children feel less anxious and more aware of what the day would entail.

Certainly they presence of a specialized child specialist play person really in terms of
the difference in training to speak at the right level for the kids to understand what’s
going on to alleviate the fears can only be a good thing (break) They took (child) round
and went through the procedure with them in a very simple way so he could
understand it and in a way that wouldn’t induce anxiety (Area 2; Parent 326)

She [play specialist] went over absolutely everything that would happen, and she was
really good as she was jogging his memory obviously she had spoken to him at the pre
op the first time so she was reminding (child) what was going to happen so everything
through from putting the cream on their hand, to what was going on their hand and
jogging memory and he was remembering what colour it might be and things like that,
no she was very good. (Area 2; Parent 259)

(At hospital Y)There was no showing what was going to happen to him or explaining
that he was going to get put to sleep. At (hospital X) they told him about fairy dust and,
you know, all sorts of stuff to make it nice, and they told him about the tooth fairy. They
didn’t do any of that at (hospital Y); it was just in, ‘We’re going to sort him out. You go
and sit there and we’ll bring him back in’, and that was it, whereas (hospital X) was
much, much better. (Area 4; Parent 648)

Hospitals without a play specialist still often had a child friendly environment with activities
for children and, on occasion, entertainers such as clowns who came into the ward.
Families readily welcomed all of these aspects of quality provision.

(Discussing a clown at the ward) They were all looking at him and listening and he
was just telling them jokes and everything, everybody was laughing and the children…
so it was fun (Area 1; Parent 810)

The influence of the wider social context on dental health:
When looking at any differences in population between hospitals it was apparent hospital 1 had a greater number of languages spoken and a greater proportion of families who had moved since their child had been born. One participant, whose first language was not English, commented on the difficulty of translating materials such as leaflets and the loss of information and context that can occur. As noted in Chapter 4, difference between DGA services makes distributing information increasingly difficult as, even if translations can be made available, the information given may be more confusing with a greater chance of misunderstanding if translation is difficult for the language in question.

Sometimes when they make the translation to English to Somali, it makes more sense when it’s in English than when they do it in Somali. (Area 1; Parent 810)

The migration of people from other countries was also a factor mentioned by dentists causing difficulty in treating caries early. Dentists stated often by the time they first see a patient it can be too late and for these patients who have only recently moved to the area or into the country nothing within this service could have been done to prevent the extent of the decay.

They’re first timers and they’ve come to England. The parents and the children, they’re very nice people but a lot of these patients have not been able to access quality dental care and they’ve got issues with health (Dentist 17)

Parents and dentists, in relation to maintaining good oral health, discussed the realities of day-to-day life. Diet was obviously a significant factor and parents reflected on the difficulties in controlling their child’s diet, particularly when there were a number of children of different ages and other family members who looked after and had influence over diet and oral hygiene. Behaviour is an incredibly complex and difficult area to change. However it is proposed when behaviour that causes the initial GA does not alter, subsequent need for GA extraction could occur. One parent did reflect on their behaviour and the transformation following their first child’s GA, stating a change in the use of a baby bottle at night. However, it appears while one problem was tackled, other contributing factors towards dental decay were not addressed such as brushing and excessive sweets which were identified as the cause of the second DGA within the family. Again once knowledge was gained, this can then prompt a behavioural change by restricting what food was purchased and available in the home.

(Parent speaking about her first child who underwent DGA)
You know, we don’t know anything, we give bottle, and make him sleep and that’s very bad. Very bad.

So with your younger children

I changed, yes.

...So with his (child referred for GA) teeth, what do you think were….

I think, brushing...And he eat loads of sweets.

(When questioned further as to where the challenges are with the child’s diet)

The shopping. Even, you know, at home, when I’m giving him cereal he has to put sugar on it. This is challenge to me at home. Sometimes, when I’m around I can look after them. When I’m not around they can use sugar, and things, and so now I make, you know...every time when I go to shop I have to buy sweets, sweets, sweets, now, when I’ve seen his teeth, and the dentist told me, this is about the sweet, I have to stop it. Now, I made one day. Only Friday. (Area 3; Parent 918)

Discussion

The main aim of this paper was to explore the themes that reflect the topics developed in Chapter 4 generated from observational data collected at hospitals where qualitative interviews took place. Qualitative interviews are able to shed further light on observational data collected by the research team and give both a patient and service perspective on the impact and reason behind differences in the delivery and organisation of services and the population who attends them [3].

It appears both parents and clinicians see DGA as a vital service when severe caries is experienced in young children. However certain aspects of individual services stood out as making this experience less traumatic for both parent and child and taking opportunity to reiterate preventative advice and treatment, which could lead to improved oral health in the future (although from this work we cannot know if any behaviour change was effectively implemented or continued for any time). These impacts and improvements clustered into three main themes that are described and expounded on below.

Organisational and professional concerns regarding referrals, delivery of treatment and prevention

One important issue was the wait time experienced by some individuals resulting in prolonged pain, recurrent abscesses, etc. This negative impact was recognised in chapter 6 where an extended delay was associated with increased disturbed sleep and pain
experienced thought out the wait. This was also acknowledged by those who worked in the area and was one of the reasons for the establishment of the alternative pathway within one particular region to alleviate the pressure/wait for one particular hospital included in the research and attempt to treat children in an alternative setting without GA (discussed by Dentist 5 within the organisational and professional subtheme).

The need to be radical with treatment and remove any teeth with poor prognosis was a factor mentioned by dentists in avoiding a repeat GA. It could be seen within some hospitals a full clearance occurred for some children when decay was so rampant that any teeth left may have resulted in a re-referral. This has been demonstrated in previous research, one paper indicating that 75% of single tooth extractions required repeat DGA for caries left at initial DGA [7]. This paper also suggested a radical treatment approach to reduce the need for repeat GAs. Repeat DGAs, for a child and within the family, are still a significant issue as demonstrated in Chapters 4 and 6.

Chapter 4 noted the need for effective prevention in primary care in order to reduce the number of children being referred for DGA. However another important aspect is for some children a dental visit and subsequent referral to a hospital for DGA may be one of their first experiences with a dentist (as discussed in the results section) and the opportunity to not only return them to a state of good oral health but also to instil the importance of maintaining oral health, cannot be missed as every contact with a dental professional should count in relation to prevention. Opportunities to change behaviour are an important aspect of various health psychology interventions and research, i.e. changing risky health behaviours such as smoking, these have been labelled ‘teachable moments’ [8]. These teachable moments describe naturally occurring health events such as cancer diagnosis for smoking cessation whereby perception of personal risk and emotional response can be identified as a time to facilitate change [9].

A study conducted in New York showed those children undergoing DGA who attended a follow up appointment within 2 weeks that went over preventative advice, were less likely to develop new carious lesions than those who failed to attend. However one significant issue with this was that the failure to attend rate was high with only 39% attending the immediate follow up [10]. Additional research has suggested not only a radical approach to extraction but also special preventative care is required as high risk children seem to not respond to regular preventative care and often return for a repeat GA [11]. One hospital had seized this opportunity by having a dedicated prevention clinic, which had to be attended before the child could be seen for their operation. While this is not a definitive
solution to correcting poor oral health and associated behaviours, given the variety of complex causal pathways that lead to the need for a DGA, it is an aspect of service delivery that may tackle decay in high-risk children.

Good oral hygiene and behaviour remains an important factor in maintaining oral health however this is a difficult area to change as it is influenced by complex processes including social determinants of health [12]. Preventative measures should also be instigated, if possible, from all health professionals involved. A number of Dentists discussed both fluoride varnish and fissure sealants as tools to aid preventing dental caries. One particular dentist questioned why fluoride varnish was promoted and supported via UDA payment over fissure sealants. Fissure sealants have been shown to be superior over fluoride varnish in preventing decay [13] and are particularly relevant for this high risk population as patients are often irregular attenders [14, 15], making constant application of fluoride varnish problematic [16, 17]. Fissure Sealants have been shown to reduce caries up to 48 months when compared to no sealant [18] and therefore maybe more suitable for a population who attend infrequently, although establishing regular dental attendance should always be the goal of both parent and dentists in regard to high risk children.

The role of hospital environment and routine on the emotional experiences of children

Parental emotions and experiences and children’s experiences, related by proxy, regarding both the day of the GA operation and specifically the child anaesthesia and recovery period were explored. All parents interviewed felt extraction under GA was the only treatment option for their child whether alternatives such as LA had been tried or not. It was apparent for some the experience of not only the child going under anaesthetic but also recovery was distressing; they were shocked at the amount of blood and by the emotional state of their child. Other children being present during their child’s recovery could have exacerbated this. Parents commented this was upsetting for both themselves and their child. In future it would be advisable to prepare parents and children what they will experience on the day as many of the negative aspects of the service such as wait times were lessened when parents were warned about specific parts of the process. Conversely if parents and children were provided with too much detail on the potential negative aspects of DGA this could increase the fail to attend rate and therefore this is a subject that would have to be handled with delicacy.
The ability to aid not only the physical but psychological wellbeing of a child is an important factor. There is a growing body of literature that emphasises the need for children to have the right to information and participate in the decision process, depending on age and maturity [19–21]. In this respect the play specialists or those who interacted with children and discussed the procedure in a way they could understand were a valuable asset and continuously discussed in a positive light by those interviewed. Work that specifically looks at play specialist involvement such as Hubbuck's book *Play for Sick Children: Play Specialists in Hospital and Beyond* note that 'For most children the hospital environment is entirely abnormal compared to their everyday home life and day-to-day activities' [12] this book emphasises the importance of the play specialists role within a multidisciplinary team but is more descriptive than results based. Few would disagree that any action, which can calm and prepare children for anaesthesia should be encouraged however there also needs to be more research conducted to confirm the evidence base of this benefit. This engagement and use of play specialists had been incorporated in a number of the hospitals observed within this particular research.

The child friendly nature of certain hospitals was also commented upon in a positive light. In recent years the impact of hospital environments on a child’s emotional wellbeing has been of increased interest and activities for children not only to relieve boredom but also reducing isolation and anxiety have been described as invaluable within a hospital setting [13], this was also reflected in the hospital settings with parents commenting on the activities, technology and organisation of the settings impact on their child.

The majority of parents reported a positive impression of treatment following their child’s DGA. This is in keeping with previous research [4, 22] indicating an improvement in quality of life and overall health occurred following treatment under DGA (usually within 2 weeks). It should be noted that even those, in this study, who found the experience distressing acknowledged its necessity and positive outcome for their child.

There were very definite positives and negative aspects to services discussed with both parents and dentists. A number of these were beyond the control of the service given restrictions within the hospital setting. For example, privacy in the recovery area outside the operation theatre was often shared with other children undergoing the same treatment. However aspects such as play specialists (or staff who took time to involve both parent and child) were consistently mentioned as an invaluable aspect to the service.

The influence of the wider social context on dental health
Success for implementing prevention advice and behaviour change within high-risk children is largely influenced by the social context of the population. It is important to note any prevention must acknowledge the diversity of the group and this should be included in the design of preventions to tackle this issue. This includes the ability to appropriately translate material but also address the frequent relocation of parents and children within certain locations in trying to give a consistent message. New technology could be incorporated such as information online and via mobile phone. These types of interventions have started to be used both within oral health education and also other areas connected to oral health using the common risk factor approach such as weight gain and diet advice [23, 24].

Limitations and future research

The number of interviews conducted and the representativeness of the conclusions generated to the rest of the population limit qualitative findings from this research. Also given the number of parents approached to take part in interviews and those who actually agreed (41% consent for parents 29% for Dentists) means an important part of the population could have been missed. This is a problem with the majority of research; those who don’t consent can often be the people we most want to hear from. However the interviews appear to contain a range of respondents, with children of various ages having a number of teeth extracted (ranging from 1 to 12), both mothers and fathers were included in interviews with participants attending a variety of hospitals resulting in a varied combination of respondents for interviews. A range of dentists was also included in interviews, from those who conduct DGA operations; those who refer in to the service and those who treat referred GA children in a primary care setting. Given the combination of this research alongside a large quantitative sample, this blend of information can be used to enhance the understanding of this potential complex area of service design and delivery. In this way the data complements one another as qualitative research is not usually used to generalise to the wider population but in this situation can be used to better understand the quantitative and observational data acquired and give validity to the conclusions and themes established. In this way the research has not used methods simply to satisfy a tick box approach but to create research which logically allows for the most important and diverse information to be gained [25].

As the female researcher (MG) was from a non-clinical background it was felt this was important to reiterate to both dentists and participants. It was believed this meant that certain topics could be addressed without parents or dentists feeling they were being
judged or scrutinised by someone within the profession and that there was a genuine interest in their individual views and how they perceived the impact of GA without a predefined assumption of what this should entail. This was discussed as the main focus of these interviews with participants. However, having said this, there is in any interview recognition that information gained is in part directed by the line of questioning and given the research area, parents and to some extent dentists may have felt certain responses were required of them.

Several aspects which anecdotally have shown to be a positive feature when attending for a DGA such as play specialists could be further explored on a wider scale between hospitals to see not only the impact on the day of the operation but on a short and long term basis in relation to anxiety, subsequent hospital or dental visits and recovery following a DGA.

**Conclusion**

This paper has discussed the effects on families of a paediatric referral and subsequent extraction of carious teeth across a number of sites in the North West England under GA. It is clear the setting and organisation within a hospital can have an impact on the emotional wellbeing of the child and a balance has to be sought between being able to see and treat children in a timely fashion alongside treatment which reflects not only the physical but psychological needs for that child. It is important to consider how these impacts and differences observed can translate into improving patient care and experience. Given the information gained from the quantitative data collected from referral notes/questionnaires, observational data and qualitative interviews, the authors have constructed a ‘reference standard’ DGA service, which incorporates ‘best practice’ from the hospitals visited. While this is not always attainable given restrictions to the layout and structure of hospitals settings, it does give context to the best practices across hospitals that can be implemented throughout DGA services (Figure 5.3).
Follow up with dental or equivalent team (siblings assessed for high risk of caries). Prevention discussed and preventative treatment applied techniques to help instil oral health such as plaque disclosing tablets given.

**List of Abbreviations**

GA - General Anaesthetic  
DGA - Dental General Anaesthetic  
GDP - General Dental Practitioner
References


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Chapter 6

Issues Arising Following a Referral and Subsequent Wait for Extraction under General Anaesthetic: Impact on Children
Foundation and Summary of Chapter 6

Chapters 4 and 5 established there were a number of differences between services. One notable factor was the wait time, which appeared to vary considerably across hospitals and regions. It was hypothesised that there would be a significant difference between hospitals in the time taken from referral to operation and the impact of caries on referred children could be exacerbated with an increased wait time. Chapter 6 therefore explored the potential day-to-day impacts on children who have been referred for multiple extractions due to caries. In this respect this chapter gives an indication of the impact on quality of life of children referred with severe dental decay and highlights not only the importance of continued care and management once the child is referred but also the need for improved prevention within primary care.

This manuscript was submitted to BMC Oral Health in August 2014 and Accepted with minor amendments in December 2014

Authors Contributions
IAP and CS contributed to the protocol, design and manuscript. GD contributed to the design of the data collection tool and manuscript. MG contributed to the design, acquisition of data, analysis, interpretation and manuscript. TW supported analysis and contributed to the manuscript.
Abstract

Background
Untreated caries in young children can result in a referral for extraction in hospital under general anaesthetic (GA). This study aims to explore the impact of caries during the ensuing wait for GA on children residing in the North West of England.

Methods
The study involved 456 respondents referred to six hospitals in the Northwest of England. Over a two-month period each of these children/families completed a questionnaire and gave permission to access their referral and consultation notes.

Results
Children (6.78 years old: 1.50 to 16.42) had on average five teeth extracted (ranging from one to a full clearance, with all teeth removed). Sixty seven per cent of parents reported their child had been in pain, 26% reported schools days being missed and 38% having sleepless nights. The average time from referral to operation was 137 days. Results indicated that children could be in discomfort during their wait, as pain was experienced, on average, 14 days before the operation. Wait time significantly predicated the number of sleepless nights $b=.004$, $t(340)=2.306$, $p=.022$.

Conclusions
It is clear that pain, sleepless nights and missed school are a feature during a wait for dental GA and can be exacerbated by an extended wait. These data support the need for not only effective prevention of caries within primary care to reduce wait times and experience of GA but also effective management of pain and infection during a prolonged wait for treatment.

Keywords
Caries; Children; Pain; Impact; General Anaesthetic
**Introduction**

Gross, untreated caries in children can result in significant morbidity, including those elements described within the PUFA index: pulpal involvement, ulceration, fistula and abscess [1][2]. These effects are not only observed short term, but can persist with long-lasting impacts on both oral and general health in later life [3]. Whilst caries has been shown to contribute to problems including weight, communication difficulties and impaired cognitive development, it can also impact on day-to-day activities, for example attending school and sleeping at night [1, 4–6].

When dental pain or discomfort experienced by a child becomes too severe (typically due to the presence of infection) a common treatment choice is extraction. General anaesthetic (GA) has been a technique used within dentistry for over 100 years as a way of carrying out dental treatment in young children, anxious adults and individuals with special care needs. In England the use of GA has been restricted to a hospital setting following the publication of the Poswillo report [7] and then 'A Conscious Decision' [8].

While GA extraction is frequently agreed to be the only option in cases involving very young children, it should be carefully considered against other options such as Local Anaesthetic or Inhalation Sedation due to the risks associated with any GA procedure. A number of studies have confirmed the negative effects of Dental General Anaesthetic (DGA) on both the child and their immediate family, indicating that associated morbidity can be an upsetting experience for not only the patient, but also the parents who care for them [9]. This is important to consider in relation to the repercussion on future dental attendance and treatment, for example the impact of DGA on dental anxiety. Anxiety may be the reason a child requires a GA, either through fear of treatment under local anaesthetic or apprehension (of the child or parent) causing a delay in seeking early (and regular) treatment at a general dental practice [10–12]. Given that general anaesthetic has also shown an association with anxiety post procedure [9], this could create a cycle of negative response with continuing dental anxiety and a pattern of reoccurring attendance for DGA. Therefore the problems associated with dental decay could be exacerbated when considered alongside the prolonged wait and subsequent treatment using GA.

While DGA can be distressing it is acknowledged as a vital component of dental care and has been shown to produce immediate benefits in regard to oral health [13]. DGA is of particular benefit when other treatment options are unsuitable particularly in regards to
those with medical problems, which restrict treatment options or young children where options for treatment can be limited due to cooperation.

**Aim**

This study aims to explore the impact of decay and its sequela on children awaiting extractions under GA, which referring or triaging dentists have deemed are beyond simple restoration.

**Hypothesis**

1) There will be a significant difference observed between hospitals and the time children wait from the decision to refer until treatment (RTT).

2) Increased wait times will correlate with increased negative impacts on children.

**Methods**

This was an observational study that recruited patients who attended six randomly selected hospitals throughout the North West of England for extractions under GA. Hospitals were selected using a random number generator. Each hospital was then visited for a period of two months with the researcher attending every session scheduled for DGAs for extraction, commonly known as outpatient GA, i.e. those not specifically for special treatment needs or requiring other complex procedures. This permitted the authors to gain a representative sample from each hospital, characterising the number of patients seen on average within each site. Sample size was calculated based on information gained from both the Dental Observatory [14] (now the Dental Public Health Intelligence Programme) and from a previous service evaluation completed by the authors. Based on these data and given the ratio of male to female participants, an absolute precision of 5% and a 95% confidence level, a sample of 374 children was calculated to be required [15]. Other proportions with known data were calculated i.e. proportion of children seen who were five years and younger, but as the ratio for male to female was almost 50:50 this yielded the largest minimum sample size needed.

In addition to information collected from the referral and clinical notes, a questionnaire was given to parents with questions on impact of the situation based on the Children’s Dental Health Survey [16] with additional questions on school attendance and effects on sleep added following further research [17, 18]. Full ethical approval for this study was obtained from the NRES Committee North West Preston (11/NW/0503) and all participants gave informed consent before taking part (copies are available in Supplemental Files, Appendix 12.3.4).
Results

Given the final sample size of 456 there were deemed sufficient numbers for further analysis around descriptive statistics. Data were entered into SPSS (IBM Version 20) and these observational data were analysed using appropriate methods, taking into account assumptions for parametric tests.

All analyses for this paper have been carried out on those who consented to participate. Therefore the unit of analysis are the individual children attending for extraction under GA. In total 493 participants attended and underwent a DGA procedure and 456 agreed to complete the questionnaire resulting in a 93% consent rate. However this figure was out of a potential 606 available places on the GA list, which were not all filled due to ‘Failure to Attend’ (FTA) or patients sent home due to illness or having eaten shortly before the operation. The total FTA rate observed within the study was 16%.

Analysis on referral data was only carried out where notes were present for that participant. At hospital 4 the majority of complete referral letters were missing. However often the medical history and teeth requested for extraction were recorded in the main hospital procedure notes, and these data were collected (Table 6.1).

Table 6.1: Basic Demographics and (referral) reported impact of decay on children

<table>
<thead>
<tr>
<th>Hospital 1</th>
<th>Hospital 2</th>
<th>Hospital 3</th>
<th>Hospital 4</th>
<th>Hospital 5</th>
<th>Hospital 6</th>
<th>Total</th>
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<td>n=76</td>
<td>n=49</td>
<td>n=130</td>
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<td>22/26</td>
<td>19/17</td>
<td>38/38</td>
<td>26/22</td>
<td>75/55</td>
<td>244/211</td>
</tr>
<tr>
<td>55%45%</td>
<td>45%54%</td>
<td>53%47%</td>
<td>50%50%</td>
<td>54%46%</td>
<td>58%42%</td>
<td>54%46%</td>
</tr>
<tr>
<td>Age: Mean (Min–Max)</td>
<td></td>
<td></td>
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<tr>
<td>6.36 (1.5-13.17)</td>
<td>6.54 (2.17-13.83)</td>
<td>7.56 (3.83-13.92)</td>
<td>6.78 (1.83-13.42)</td>
<td>7.01 (3.67-12.42)</td>
<td>6.95 (1.75-16.42)</td>
<td>6.78 (1.5-16.42)</td>
</tr>
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<td>Pain Yes*</td>
<td>55 (47%)</td>
<td>12 (25%)</td>
<td>17 (49%)</td>
<td>3 (17%)</td>
<td>32 (82%)</td>
<td>168 (45%)</td>
</tr>
<tr>
<td>Anxiety Yes*</td>
<td>32 (28%)</td>
<td>9 (19%)</td>
<td>3 (9%)</td>
<td>1 (9%)</td>
<td>13 (33%)</td>
<td>19 (18%)</td>
</tr>
<tr>
<td>Infection Yes*</td>
<td>35 (31%)</td>
<td>13 (27%)</td>
<td>13 (37%)</td>
<td>5 (26%)</td>
<td>29 (74%)</td>
<td>49 (43%)</td>
</tr>
<tr>
<td>No. Teeth X: Mdn (Mi-Ma)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 (1-20)</td>
<td>7 (1-15)</td>
<td>4 (1-7)</td>
<td>4 (1-12)</td>
<td>5 (1-13)</td>
<td>4 (1-18)</td>
<td>5 (1-20)</td>
</tr>
<tr>
<td>RTT (days): Mdn (Mi-Ma)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>239 (6-577)</td>
<td>141 (24-217)</td>
<td>81 (43-217)</td>
<td>-</td>
<td>126 (6-362)</td>
<td>82 (1-418)</td>
<td>137 (1-577)</td>
</tr>
</tbody>
</table>

*Recorded by referring dentist. X = Extracted. Mdn – Median. (Mi-Ma) = Minimum to Maximum
Medical history was recorded in referral notes in 82% of cases, with 22% of these records reporting relevant medical history. The DGA lists included in this study were not specifically for special needs or complex care however those with reported medical issues included heart conditions, cerebral palsy, clefts, and various allergies, including penicillin. Special needs, behavioural difficulties or learning disabilities were also recorded. These factors could have contributed to the need for DGA when age or numbers of teeth to be extracted were not necessarily the main factor triggering the referral.

A history of previous DGA for that child was gained from the questionnaire. Those who reported their child had a previous extraction experience under general anaesthetic ranged from 12% to 37% across the 6 hospitals (Table 6.2).

Table 6.2: Previous DGA experiences

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>Chi square</th>
</tr>
</thead>
<tbody>
<tr>
<td>No previous GA</td>
<td>103 (88%)</td>
<td>40 (85%)</td>
<td>26 (72%)</td>
<td>66 (87%)</td>
<td>31 (63%)</td>
<td>89 (70%)</td>
<td>x²=24.216 (5), p=0.0001</td>
</tr>
<tr>
<td>Previous DGA</td>
<td>14 (12%)</td>
<td>7 (15%)</td>
<td>10 (28%)</td>
<td>10 (13%)</td>
<td>18 (37%)</td>
<td>39 (30%)*</td>
<td></td>
</tr>
</tbody>
</table>

*To determine exactly which hospital is significantly different, hospitals were looked at individually against the collective (combining hospital data). Hospital 5 and 6 had significantly more children attending for repeat DGA than that of hospital 1,2,3 and 4.

The duration of RTT was explored between hospitals using Kruskal Wallis because of the non normal distribution and violation of homogeneity of variance (Hospital 4 was removed from analysis as there was insufficient information available as referral letters were not present within the consultation notes). A significant difference was detected H (5) =170.117, p= 0.0001, the null hypothesis was rejected and pairwise multiple comparisons computed. Dunn-Bonferroni tests were undertaken to compare ranked data [19] and indicated children waited significantly longer from the time they were referred to the date of the operation at hospital 1 compared to all other hospitals (H1 vs. 2 U = 108.88, r = 0.497, H1 vs. 3 U= 162.02 r = .681, H1 vs. 5 U = 129.991 r = 0.575 H1 vs. 6 U = 161.415 r = 0.801 and for hospital 2 compared to hospital 6 U 52.527 r = 0.238) (medians presented in Figure 6.1).
Pain was experienced by two thirds of patients (67%) and over a third had sleepless nights (38%) (Table 6.3). Overall 78% of respondents stated they had at least one of the issues listed in relation to the dental problem they were referred for. There was no correlation between number of negative impacts and time a child waited for their operation ($r_s = 0.049, p = 0.365$).

Table 6.3: Impact of dental problem on child, recorded by parents

<table>
<thead>
<tr>
<th>Impact on Child (n = 456)</th>
<th>Yes/ No</th>
<th>Days Median/ Mode (min - max)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain –days since child was in dental pain</td>
<td>(67%/33%)</td>
<td>14/ 0 (0-365 days)</td>
</tr>
<tr>
<td>Limitation on chewing or talking</td>
<td>(22%/78%)</td>
<td>-</td>
</tr>
<tr>
<td>Affect on self confidence</td>
<td>(4%/96%)</td>
<td>-</td>
</tr>
<tr>
<td>Impact on emotions (irritability)</td>
<td>(20%/80%)</td>
<td>-</td>
</tr>
<tr>
<td>Social behaviour i.e. playing and speaking</td>
<td>(6%/94%)</td>
<td>-</td>
</tr>
<tr>
<td>Absenteeism due dental issue (days)*</td>
<td>(26%/74%)</td>
<td>2/ 2 (1-30 days)**</td>
</tr>
<tr>
<td>Sleepless nights due to dental issues</td>
<td>(38%/62%)</td>
<td>3/ 10 (1 - 10+ nights)**</td>
</tr>
</tbody>
</table>

* Filtered for those school age at operation **Filtered on those who experienced this impact
The time taken from initial referral until the operation and the number of days since a child was in pain was not significantly correlated (spearman’s rho). This indicated that pain was not necessarily just experienced at referral and could continue sporadically throughout the wait, no matter how long the wait was ($r_s = 0.130, p = 0.061$). In fact 45% of patients had experienced pain within the last month (31 days) and 27% pain within the last 7 days. Given an average wait of 137 days (approximately 4.6 months); this confirmed children are in pain while they wait for their operation. This is substantiated by the affect on sleep and missed school throughout the wait time. Multiple regression indicated number of days from referral to operation significantly predicted sleepless nights $b = .004, t(340) = 2.306, p = .022$ (having adjusted for age, see Table 6.4).

Table 6.4: Multiple Regression on wait time and impact on sleep

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>SE B</th>
<th>$\beta$</th>
<th>t</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>2.002</td>
<td>0.504</td>
<td>3.969</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wait time (from initial referral to operation)</td>
<td>0.004</td>
<td>0.002</td>
<td>-0.123</td>
<td>-2.276</td>
<td>0.023</td>
</tr>
<tr>
<td>Age</td>
<td>-0.12</td>
<td>0.005</td>
<td>0.125</td>
<td>2.306</td>
<td>0.022</td>
</tr>
</tbody>
</table>

Therefore for every day a child had to wait they would miss an additional 0.004 night’s sleep.

*According to this model;*  
A child referred to Hospital 1, where there is an average wait of 264 days, would experience 3.058 sleepless nights due to their dental problem (having adjusted for age); a child at Hospital 4, where there is an average wait of 73-days would experience 2.294 sleepless nights due to their dental problem (having adjusted for age).

Despite 25% missing days from school there were insufficient data to support a regression analysis.

Figure 6.1 shows a boxplot of wait times and last pain experienced for each hospital. While wait times differed across hospitals, with greater variability, the median time in days since last pain experienced remained relatively low, with pain consistently experienced within a short period of time before the operation occurred. In fact a substantial proportion of children (i.e. falling within the 75th percentile) were still experiencing pain before the majority of children had been seen for their operation. This is troubling as it suggests pain is experienced throughout the wait for GA.
Children who experienced no pain were explored further to understand why they may have been referred and if they could be treated in another way. Age and number of teeth extracted were not significantly different from the sample that experienced pain to those who did not. However, a statistically significant difference was found for those who were referred with a medical condition/indicator, for example behavioural problems or special needs. Thirty one per cent of those with no pain had medical indicators compared to just 18% of those referred with pain $x^2 = 6.204$ (1), $p = 0.013$. Therefore those referred without experiencing pain may still require DGA but for various medical/behavioural reasons and not just the severity of caries and pain/infection experienced.

RTTs were not normally distributed, thereby violating the assumption for parametric tests so non-parametric tests were used. There was no difference observed when looking at length of RTT and for those who reported any; pain ($U = 14899.5$ (349) $p = 0.064$), any days off from school ($U = 10960.5$, $p = 0.957$) or any sleepless nights ($U = 14348.5$, $p = 0.648$) using Mann Whitney U. This indicates sleepless nights, missed days of school and pain can be factors throughout the duration of the wait. Therefore a prolonged RTT is likely to cause a negative impact on a child’s day-to-day activities and emotional state.

**Discussion**

This study aimed to explore the effects of increased RTT on children referred for a DGA extraction across 6 randomly selected hospitals in the North West. This is partly in response to current research indicating there are varying wait times and services available throughout England as a whole [20] and anecdotal evidence from dentists and commissioners as to the issues likely to be encountered with a prolonged wait for GA . The study examined the impact on those waiting for a DGA alongside information gained from referral notes.

Analysis of the RTT compared to when they were last in pain found these were not significantly correlated. This suggests children were not only in pain at the time of referral but could have been in pain throughout their wait. In fact almost half (45%) of those asked reported their child had been in pain due to their dental problem within the last month. Additionally, RTT significantly predicted the number of sleepless nights due to the child’s dental problem. This indicates the longer a child had to wait, the greater their affected sleep that could lead to further problems, for example, performance at school, or in their school readiness for younger children [21]. This also emphasises the importance of pain and sepsis management during the ensuing wait for DGA.
While dental pain was reported by two thirds of respondents other negative effects were less prevalent, with approximately a fifth of respondents reporting issues around chewing or talking and effects on emotion, in particular with irritability. However, the majority of respondents (78%) reported their child had experienced at least one of the impacts listed. Therefore respondents had been negatively affected by their dental problem, which could have been exacerbated by a lengthy RTT. One area this research explored, which went beyond what is normally asked in the Child Dental Health Survey, was if the child had time off from school and how many days this had been. Approximately a quarter of school aged children (26%) had missed school with an average of three school days missed due to their dental problem. This should be considered alongside the fact that many children would be missing additional school days while attending the hospital and recovery the following day culminating in the majority of children missing at least 2 school days with some children being absent for up to 15 days. These missed school days will not only effect the child, but the family as well. Forty one percent of all carers whose children were absent from school were employed and this could have resulted in days lost from work; for the missed school days, any pre-assessment visit, the day of the procedure and perhaps for several days after before the child was ready to return to school.

An additional troubling element emerging from the analysis is the high number of repeat DGAs seen across the hospitals, particularly for hospital 5 and 6 (that served children from the same community). This impacts on the number of DGAs seen overall and builds pressure on this service, increasing the potential wait in different regions. Previous research has indicated that once a child develops caries it can develop rapidly and consequently children with dental caries should be considered differently from those caries free children [22]. Even when carious teeth have been removed following a GA, given the high number of repeat GAs there is evidence to suggest that children carry the legacy of the disease with them, potentially due to the fact that the causative factors have not been addressed [23, 24]. This could include children not being taken for preventative, routine care or receiving timely treatment. Previous research indicates that those who receive DGA do not always respond to simple preventative messages [25, 26] although parents have stated they would welcome a variety of health care interventions at this stage to avoid repeat DGA’s in the future [23]. The repeat GAs suggest more prevention needs to be done both on the lead-up to GA extraction and afterwards as a proportion of children may well return even after all decayed teeth are removed.

Treatment of carious teeth in children can be an emotive and contentious issue. While guidelines are in place [27] it is up to the referring and then operating dentists to select
from the options available for each child. Choices need to be made between restorations or extraction, and between care in either primary or secondary settings. There are uncertainties around which are the best methods to treat carious teeth in young children. One prospective study of clinical records suggested that the restoration of teeth in general dental practice did not necessarily prevent pain and extraction from occurring [28]. This idea has been continued further with current research exploring whether filling a tooth is the most effective method of managing caries in primary teeth [29].

The conflicts in treatment advice could potentially add to, and put pressure on DGA services if dentists refer when another treatment option is possible. If a proportion of children could be seen and treated in an alternative setting i.e. using other anxiety control measures and not referred for GA, the overall wait time for those children for whom a GA is essential will be reduced. The use of various treatment options may be one of a variety of reasons for the varying wait times observed across regions which are then seen to impact on a child’s life in a variety of ways i.e. pain, sleepless nights, etc. It should be noted for some children, who are too young, anxious, unable to co-operate or have relevant medical conditions, which prevent treatment being offered in another way, DGA extraction may be the only viable option for dental treatment.

**Conclusion**

Our data suggest the need for effective management of pain and sepsis while children await DGA. Improved clinical management and prevention of caries within primary care could reduce the number of children being referred for GA extraction. This would also have the effect of reducing wait times for those children for whom no other option is available except DGA. However given the principle that availability of good health care tends to vary inversely with the need in the population (inverse car law) [30] there is an issue with concentrating purely on prevention within attendance at primary care facilities. Additionally consideration should be given not only to the number of children referred needing a GA but also the high number of repeat GAs. Considering the concept of “making every contact count” there may be opportunities to deliver preventive advice, or even treatment (such as fissure sealants) during DGA appointments to positively impact on oral health and in reduce future extraction under GA.

**List of abbreviations**

GA – General Anaesthetic
DGA – Dental General Anaesthetic
RTT – Referral To Treatment
References


14. Davies G: Production of Data about Admission of Children to Hospital for Dental Extractions in the North West Region in 2008/09. The Dental Observatory. The Dental Observatory; 2010.


Chapter 7

Subgroups within a Dental General Anaesthetic Cohort: Who makes up this Vulnerable Group?
Foundation and Summary of Chapter 7

While Chapter 4 explored the background and differences to the Dental General Anaesthetic (DGA) service and Chapters 5 and 6 looked at the impact of the differences of those services. Chapter 7 is the final chapter within this section that looks to understand the population referred for a DGA and specifically if there are any distinct groups within those referred for the general anaesthetic. It is understood that those experiencing severe caries and resultant extraction under general anaesthetic could be considered different from the general population given their need and the dental care and management required. It was possible that an intervention to target this group as a whole would be most appropriate however without understanding this population it was not possible to determine one way or another. It was therefore important to establish if children were referred for DGA for different reasons i.e. barriers to information or prevention, medical indicators, etc. This chapter uses Multiple Correspondence Analysis (MCA) to determine if any subgroups exist within this referred population. From the characteristics of each subgroup it was possible to postulate the most appropriate interventions. These were taken from the scoping review (Chapter 2) and qualitative interviews (Chapter 8).

Authors Contributions
IAP and CS contributed to the manuscript. MG contributed to the design, acquisition of data, analysis (MCA), interpretation and manuscript. WB (of the Cathie Marsh Centre) supported the analysis and kindly gave her time to review the paper.
Abstract

Aim/ Objectives
Caries in young children can result in the referral for extraction of teeth under General Anaesthetic. This study aims to explore any subgroups within the population referred for Dental General Anaesthetic (DGA) in the North West of England that may require varying interventions and care management for their oral health, either within a dental setting or via other opportunities.

Methods
The study involved 456 respondents across 6 hospitals in the North-West of England. Data comprised of information gained from referral and consultation notes and questions answered by the parent/guardian. Multiple correspondence analysis (MCA) was performed to determine if there were any subgroups within this population.

Results
A three dimensional solution from MCA analysis was utilised which provided an inertia of 51.92%. When looking at the location of points on these axis, three distinct groups could be established from the MCA graphs generated, these were characterised and stated as the; 'Hard to Reach' group, 'Troubled' group, and groups referred with 'Additional needs'.

Conclusions
These groups indicate that certain features found in the process of referral for GA require diverse yet patient-specific care strategies and treatment options following DGA. Patient-specific advice could synchronize with groups associated with the summaries presented in the MCA. There are three distinct groups within this sample who could receive tailored care to attempt to keep them “caries-free” and avoid a repeat GA in the future. It may be possible to help decide which treatment and advice is necessary by recording elements depicted in this research with interventions tailored to individuals having high levels of the specified features.
Introduction

Dental caries is a preventable disease that occurs throughout life but, in young children, severe forms can be complex to treat and may require a General Anaesthetic (GA) for tooth extractions. Despite an improvement in caries prevalence throughout England over the past 30 years (see Figure 7.1), mainly due to the wide use of fluoride over this time [1, 2] there is still a significant proportion of young children that suffer this preventable and damaging condition. The burden of dental disease remains worldwide but can be particularly prevalent in underprivileged groups in both developed and developing countries [3]. It has been acknowledged, not only by academics within the discipline but also by NHS Commissioners and Consultants, that this is a significant and pervasive problem [4].

Figure 7.1: Average DMFT/dmft per child in England, 1973 to 2003 from national surveys [5]

Management of caries can range from prevention to intervention, including restorations or extraction depending on a variety of factors, such as the severity of the disease [6–8]. If disease severity is too great or other factors such as compliance make treatment under local anaesthetic problematic, one option is to extract teeth under GA. While GA can provide the optimum situation to provide dental care it is thought of as a procedure used when other alternatives have failed or are not possible given not only the social, clinical and educational issues associated with these procedures, but also the substantial cost to the NHS [9].

This study expresses a means of identifying populations at risk by using GA referral as the risk factor and, uniquely, aims to describe this group in terms of their demographic and
situation. It is vital to fully understand a population before commencing a preventative strategy (based on MRC guidelines) [10]. It has been observed that children with and without caries should be managed differently given the profound difference in risk of developing new cavities [11]. Existing evidence implies children who have been referred for Dental General Anaesthetic (DGA) should, by definition of their referral, be managed differently from the non-caries population. This ultimately will occur given the extraction they will undergo however the care pathways may also have to be more radical in order to attempt to keep them “caries free” in the future [12, 13]. It was hypothesised that within this group of referred children there maybe further sub groups requiring differing care strategies and support in relation to both stopping caries developing in the first instance and keeping children caries free in the future. Maintaining oral health following extraction remains a significant problem for this population with a high proportion of children returning for further extractions, often within a two year period [14, 15].

Objectives
To identify paediatric sub-groups that may be of interest and that account for Dental General Anaesthetic (DGA) i.e. medical indicators, access and attendance, prevention, barriers to care, deprivation.

Hypothesis
There will be a distinct set of subgroups that emerge from MCA analysis on children attending for DGA extraction.

Methods
This was an observational study conducted across 6 hospitals in the North-West of England that provided DGA extraction services for children, commonly known as 'outpatient GA'. All patients (and their parents/guardians) who attended these hospitals over a two-month period were approached to take part in the study. Participants were given information on the research and if they agreed to take part signed a consent form allowing access to referral and consultation notes and completed a questionnaire. Pseudo-anonymised (patient ID) details were entered onto STATA (2007, STATA Statistical Software 10, TX) for further analysis.

This work is part of a larger study looking at DGA extractions therefore sample size calculations were based on both the representativeness of the sample and the analytical methods used. Firstly, known data from Hospital Episode Statistics (HES) were utilised to calculate the population referred in the North West England. Given an absolute precision of 5% and a 95% confidence level, a sample of 374 children was calculated [16]. As MCA
is part of a family of descriptive methods that reveal patterning in complex datasets (such as clustering, factor analysis and principle components analysis) [17], the general method of sample size calculation is based on either absolute minimum sample sizes or the ratio of subjects to variables. Minimum sample size have suggested that a sample of 200 would be fair and 300 good [18] and a variety of ratio of subjects to variables have been proposed, one of the most conservative has been 10:1 [19]. There were 8 variables included in the MCA analysis (indicating a minimum of 80 participants would be required). Therefore a sample size of 456 and the number of participants included in the final MCA of 244 (given missing data across variables), sample size was deemed adequate for this analysis.

This study explored those referred for GA extraction and determined if there were any features of respondents referred along this pathway that cluster and exhibit shared identities. This was in order to assess whether a variety of interventions may be required to tackle each group or if the group is homogenous, an over arching intervention would be appropriate. Exploring indicators of those needing a GA extraction and how they relate to each other is a novel approach to this area of research and further explores the debate particularly around targeted and universal interventions [20–22].

There are a variety of determinants that could influence the likelihood of a child requiring extraction under GA beyond the biological factors known to be the cause of tooth decay. These range from individual factors to social and living circumstances as well as general socio economic, cultural and environmental conditions [23]. Factors utilised in this study concentrated on variables that could effect the distribution of information to parents or the ability to provide early treatment such as a child’s attendance at a dentist, the first language of the parents or their movement in and out of a geographic area [24]. Additionally research has shown those with additional needs or relevant medical issues could also have a higher prevalence of dental caries [25]. In relation to DGA, previous research has shown that those with a disability or chronic illness require more extractions and are usually older than those referred without these issues [26]. Therefore a variable on relevant medical history recorded by the dentists was utilised. Various studies have also shown that children can return for a repeat DGA within a number of years for subsequent extractions [13] therefore repeat GAs may be a factor for a number of children and has been included as a variable. Therefore features to be included in MCA were; issues with the ability to treat or prevent caries (attendance, age of child and prevention techniques), aspects which could effect information being received (relocation and language spoken), those who had conditions or previous DGA experience which may
contribute or indicate a need for DGA in the future and socio demographic aspects (income).

**Results**

Multiple correspondence analysis is a useful technique that allows for the comparison of the 'correspondences' or associations between categories, at a categorical level. This is achieved by quantifying categorical data and showing observations, which can be clustered together [17]. In this way it is able to show the patterns in data, which would otherwise be too complex to interpret due to the size and richness of the dataset. Interpreting MCA lies in the distribution of category points, their location to each other and which side of the axis they are on. Those at the far end of the axis are the main contributors to this interpretation. Given the type of analysis only general statements can be made when interpreting data, not precise conclusions [27].

The application of MCA ranges throughout the fields of health, marketing, social sciences and many others due to its diversity and flexibility [28, 29]. MCA was carried out for this work to explore potential subgroups of children receiving a DGA extraction. The analysis of the data is based on information from patients attending 6 different hospitals. The variables in Table 7.1 were included in the final MCA analysis (features such as anxiety were dropped from initial analysis as they contributed little to the output and other features recorded were not utilised such as missed school and due to caries as these would not contribute greatly to the understanding of patient needs). Given the majority of included variables were binary, other variables were dichotomised, as if possible variables should have a similar (or same number) of categories [29]. In order to dichotomise income the authors took the most commonly used threshold to determine if someone has a relative low income; 60% of average income [30]. This meant income was split at £13,000 per annum. Age of child was also dichotomised for those above and below 4 years old to represent as close as possible school and preschool children, additionally 4 years old was a criteria for certain hospitals in referring treatment to tertiary care.
Table 7.1: Summary of variables included in MCA

<table>
<thead>
<tr>
<th>Variable</th>
<th>Binary response</th>
<th>Response (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lifetime Residency</td>
<td>Lifetime resident</td>
<td>337 (88.5%)</td>
</tr>
<tr>
<td></td>
<td>Non lifetime resident</td>
<td>44 (11.5%)</td>
</tr>
<tr>
<td>Medical History</td>
<td>No Relevant Medical History (NRMH)</td>
<td>250 (78.4%)</td>
</tr>
<tr>
<td></td>
<td>Relevant Medical History (RMH)</td>
<td>69 (21.6%)</td>
</tr>
<tr>
<td>Repeat DGA</td>
<td>No previous DGA</td>
<td>355 (78.4%)</td>
</tr>
<tr>
<td></td>
<td>Previous DGA</td>
<td>98 (21.6%)</td>
</tr>
<tr>
<td>Dental Attendance</td>
<td>Regular Attender</td>
<td>341 (75.4%)</td>
</tr>
<tr>
<td></td>
<td>Irregular attender</td>
<td>111 (24.6%)</td>
</tr>
<tr>
<td>Prevention discussed</td>
<td>No FS/FV discussed</td>
<td>312 (68.6%)</td>
</tr>
<tr>
<td></td>
<td>FS/FV discussed</td>
<td>143 (31.4%)</td>
</tr>
<tr>
<td>Income – deprivation indicator</td>
<td>Low income</td>
<td>131 (47.5%)</td>
</tr>
<tr>
<td></td>
<td>High income</td>
<td>145 (52.5%)</td>
</tr>
<tr>
<td>First/ main Language</td>
<td>English as first language</td>
<td>411 (91.9%)</td>
</tr>
<tr>
<td></td>
<td>English not as first language</td>
<td>36 (8.1%)</td>
</tr>
<tr>
<td>Age of Child</td>
<td>Child under 4 years old</td>
<td>59 (13.2%)</td>
</tr>
<tr>
<td></td>
<td>Child over 4 years old</td>
<td>388 (86.8%)</td>
</tr>
</tbody>
</table>

MCA provides a measure of inertia, which represents the goodness of fit of the data. MCA produced 8 dimensions and a three dimensional solution provided an inertia of 51.92%. As the three dimensions explained the most variance, and the addition of further dimensions added little to this explanation, analysis has just concentrated on the first three dimensions (Table 7.2).

Table 7.2: Summary table of Inertia for MCA

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Inertia</th>
<th>Percent</th>
<th>Cumulative percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.2355167</td>
<td>23.55</td>
<td>23.55</td>
</tr>
<tr>
<td>2</td>
<td>.1462978</td>
<td>14.63</td>
<td>38.18</td>
</tr>
<tr>
<td>3</td>
<td>.1373846</td>
<td>13.74</td>
<td>51.92</td>
</tr>
<tr>
<td>4</td>
<td>.1238395</td>
<td>12.38</td>
<td>64.30</td>
</tr>
<tr>
<td>5</td>
<td>.1128797</td>
<td>11.29</td>
<td>75.59</td>
</tr>
<tr>
<td>6</td>
<td>.0958998</td>
<td>9.59</td>
<td>85.18</td>
</tr>
<tr>
<td>7</td>
<td>.0895783</td>
<td>8.96</td>
<td>94.14</td>
</tr>
<tr>
<td>8</td>
<td>.0586036</td>
<td>5.86</td>
<td>100.00</td>
</tr>
</tbody>
</table>
Table 7.3 provides information on how each category is plotted onto the graph. The column 'Co-ordinate' indicates the coordinates for each category on the graph for each dimension included (1, 2 and 3). The 'Contribution' column reflects how well each point loads onto the respective dimension i.e. it can be seen in Table 3 the previous DGA group loads heavily onto Dimension 3. The 'Mass' column indicates weights for each point. A category can contribute to the axis in two ways one when it has a large mass or when it is a large distance from the centroid (even if it has a low mass) [31].

Table 7.3: MCA dimensions discriminations measures and Key for Figure 1, 2 and 3

<table>
<thead>
<tr>
<th>Category</th>
<th>Dimension1</th>
<th>Dimension2</th>
<th>Dimension 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mass</td>
<td>Co-or</td>
<td>Cont</td>
</tr>
<tr>
<td>Non lifetime resident</td>
<td>13</td>
<td>1833</td>
<td>89</td>
</tr>
<tr>
<td>Lifetime resident</td>
<td>112</td>
<td>-210</td>
<td>10</td>
</tr>
<tr>
<td>NRMH</td>
<td>107</td>
<td>139</td>
<td>4</td>
</tr>
<tr>
<td>RMH</td>
<td>18</td>
<td>-806</td>
<td>25</td>
</tr>
<tr>
<td>No previous DGA</td>
<td>100</td>
<td>156</td>
<td>5</td>
</tr>
<tr>
<td>Previous DGA</td>
<td>25</td>
<td>-619</td>
<td>20</td>
</tr>
<tr>
<td>Regular Attender</td>
<td>101</td>
<td>-316</td>
<td>21</td>
</tr>
<tr>
<td>Irregular attender</td>
<td>24</td>
<td>1332</td>
<td>88</td>
</tr>
<tr>
<td>No FS/FV discussed</td>
<td>80</td>
<td>189</td>
<td>6</td>
</tr>
<tr>
<td>FS/FV discussed</td>
<td>45</td>
<td>-341</td>
<td>11</td>
</tr>
<tr>
<td>Language Other</td>
<td>8</td>
<td>3013</td>
<td>157</td>
</tr>
<tr>
<td>Language English</td>
<td>117</td>
<td>-216</td>
<td>11</td>
</tr>
<tr>
<td>Child&lt;4 years old</td>
<td>17</td>
<td>528</td>
<td>10</td>
</tr>
<tr>
<td>Child.&gt;4 years old</td>
<td>108</td>
<td>-82</td>
<td>1</td>
</tr>
<tr>
<td>Low income</td>
<td>61</td>
<td>361</td>
<td>15</td>
</tr>
<tr>
<td>High income</td>
<td>64</td>
<td>-323</td>
<td>14</td>
</tr>
</tbody>
</table>

Co-or = Coordinate, Cont = Contribution (contribution Statistics x1000 for column categories in principal normalization),
Number of observations 224 (missing observation due to missing data over a number of categories)
Figure 7.2: Indicators from MCA Dimension 1 and 2

STATA produces graphs for the three dimensional solution, providing a visual display of the trends within the data. Points that are mapped close together have similar profiles. Figure 7.2 shows the first two-dimensional map with dimensions 1 and 2 displayed. Dimension 1 appears to separate those who are a potentially difficult to reach population (non lifetime and irregular attenders) from those who could receive prevention or interventions through more established practices. While the horizontal axis marked as dimension 2 distinguishes those with relevant medical history, previous treatment such as prevention (fluoride varnish and fissure sealant) and previous DGA.
Adding a third dimension illuminates a number of additional differentiations and associations in interpreting the data. Looking at Dimension 1 and 3 (Figure 7.3) it can be seen that low income has emerged as sharing a similar profile with children referred below the age of 4 years. The axis now separates these features along with irregular attendance and whose first language is not English from those with high income and relevant medical history.
For Figure 7.4 that explores dimension 2 and 3, there are less defined groups. However non-lifetime residence can still be seen as one of the factors furthest from the centroid with children less than 4 years old being located on the opposite side of the axis. Previous DGA is also a large contributor on the left side of the graph opposite high income.

Throughout all the graphs Hospital 1 appears to be associated with irregular attenders and for certain outputs is also clustered with non-lifetime residence and young children referred into the service.

Figure 7.5 shows the individual cases plotted on a graph, the location reflect each individual’s response to the features included in this MCA. Therefore participant 43 and 819 are non lifetime residents, irregular attenders and with a language other than English (which can be verified going back to individual responses on the data set)
In order to address the validity of the dimensions identified in this Multiple Correspondence Analysis the same features were included in a Principal Components Analysis (PCA). This was run as a complementary analysis in order to confirm that the results in MCA could be replicated, it was not used as the main test as this study utilised binomial variables, and PCA does not always give reliable results for anything other than interval data. PCA produced a scree plot identifying three components with eigenvalues over one (and therefore these were retained), which explained a total variance of 52%, identical to that of MCA.

*Figure 7.6: Scree plot of eigenvalues for PCA*
Table 7.4 illustrates the principle component loadings on the original variables, which represent the correlation between the component and the original variable, only those with absolute values of above 0.3 have been kept to make interpretation easier. It can be seen that lifetime residency, dental attendance and language-spoken load high onto component 1, while child age, prevention discussed, medical history and lifetime residency load onto component 2 and previous GA and income load onto component 3. These can be seen to match some of the dimensions described from MCA with features that load onto component 1 representing the hard to reach families who have additional barriers of maintaining oral health and being provided with correct and consistent information by moving and/or having irregular dental attendance. Categorical Principal Components Analysis (CATPCA) was also run which produced 4 components with eigenvalues of above 1. Again data/ component loadings were similar across PCA, CatPCA and MCA therefore these tests have validated the MCA for this study [32].

Table 7.4: Principle Components Analysis and CATPCA - Component loadings

<table>
<thead>
<tr>
<th></th>
<th>Principle Components Analysis</th>
<th>CATPCA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Com 1</td>
<td>Com 2</td>
</tr>
<tr>
<td>Lifetime Residency</td>
<td>0.4518</td>
<td>-0.4688</td>
</tr>
<tr>
<td>Medical History</td>
<td>0.4994</td>
<td></td>
</tr>
<tr>
<td>Repeat DGA</td>
<td>0.6886</td>
<td></td>
</tr>
<tr>
<td>Dental Attendance</td>
<td>-0.4730</td>
<td></td>
</tr>
<tr>
<td>Prevention discussed</td>
<td>0.4480</td>
<td></td>
</tr>
<tr>
<td>Age of Child</td>
<td>0.4260</td>
<td></td>
</tr>
<tr>
<td>Income – deprivation indicator</td>
<td></td>
<td>-0.6596</td>
</tr>
<tr>
<td>First/ main Language</td>
<td>0.5881</td>
<td></td>
</tr>
</tbody>
</table>

Com = Component

Discussion

MCA is an exploratory technique and allows defined patterns to be identified in categorical data. As far as the authors are aware this type of analysis has not been used before to explore subgroups within children referred for DGA and provides a new insight into this area. MCA, unlike other methods, is not looking to predict caries experience but is looking
to establish if certain features of the respondents “group” together and would therefore require a varied or tailored intervention. From data analysis and the graphical representation 3 distinct clusters within MCA were identified. These are described below:

1. Irregular attendance, non-lifetime residents and those whose first language is not English are located in the same part of the graph. These appear to be quite separate from other indicators as they lie at the far end of dimension 1. This cluster could be thought of as the ‘hard to reach’ population given barriers to attendance, transience and potential issues with translation.

2. Relevant medical history (RMH) was located close to previous DGA, in the bottom right dimension indicating a proportion of those who have had previous GA’s may have an additional medical requirements which contribute to the need for treatment under GA and may be a contributing factor towards caries development. These categories also appear to be associated with prevention being discussed with the parent, such as fluoride varnish or fissure sealants and to a lesser extent a higher income (defined as income over the level of poverty). This could indicate that those who have received specific preventative advice may again have additional problems, which are also contributing to the need for GA and dentists have attempted to incorporate clinical prevention in order to reduce caries experience. This group could be seen as incorporating those requiring GA for reasons other than just caries severity or age and will be referred to as ‘additional needs’.

3. To a lesser extent, those with; children under 4 years old, low income, have not been part of any discussions around in practice prevention and have No Relevant Medical History (NRMH) are also clustered together but are close to the centroid of the axis and therefore are not well represented in the two dimensions. Therefore caution is needed when interpreting features in this space. This group could be considered troubled families’ who have not been referred for alternative reasons such as medical history but have experienced caries at an incredibly young age and have received little prevention.

The hospital attended has been included as a supplementary variable, as in this way it does not affect the MCA solution but the hospital categories are mapped onto the graph enriching the interpretation of the data further. The one hospital, which is represented in
this space close to other variables, is Hospital 1 whose patient type appears to be associated with irregular attendance and non-lifetime residents.

**Hard to Reach families**

The main group which could be seen throughout the graphs produced and contributed highly towards the first axis was the ‘hard to reach’ group. Patients who were irregular attenders and had moved within the child’s lifetime comprised this group. It is not surprising these observations contributed highly to the first axis as relocation into a county or movement to different areas could be a barrier in being able to find a dentist and maintain regular dental visits. Research has shown there are still barriers in some areas in being able to register with a new dentist, this could be for example, if the family dentist is not taking on any more NHS patients [33]. Additionally parents perceive a number of barriers to attending the dentist, from not realising the appropriate age which their child should start attending and also lack of information provided on paediatric dental visits [34]. An alternative hypothesis is dentists may be less willing or feel less able to treat patients who attend irregularly either through not being able to build up a rapport or if they believe their efforts will still result in an extraction under GA. Certainly it was noted in this study a number of referrals to GA resulted from the first attendance of a child to a dentist.

The movement of families in and out of local authorities is not just an issue for dental attendance but also, connectively, in implementing interventions to improve oral health. One study exploring participation in a dental health promotion intervention found that a high degree of residential mobility in the population affected the interventions ability to impact positively on the community as a whole [24]. More worryingly some of the children who had changed addresses had moved 30 times in three years which indicates the difficulty in being able to provide regular care to certain families who have unstable or chaotic lives. While the study in question could not identify the reasons for this level of transience it was hypothesised that it could be due to the breakdown of family units, formal and informal child care arrangements or alternative housing opportunities. The study also discussed traveller’s families and the ability to identify additional services for recognised sites that are reachable by health care workers. Additionally within this study between 3% and 8% of children within this group had been made homeless at some point since birth [24]. This troubling level of homelessness within a family is a further issue and the difficulty in keeping track of homeless families and the connection with accessing routine health services was noted. Furthermore, within this established factor were those whose first or main language was not English. Again non-lifetime residency could be
expected to cluster with language given that some of the movement will those moving into the country after the birth of their child. Language and attendance could also been recognised as associated as previous research has again shown barriers to attendance within minority ethnic communities includes language, cultural misunderstandings and mistrust of dentists [35].

*Troubled and challenging families*

The second group discussed was the troubled or challenging family group. These consisted of young children (below the age of 4 years old) with no relevant medical history reported, those on a low income and also those purporting to have received no clinical prevention such as fluoride varnish or fissure sealants. Age is a substantial contributing factor to the need for DGA due to the pre cooperative nature of very young children [8, 36], a study looking at the difference between those who require DGA and LA found that after ‘number of teeth to be extracted’, age was the most important factor with 99% of children under 5.5 receiving DGA [37]. This group also stated they had little clinical prevention discussed or implemented. This could be due to the combination of the age of the child and attendance if they had only recently begun to visit the dentist (irregular attendance is clustered within this group in Figure 7.2). This is a concerning association as young children at high risk for caries are a group which will require additional support and preventative techniques such as fluoride varnish and therefore this needs addressing within dental practice. An important factor to note is that aspects such as clinical prevention was self reported and therefore may be biased given parental response. While this information was checked against dental notes these would not often mention preventative strategies and therefore this information should be treated with caution.

*Medical History*

The third group included those referred with relevant medical history; this category was also associated with having previously experienced a DGA. Relevant medical history could cover special needs, behavioural problems, medical issues or a combination of these. However it is important to note none of these children were being seen on a special needs list. Special need lists were usually conducted as a separate session at a number of the hospitals visited. The researcher did not attend these as they fell into the exclusions criteria detailed in the protocol. Therefore while children in this study may have had medical indicators described in their referral they were still sent to what is often referred to ‘outpatient’ or ‘chair’ GA. Therefore these medical indicators may be considered to have potentially contributed to the caries experience and not solely due to the need to be examined or treated under GA. In chapter 10 it was shown those with a medically reported
issue were more likely (relative risk ratio 1.75) to have a repeat GA than those without a medical issue. Those with special needs and various disabilities have been shown to have a high incidence of oral disease which can be associated with the specific needs of the individual such as drug treatment, diet and feeding practices and difficulty in maintaining oral hygiene habits [38, 39]. Additionally, the need for treatment under general anaesthetic could be in part due to the medical indicators reported. For example if a child is autistic and requires treatment their cooperation may be another factor to consider in relation to DGA. This cluster also included those who reported discussion around fissure sealant and fluoride varnish indicating those with medical indicators may be having proactive preventative treatment. Although given the association with repeat GA’s this group may always require certain treatment under GA despite additional support and prevention administered due to extenuating circumstances.

**Conclusion**

It can be observed that children referred for DGA could be divided into a number of groups which may require varied care management both pre and post DGA treatment, community based prevention programmes and either through a paediatric pathway or special care pathway. The following are summary suggestions for management for each group.

**Group 1:** Irregular attenders, who are more transient and may have additional language issues could be targeted with interventions that are not restricted to location and are easily translated, such as online or mobile phone interventions to encourage dental attendance, preventative treatment, maintaining good oral hygiene and optimal diet and feeding practices [40]. Treatment such as fissure sealants may be more appropriate for this group who may not attend regularly enough to effectively receive other preventative treatment such as fluoride varnish [41, 42] although maintenance of fissure sealant is still important.

**Group 2:** Radical, intensive treatment and prevention may be required for those children who attend at a young age for DGA as previous research has indicated early childhood caries experience can predict future dental decay [43] and a significant proportion of children are likely to return within a few years for repeat DGA [44]. This could involve proactive clinical prevention such as fluoride varnish [45] and prevention sessions with parents to instil the importance of oral hygiene and regular dental attendance [46, 47].
Group 3: Children with additional medical problems such as chronic conditions may require long term medication, if possible these should be sugar free or given during their mealtime [41]. Disabilities which effect dexterity and therefore brushing could be aided using 3 headed toothbrushes this may also be useful for children with short tolerance or attention span [48]. Other activities such as weaning children as soon as possible from bottles could help with reducing risk of tooth decay.

The implementation of these management strategies could occur following a number of simple questions to families and reference to the dental history by the GDP, based around the 8 summary variables utilised in this chapter. For example establishing dental attendance could determine whether fissure sealants may be appropriate. As these are just suggestions further research should be conducted to establish if various strategies are appropriate for these groups. These summary questions could also be used to identify appropriate techniques and prevention from the oral health toolkit 'Delivering Better Oral Health' [41] or similar caries management systems.
References


Chapter 8

A Qualitative Exploration of the Complex Causes of and ways of Reducing DGA in Children
Foundation and Summary of Chapter 8

Chapters 4, 5, 6 and 7 have set the scene regarding Dental General Anaesthetic (DGA) extraction and the population referred. This corresponds to the first part of the MRC Guide to Complex Interventions, the ‘development phase’, identifying the evidence base and characterising the population involved. Obtaining this background understanding was an important aspect in starting to gain an insight into the complex causal factors that results in a DGA. The next stage, given this understanding, was to explore the area further and detail a variety of methods which could be used to reduce the number of DGAs in England. In order to do this it was vital to involve those connected to the DGA pathway. Not only those referred in i.e. children and their parents, but also those working within the dental service.

Chapter 8 is the first chapter that explores the actual underlying causal pathways that result in a DGA and potential interventions, which may have an impact. This chapter involves interviews with parents, referring dentist and operating dentists in order to discover the issues surrounding this area and solutions that may work in the future. This use of people ‘downstream’ to advise on ‘midstream’ or ‘upstream’ interventions should mean they are more acceptable and appropriate for the intended population.

Therefore while the previous chapters give a greater understanding, in a broad sense, of the population and treatment process. The next section explores the fundamental issues that lead to a DGA extraction and some of the potential solutions.

Authors Contributions
MG contributed to the design, conducted the interviews, analysis, interpretation and manuscript. IAP contributed to the protocol and manuscript. CS contributed to the protocol, manuscript and supported analysis and interpretation.
Abstract

Background
A proportion of children experience decay that is so severe or at such a young age that a Dental General Anaesthetic (DGA) extraction is required. The issue of multiple decayed teeth in young children is both troubling and challenging. This paper reports on qualitative research aimed to understand the potential complex contributing factors for DGA referral and comments on interventions that may reduce the need.

Method
Qualitative semi-structured interviews were conducted with 26 people comprising parents (n=15), dentists working in primary care (n=6) and operating dentists (n=5) in relation to DGA. Participants were recruited from areas across the North West of England to ensure a variety of experiences and opinions were captured. Field notes were made during or shortly after interviews and were explored alongside interview transcripts to elicit key themes.

Results
The paper focuses on a number of themes that explore reasons behind a need for GA extraction and potential interventions that may work in the future. These can be seen to revolve around i) public health and policy ii) prevention and care in practice and the community and iii) issues with individuals and families. There is a common theme throughout these of responsibility and blame within oral health and discussions highlight the difficulty of maintaining good health given challenging situations and wider influences.

Conclusion
It is suggested a number of opportunities to improve children’s oral health could be established from both universal and targeted interventions. Tackling both additional support needed within the community for example registering children with a dentist from birth, addressing policy involving sugar and diet and confronting individual behaviours of those receiving a DGA with supportive techniques such as plaque disclosing tablets and preventative sessions to help reduce the number of repeat GA’s seen and overall children referred for a GA in the future.
Introduction

The issue of children with severely decayed teeth is not a new problem but remains a significant concern in today’s society [1]. Children suffering from pain and infection will always evoke strong emotions, especially when the cause is essentially preventable. In certain cases the decay children experience can be so severe that extraction is the only viable option. At times due to the high number of decayed teeth or the age of the child, Dental General Anaesthetic (DGA) is required in order to carry out this procedure [2, 3]. Although there are a number of factors contributing to the need for DGA extraction, the primary cause is caries, which makes this the key area to tackle when attempting to reduce the number of DGA’s [4].

The particular population of children referred for DGA can be thought of as one of the most challenging and yet needful groups. They are likely to be among the most vulnerable but also the hardest to reach, given not only the material and social deprivation but also their lack of regular contact with health providers; including dentists [5].

The Health and Social Care Information Centre reported an increase over the last three years in the number of children admitted for treatment by DGA of carious teeth with the latest figures from 2013-14 showing over 25,000 cases in 5-9 year olds. This was the largest single cause of hospital admissions for this age group, the next being tonsillectomy [6]. Overall there were over 46,000 admission episodes for dental caries treatment for children in 2013-14 [7]. It should be recognised that this figure is still an underestimate as it does not always include procedures provided by Community Dental Services [8].

Influencing policy to ensure that effective evidence-based prevention is deployed at population and individual levels are central to the research aims. This project articulates a means of identifying populations at risk by using GA referral as the risk factor and, uniquely, aims to understand the population and variation throughout the services prior to commencing a prevention strategy. By ensuring that the population needs are understood, the acceptability of a prevention strategy is increased. This also involves readdressing the upstream/ downstream model [9, 10]. The downstream model refers to interventions, which look solely at individual behaviours and ‘lifestyles’ which impact on health. The upstream model on the other hand looks to address the underlying social determinants of health and implement interventions at local and national levels [10]. In this way upstream interventions can include health promotion and prevention at a community level and can be directed at broader circumstances such as illiteracy that may impact
behaviours and subsequent conditions [11]. Within this conceptual shift in moving from downstream to upstream approaches, it is vital to incorporate the views and opinions of those patients ‘downstream’ to inform these ‘upstream’ interventions and ensure that the developed methods are the most appropriate for those they are intended to effect. While the importance of addressing the balance of upstream and downstream models is acknowledged, it is also vital not to lose sight of the impact of individual behaviours and the need for positive behaviour change in certain circumstances. This is particularly relevant to the GA population considering the high rate of repeat referrals [12]. Clearly if both individual factors and social determinants are not understood and no attempt is made to rectify these issues, DGA could remain a constant cycle for certain children and their families, this was demonstrated in the level of repeat DGA discussed in Chapters 4 and 6. Therefore a combination of both upstream and downstream modelling needs to be explored for this population. This idea of individual and community empowerment by removing barriers to good oral health and developing the capability through social action is reported in the recent strategic review of health inequalities presented by Marmot [13].

This study focuses on prevention of caries through varied means drawing on qualitative interviews with parents of children undergoing DGA or those who worked within the field.

**Methods**

Qualitative interviews were conducted with the family/caregiver and child, both before and after the operation if possible, in order to record any significant changes that occurred in thoughts and reasoning, given the serious operation being experienced. The first interview was usually conducted within the two weeks after consent was obtained at one of the triage clinics or treatment centres. The second interview occurred after the DGA operation and again parents were followed up within two weeks of this. The time between the interviews could vary depending on the referral to treatment time of the operation, at times this was up to 9 months. Interviews with those involved in the dental service, including referring GDPs, operating dentists and Consultants were conducted once, either over the phone or face to face at a clinic or practice. Interviews lasted up to 60 minutes and topics discussed included: previous problems with oral health, issues as a child develops, support and information available and dental history. This took the form of a narrative approach with participants telling a story of how they remembered a typical day, what they did, ate, whether tasks were a habit or needed a conscious reminder and any problems encountered. From this perspective the researcher then discussed possible interventions that may have worked or may work in the future, with the direction and influence coming
from the participants (i.e. parent). In order to involve the child in this process as much as possible certain props or guides were used, for example, pictures on dental care and experience, in order to gain young and older children’s understanding and experiences of their own dental health care. During or shortly following the interview field notes about each visit were made to add additional context to the interviews based on what was observed but which might not be elucidated at the interview to build a more detailed picture regarding respondents’ perspectives and experiences. All interviews were recorded and transcribed verbatim along with field notes taken on the day of the interview. This was an iterative approach, returning to continue interviews after initial coding in order to develop themes.

Table 8.1: Participant’s details (Parents and children)

<table>
<thead>
<tr>
<th>ID</th>
<th>Mother/father</th>
<th>Child included in interview</th>
<th>Child Male/female</th>
<th>Area</th>
<th>Age child at op / treatment (years)</th>
<th>Teeth extracted</th>
</tr>
</thead>
<tbody>
<tr>
<td>259</td>
<td>Mother</td>
<td>Yes</td>
<td>Male</td>
<td>2</td>
<td>7.10</td>
<td>1</td>
</tr>
<tr>
<td>328</td>
<td>Father</td>
<td>No</td>
<td>Male</td>
<td>2</td>
<td>8.83</td>
<td>5</td>
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<td>326</td>
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<td>No</td>
<td>Male</td>
<td>2</td>
<td>9.33</td>
<td>4</td>
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<tr>
<td>648</td>
<td>Mother</td>
<td>No</td>
<td>Male</td>
<td>4</td>
<td>7.58</td>
<td>7</td>
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<tr>
<td>901</td>
<td>Mother</td>
<td>No</td>
<td>Female</td>
<td>3</td>
<td>6.00</td>
<td>Restoration</td>
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<tr>
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<td>Male</td>
<td>3</td>
<td>7.78</td>
<td>Restoration</td>
</tr>
<tr>
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<td>Male</td>
<td>3</td>
<td>8.92</td>
<td>Restoration</td>
</tr>
<tr>
<td>912</td>
<td>Mother</td>
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<td>Male</td>
<td>3</td>
<td>10.03</td>
<td>Restoration</td>
</tr>
<tr>
<td>924</td>
<td>Father</td>
<td>Yes</td>
<td>Male</td>
<td>3</td>
<td>6.20</td>
<td>Restoration</td>
</tr>
<tr>
<td>810</td>
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<td>Male</td>
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<td>3.75</td>
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<td>Female</td>
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<td>6.00</td>
<td>12</td>
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<tr>
<td>811</td>
<td>Mother</td>
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<td>Female</td>
<td>1</td>
<td>2.42</td>
<td>10</td>
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<tr>
<td>806</td>
<td>Mother</td>
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<td>Male</td>
<td>1</td>
<td>4.42</td>
<td>4</td>
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<tr>
<td>802</td>
<td>Mother</td>
<td>Yes</td>
<td>Male</td>
<td>1</td>
<td>12.08</td>
<td>2</td>
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<tr>
<td>800</td>
<td>Father</td>
<td>No</td>
<td>Male</td>
<td>1</td>
<td>6.25</td>
<td>4</td>
</tr>
</tbody>
</table>

Table 8.2: Participant’s details (Dentists)

<table>
<thead>
<tr>
<th>Dentists treating referred children</th>
<th>Referring/ non operating dentists</th>
</tr>
</thead>
<tbody>
<tr>
<td>ID</td>
<td>Dentist</td>
</tr>
<tr>
<td>1</td>
<td>Operating dentist</td>
</tr>
<tr>
<td>3</td>
<td>Operating dentist</td>
</tr>
<tr>
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Results

A number of themes were established throughout coding of interviews with regard to potential ways of reducing caries experience within this population and therefore reducing the need for GA. These themes can be considered in three overarching areas; ‘National Policy and Government Initiatives’, ‘Community Practices & the Dental Practice’ and ‘Families and Individual Behaviour’. Each one will be explored in turn through the subthemes generated using a combination of thematic analysis and constant comparison. There is a structured and reviewed way to proceed through the analysis process. A variety of analyses share similar strategies and these have been used to guide the researcher and include: familiarising yourself with the data, generating initial codes, searching for themes, taking extracts and re-examining and coding in more detail, looking for connections between themes to create new sub-themes in a meaningful way, reviewing themes and defining and naming themes [14, 15]. Smith [16] has suggested this can be aided by using grounded theory techniques to link structure with process looking at themes which characterise fundamental conditions, actions and the consequences linked to these.

The need for and value of a public health approach

Dentists discussed the role of the government and the ability to communicate a public message on the root causes of caries, namely sugar. There was an element of resignation from dentists regarding their ability to impact on this area. They discussed the wider problem of dental health within children and the culture of fizzy drinks and sugar they believe is mainly responsible. Dentists could see the problem in their practices daily however many felt the only effective way to tackle this issue was a change in policy and this was ultimately the responsibility of the government.

So it needs to be a public message. It’s like they used to have a public message about crossing the road. But unfortunately, that does involve having sort of posters and stuff that say these things are not good for you. Coca-Cola or whatever. (break). We discovered in about 1960, smoking gives you cancer. And forty years later, we say no smoking in public places. It took forty years for that to happen. And it’s the same sort of thing, there’s a reluctance, “Oh we don’t want to upset the tobacco companies”. Well, tough luck. “We don’t want to upset commercial interests”. Yeah, but you’ve got to (break) If you want to address a number of GAs, anywhere in the country, you need to have a grass roots education of the population, which is not for dentists to do. It’s to be driven by, essentially the
Department of Health and Government, and does it actually involve telling people, giving them messages that manufacturers and commercial organisations, won’t want to be given out? (Dentist 16)

You know like, on the TV, like an ad campaign about how important your diet is, with teeth? I know, for us, it’s like obvious, but I don’t think a lot of parents are aware of the importance of it because they just haven’t got a clue. ‘Oh, but I thought that was okay, it says, ‘no added sugar’ on it.’ (Dentist 7)

Dentist 16 not only discussed policy in relation to influencing the behaviour and diet of families but also incentives for dentists to provide preventative treatment rather than simply extract.

I don’t know, but at the moment, the dentists have every incentive to do what the Government doesn’t want us to do. (break) That would motivate people to do it, but the response from the person in charge of dental public health, said “Oh, that sounds like an item of service. Oh, we don’t like item of service” and my attitude was, “What? You’re concerned you may over prevent now. Is that your concern?” Because, no, item of service group can lead to over treatment. And it’s ridiculous. (Dentist 16)

Additionally the need for information and support from various parts of the community was discussed. Parents intimated information given through the dentist may not be received in time to impact on their child’s early oral health. However a health visitor’s involvement (or equivalent) at an early stage was noted as beneficial, particularly around bottle use and diet. Parents also discussed utilising information and support through various community services and activities to communicate the basic oral health messages. These ranged from Sure Start centres to other spaces and facilities they may attend but that are not necessarily connected to oral health, such as GP practices or even job centres.

*Probably health care visitors or nursery although we never saw any health care visitors ... well we saw one once but that was it, he was adopted at 9 and half months and they came and said oh he looks ok, we’ll see you in two years time. So the information would have been advisable around that time or from nursery that we should have ceased giving him the bottle or at least just water at night (800)*
The brush bus so the children brush their teeth daily. We’ve got a dummy tree and things like that which have all come from support from them. (806)

So the Sure Start they came there and all the children that lived in that place were given information and had time to play, toys and stuff, so it would be a good idea to put like this information. (810)

Don’t make them eat too much sweets, so they don’t have a tooth problem, so they don’t have their tooth extracted by the doctor.... So I realised if I’ve seen this advert before I had the baby I would change the way I do things, the way I raise him or...because in some way, in one way or another, I feel that I am the reason why he had this... So, yeah, if everywhere, like, at a GP, hospital or, like, Job Centre, it’s nothing to do with it, but somewhere where they community comes. It would be easy.... I would like to give advice about that. (810)

It would probably be better if the health visitor was more involved and stuff, in it. Like years ago, I remember they used to give you a toothbrush and toothpaste for them, but like I get confused because now, they say you’re not to use the toddler toothpaste. So it’s a bit like, you feel when you buy toddler toothpaste, thinking you’re doing the right thing, you’re actually not doing the right thing (811)

**Policy and advertising within and outside the UK**

Inadequate policy in the UK was not the only issue discussed by those working within dentistry. Given the movement both within England and in and out of the country, it can be difficult to provide a constant and consistent message (this was observed in data examined in Chapter 4). Furthermore cultural norms and common practice within certain communities may be equated with behaviours which impact negatively on oral health, and can be difficult to change. This presents an additional issue, as children’s first attendance at the dentist may be when teeth are already severely decayed. A dentist discussed this regarding a proportion of patients he treats who recently had joined his practice.

‘Fizzy drinks are almost promoted in those countries like cigarettes were promoted in England in the forties and the fifties (break). The drinks industry, it’s like very much drinking Coke and Mountain Dew and Fanta is almost a healthy lifestyle choice. When they come here they’ve already, they’ve been drinking that for years, and to them fizzy drinks are cheaper than water in a lot of these countries as well.’ (Dentist 17)
This theme was also echoed within the UK when there were certain companies or promotions that had a potentially negative effect on oral health, particularly for young children. While dentists remarked this had improved, they acknowledged there were still issues within this area.

Sunny D was the one before that, I can remember Sunny D, and before that it was Bedtimers, which was a chocolate stuff they put in the milk before bed, and it was obviously chocolate…it just comes in a peak, these things come, and suddenly they were coming in with disasters and it was made out, by the company, obviously, to be good. And so they all piled in there, and six months later decay all over the place. So I remember all that at various stages (break)… I think we’ve massively improved things, but you are still swimming against the tide, here, aren’t we? There’s so much rubbish that they get, that they want, and it’s just handed to them to shut them up. (Dentist 8)

Dentists made reference to other models in the UK, which seem to be working and felt this should be established throughout England. These models often target parents early as many dentists felt by the time parents attended with children potential problems had already progressed too far.

You know, so in spite of the fact that we have things like delivering better oral health, all this guidance that’s available, their general dental services, there’s something not capturing these, we’re just not capturing these kids early enough. The Scottish model, the Child Smile model, I think is fantastic, because it really demonstrates the impact of early intervention, and that’s before, that’s nursery school kids. It’s using Health Visitors and capturing kids before they have their first contact with the general dental services, because a lot of the time, in this very, very young age group, the first contact with the Dentist is when they’re in pain, that’s what prompts parents to take them along, and by then it’s far too late (dentist 3)

Parents also commented on certain policies such as restriction of food within school that had forced change in diet at certain times or had impacted on other oral health related activities.

Yeah, they’re not allowed it. If you put a chocolate bar in their lunchbox, they’re not allowed to eat it. (811)
When you've got the posters up and things like that and the parents see it, I think that's a bit shocking for them, posters and things. I think shock tactics do work. Even for myself, even though I've not really given him a lot, it was still like wow, such small things. (806)

This opinion given by parent 806 was not reiterated by other families who did not mention shock tactics. Change was often more associated with positive techniques and information. Literature on other public health strategies such as smoking cessation has not always shown shock tactics to be beneficial.

Uncertainty and motives in community prevention and referral practices

The second overarching theme concentrates on the prevention and impact on oral health both within the community and throughout dental practices. Preventative measures within dental practices were discussed by a number of those working in the area. Fluoride varnish was discussed in both a positive and negative light. Dentists acknowledge there was a lack of prevention and it was not widely practiced. However, others also questioned why fluoride varnish was being pushed and the inadequate use of the UDA (Unit of Dental Activity) System (the currency of the 2006 NHS Dental Contract in England) to encourage preventive treatments and therapies used.

There was further acknowledgement of inappropriate referrals for DGA and a lack of treatment prior to, and following on from, the referral. There was discussion that dentists, given the perceived difficulties of treating children, may refer on and, once this is done, feel that this child was no longer their responsibility. Parents also described a lack of treatment and management as a factor, particularly when returning to their own GDP for pain management while the child was proceeding through the GA pathway.

What would have been a far better strategy with these, is when they come in with a problem, you deal with the problem, would be also to fissure seal the teeth. That’s a one off thing and that’s the teeth, on average, sorted for five years. So, one strategy involves twenty applications of topical fluoride and the other strategy is a one off fissure seal, which has been shown to be more effective than…but why don’t they get us to do that? “Oh, we’d have to give you some UDAs for that”. And it’s unbelievable. The beauty of the UDA system is it would have been very easy to modify it, to encourage the behaviour they want. So if you want fissure sealing, if you
want topical fluoride, if you… also if you wanted a dentist to see the patients less often, there’s ways of doing it. You gave a UDA or a portion of a UDA for doing a particular thing, fissure sealing or what have you, guess what, it will happen. (Dentist 16)

The issue really is that I don't think there is a lot of prevention going on in primary care, so if you look at the number of potential of FP17 they deal with topical fluoride and despite the massive push that's gone from a huge two percent to a ginormous three percent (Dentist 2)

We now have evidence of a number of practices where paediatric care falls short of expectations and I think again with hindsight being aware that this was a possibility we should have put and had planned an action plan for once that poor performance was identified what exactly would be the sanctions and actions and that's sort of being developed as an after, but probably should have been part and parcel of the... So it was sort of nothing and then a referral for GA the first sign of a problem, where I would have expected to see proactive prevention monitoring and stabilising that may have prevented the episodes of pain and even when the episodes of pain did occur, there are things that can be done to relieve that that weren't being done and it seemed to me that some of the practices were very much making a decision to refer and then taking the philosophy - well it's off my desk, it's out of my surgery, that's someone else's problem. (Dentist 5)

To be honest he could've done miles more. I'm no dentist but I know that. And to me he's failed me massively and I will not be recommending him at all whatsoever and I will have his head on a poker, I really will! Because my child's going through unnecessary trauma because he's not done his job. (818)

So, yes, in an ideal world I’d like to wave my magic wand and make all those kids caries free, and then support the families through the Primary Care Services in continuing to keep the children caries free, because that, again, is the key, because if they have early decay, or if they have decay experience early on in life, that’s one of the strongest predictors that they’re going to have decay later on as well. (Dentist 3)

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1 Forms detailing dental activity showing patient charge, number of units of activity performed and treatment banding information
2 Dental contracts changed from Fee for Service, which had a variety of differently priced items for which dentists were paid, to Units of Dental Activity which includes three bands of treatment. These changes could mean a dentist would be charged
While areas of improvement were discussed, the positive aspects already being carried out within certain localities were acknowledged by Dentists. During the time of the research Great Manchester also introduced ‘Baby Teeth DO matter’ which was welcomed by dentists [18]

_Impressions of Manchester_ [18] (Fig. 1)

_In Manchester, ‘X’s (person) done a lot of good work, trying to push a preventative agenda. It’s largely driven by fluoride toothpaste and topical fluoride applications, now varnish (Dentist 16)._**

**Individual factors and issues to influence upstream actions**

As discussed, parents intimated that information provided at an earlier stage from health visitors, would have been beneficial. One parent identified the problem of using a baby bottle at night resulting in decay. This practice was stopped as soon as the dentist diagnosed caries and a referral was made. Such testimonies were reiterated by dentists with parents unaware of the damage certain drinks and feeding practices can do indicating an issue within health literacy and the ability to obtain this information.

_I think the main reason is that we kept him on a bottle too long and going to sleep at night so it wasn’t really about cleaning his teeth it was I think it was having the bottle at night and it wasn’t until we went to the dentist and he had holes in his teeth that we just stopped it there and then. So I think the holes are our fault (800)._**

_Most of my patients aren’t aware that drinks have such a major effect. Their diet’s like… ‘Oh but they eat this,’ and the diet could be all well and good, but their drinks, because they’re having it in their school packed lunches, and the Fruit Shoots, constantly, all the time, they’re just not aware. And then when you tell them, it’s like, ‘Oh, okay.’ (Dentist 7)._**

While health literacy appears to be a vital aspect to maintaining good oral health, it can be seen that changes to diet in particular are difficult to effectively implement and maintain. Parents consistently mentioned the issue of controlling foods such as sweets and difficulty in encouraging nutritional foods such as vegetables. This was exacerbated by early behaviour that contributed to poor oral health, that was now instilled in the child and difficult to change.

_He told him to not eat sweets, because the sugar level of sweets are very high. But_
you know how kids are. (920)

It would be easy; because I didn't give him vegetables when he was younger and I cannot give him now because he is refusing. He doesn't know them so...yes. I would like to give advice about that. (810)

The comment by dentist 7 in relation to parents being unaware of the impact of some drinks given to children was observed to a certain degree on two occasions by the researcher and recorded in field notes; where the behaviour discussed contradicted what was actually happening within their household at the time of the visit. One parent before the operation had discussed the use of juice within her baby bottle.

My dentist was quite rude with me actually, because obviously, he wasn't happy that I'd put juice in a bottle, but my other children had juice and they were fine. But he was sort of like saying that if she carried on to have a bottle, and juice in it, then he'd refuse treatment for her. At the end of the day, she's a child and they all have different ways of...it's a comfort. And it's like taking something off them and like a smoker, taking their cigarettes off them, do you know? (811)

Following the operation and a visit to the family the researcher noted the child came into the room with a bottle of juice, which the mother then attempted to hide. The mother's reaction would indicate she was aware of the effect of this behaviour in the context of dental health. In fact the mother discussed the consumption of juice in a bottle and suggested she thought she had changed this behaviour for the better

Yeah (now), she just has like very, very watered juice. It's virtually water but she has a tinge of juice in it. (811)

This is an interesting point as the shift in behaviour rather than complete behaviour change indicates an awareness of some degree of the potential impact. Behaviour change is a complicated and challenging area with a variety of reasons as to why behaviour change is or is not adopted. Additional issues discussed with this parent illustrates this point, because whilst she stated her other children had juice and sweets and not suffered dental health problems, she then went onto disclose that her older child had experienced extraction under GA and other siblings had also had teeth removed at various practices.
Another parent also did not seem to make the connection between the sugar in drinks and its effect on teeth. When asked about diet and advice given the parent stated:

‘He did explain, obviously, does she have lots of sugary things, does she have lots of cakes and biscuits, and sweets and things like that? No, because she’s hyper, as we well can see, I’ve not had sugary things in the house since she was about two and a half. (818) However at the time the child was drinking a large bottle of cola.

It is well accepted that even when parents seek to reduce sugar consumption, their efforts are often hindered by the so called “hidden sugars” or those sugars that appear naturally or in foods traditionally considered as healthy and “good choices”; for example fruit juices.

**Challenges with routines and independence**

Parents discussed a variety of challenges around maintaining routine, which could impact on regularly attending dentist or routines relating to maintaining oral health daily, such as brushing. There were indications that reminders from dentist and other support structures could help support a regular routine. Additionally, parents discussed the difficulty in maintaining oral hygiene as children gained independence and attempted carry out oral hygiene on their own. All of these combine to illustrate the difficulties in juggling busy lives and managing to adhere to practices that maintain good oral health.

*Ah you know what I don’t really know what day it is half the time with working night time so I have no idea, time passes me by in a blink of an eye - could have been last week could have been a month ago, could have been months (326)*

*I wasn’t aware dentists didn’t give a call to give you reminder if you cancel them so I kind of as well as working and everything I had kind of thought to myself I’ll just wait for it to come through so it was kind of my fault as well that we hadn’t been in over 12 months (806)*

*I do have to fight with...my oldest two now, they’ve got to the stage where they’re fine, they’ll just go and do it, but I’m still fighting with the others at the minute. Well my ten year old, she’s sort of half and half at the minute. So yeah, I’d probably say about ten, eleven, then they get used to it and…but up until then, no, I think you’ve got to supervise them. (811)*

Dentists also commented that parents often attributed the problems of maintaining a healthy diet or oral hygiene to their children (or other members of the family) and had to
reiterate the carer’s role in controlling the environment around their child and their own actions in creating an environment where optimal oral health can be maintained.

“He’s always sweets, he doesn’t stop” and I say, “right, who’s buying them?” and that’s what makes me - they blame the children. "Do you brush their teeth before they go to bed?", "no, we don’t, they don’t let us", "what do you mean? You’re the parents. What do you mean they don’t let you?". It’s just that basic level. (Dentist 17)

Anxiety and fear of the dentists being passed from parent to child

Whilst anxiety can be a factor in a reason DGA referral, it also is associated with irregular dental attendance. Dentists and parents discussed the issue of parents’ anxiety and how this could impact on or be passed onto children. Parent 259 demonstrated this within a conversation with her child, where she flipped from discussing a fear of the dentist, then attempting to put the dentist in a positive light before finally reverting back to ‘not being sure about the dentist’.

I’m not a great fan of the dentist, I try not to project it onto both of them but (to child) the dentist is great isn’t he? (Child - shakes head - no). No! (laughter) (inaudible). No.. No I’m not sure about our dentist... To be quite honest... (259)

Don’t be scared,’ they tell them as they walk in. We haven’t done anything yet, there’s nothing to be scared of, but they’ve already planted that in their brain, and the kid’s already… ‘If you don’t sit there, the dentist is going to take out all of your teeth!’ A lot of parents say that, and it’s just…oh gosh, here we go.’ (Dentist 7)

It’s very difficult because you can’t…in the past you could bluntly tell the parent to leave. It’s hard to do that these days because of…there’s child safeguarding issues and things like that. In a way you have to have the parent, or a parent with you, and it’s very difficult; you end up managing both at the same time (Dentist 2)

Positive behaviour change

Parents and children involved in the interviews discussed techniques, information and instances, which they believed either helped change their behaviour or if implemented early, would have helped negate the need for DGA. Firstly, on basic level, parents discussed the information they were provided with at the hospital, either at triage or another opportunity, and how well this addressed their diet and ways of improving oral hygiene. Most welcomed this information. Following referral and extraction under GA
parents discussed changing shopping habits to try and restrict sugar intake and brushing habits so parents were with their child when they brushed their teeth. They were appreciative of techniques that helped instigate these new behaviours such as plaque disclosing tablets.

*We cut down, we looked at his diet; we did a little diary for the diet. (break) Also we had a separate appointment to learn how to brush his teeth properly and just to look at what we were doing.* (648)

*We are now taking care, because he’s getting the other teeth now, very fast and that’s we have stopped with the fizzy drinks and sugars and all these things, yeah.* (920)

*(After GA) it is a fight trying to make her brush her teeth. I’m trying to make it fun now, so I’ll do it with her as well.* (818)

*And then, she’s given her these purple plaque detector things, that you put in your mouth, it’s basically like a food colouring, and she’s to put them in her mouth before she’s brushing her teeth, and she said to do it at the night time not in the morning, just in case you get blue lips! And basically you can see where the fresh plaque is and where the old plaque is. The old plaque sits at a darker colour, and the fresh plaque sits at like a purple, pinky, kind of colour. And you can see…it’s like a guide basically, so you can work on the areas that you’ve not been cleaning properly. And she loves it.* (818)

*The shopping. Even, you know, at home, when I’m giving him cereal he has to put sugar on it. (break) His dentist told me, this is about the sweet, I have to stop it. Now, I made one day. Only Friday.* (918)

As discussed in the subtheme which was based around ‘public health’, parents also were confused about some of the messages being given. This included the use of ‘toddler’ or ‘child’ toothpaste which was now understood to be detrimental to their young child’s oral health as it did not contain the recommended level of fluoride. However at the time they thought they were doing the right thing. This has also been reiterated with other areas such as juices where parents believe these will be good for their child (and in certain circumstances they are). However the message can become confused and distorted meaning only very simple messages that are now being advocated should be utilised
such as only water or milk in the baby bottle.

“I thought these were okay, were healthy. I thought a yoghurt was okay because it was healthy. I thought orange juice was okay because it’s healthy. I thought apple juice was okay because it’s healthy”. (16)

Parents also thought the experience may impact on sibling’s behaviour although again this was putting the onus on the child rather than themselves

Its hard to tell these days as they put themselves to bed these days with everything I mean they go up go to the loo clean their teeth and everything. But I guess probably (younger child) as well is a little bit more nervous about it now as he has seen what’s being pulled out of (old child’s) jaw (326)

Overall it can be observed a central aspect within the data is the concept of responsibility and blame. A general cycle emerges (illustrated in Figure 8.1), with parents citing a failure by the dentists in relation to caring and treating their child. While dentists perceive a difficultly in changing parental behaviours. The subtext throughout a number of conversations indicates parents feel this blame and responsibility acutely, as it focuses on judging them as a parent. Both parties also state a lack of upstream interventions from the government and public health that are desperately needed to make an impact in this area.

Figure 8.1: A Cycle of Responsibility and Blame
Discussion

Parents and children were interviewed when possible both before and after the DGA experience, not only to explore their understanding of what would occur before the operation and the consequent impact following extraction, but also to assess if any behaviour change had been instigated or attitude had changed towards oral health as a whole. Through interviews this did not seem to be the case with most parents and children discussing changes following referral and that this was enough to make people reconsider actions and consequences, whether it be their own or an external factor such as their dentist and the treatment and prevention administered at their practice.

One theme that emerged through both interviews and field notes was participants’ contradiction between their intended actions with either past behaviour or behaviour observed at the time of the interview. One parent in discussing a health behaviour, which had potentially contributed to her child’s severe caries and consequent extraction under GA (participant 811), likened taking away the child’s juice to that of taking cigarettes from a smoker. This analogy was interesting as it shows the concern parents have in depriving their child of something rather than preventing health problems. This is particularly in relation to sweets and chocolates that they may see other parents allow their children. This particular parent went on to discuss the change in behaviour they perceived had been implemented by watering down the juice. It is also apropos that the parent likened this behaviour to smoking as these tweaks or shifts in behaviour change rather than completely changing behaviour can be seen in other risky health behaviours such as smoking during pregnancy [19]. It was observed in one systematic review looking at qualitative studies of smoking in pregnancy that some mothers attempted to reduce smoking as a way of reducing the risk, viewing this as a positive change (as an alternative to quitting) and that there might be an implicit threshold where smoking is ‘safe’, [20] despite general guidance to quit rather than cut down [21].

Participant 811 along with expressing the wish to not deprive their child of juice or equivalent had also discussed the dentist’s rudeness towards her in trying to instil a change in what her child consumes. While the dentist had tried to change the behaviour they believed was an integral part of the caries experience and subsequent need for DGA, this message did not lead to a complete behaviour change. This could have been for a number of reasons but one of the considerations mentioned by the parent was the rudeness of the dentist. Research has indicated that health care professionals who are
overly imposing can have a weaker impact than those who take a ‘softer’ approach when looking at behaviour change [17].

One participant mentioned shock tactics and fear in media such as posters to change behaviour. However they were the only participant to do so and this could be seen as a deviant case as they had opposing views to the majority of the group. While fear or shock tactics are still used within health promotion and interventions, research has shown fear alone has little effect on behaviour and it is only when they are combined with other behavioural techniques such as an action plan that the likelihood of a change in behaviour increases [22, 23].

The overwhelming theme throughout participant discussions was the lack of upstream interventions coming from a public health or community perspective, which could benefit the area of child oral health and subsequent need for DGA. Throughout discussions the need to tackle oral health during the early years of a child’s life was noted as key by both dentists and parents. Both suggested that by the time a child first saw the dentist it was often too late as either parents did not realise they should have visited early or felt they were not given the right information. Therefore this would suggest that for these children the dental practice might not be the primary area to make a difference. Parents suggested that support could be made available via additional facilities, for example, Sure Start centres and nurseries, through health visitors and at GP practices. In this way dentists and oral health teams would need to engage with other health professionals to develop partnerships to promote oral health strategies and make sure a clear and simple message is given. This also fits into the idea of making every contact count which is a vital component to consistent messages given. This has begun throughout Greater Manchester with ‘Baby Teeth DO Matter’ with a simple message being given but where dentists were given ownership over services and how these messages were translated to young children. In many circumstances dentists made contacts with Sure Start centres and nurseries and even some made contact with local media [18].

Additionally, through parents’ responses and some observed behaviour, it was apparent that while participants wished to present themselves as good and responsible parents who were concerned about their child’s health, often the reality of day to day life made this ‘good’ health behaviour difficult to adhere to. Therefore looking at what could be considered ‘victim blaming’ and tackling purely the parents or guardians on an individual level would not always be beneficial. Instead this is an area where public health and policy need to play a part. One element of behaviour change when looking at policy is to create
environments which allow or control situations or provide certain regulations or fiscal changes which would encourage or make certain behaviours easier [24]. Interventions that have looked to change behaviours related to dental health such as childhood obesity have used a number of policy related methods to improve health. One study looked at a combination of a public health and family centred approaches by improving the health literacy of parents and performance of health professionals in their current practice [25]. Another study which observed a policy change on school nutrition, involved restricting certain foods within a school setting and showed a positive impact on childhood obesity [26]. This along with other similar studies have shown these types of multi-level interventions, both from a public and tailored approach, can be successful in changing child health whether it be obesity [27] or dental health [28].

Many of these ideas are reflected in the Childsmile project currently implemented in Scotland that was mentioned by a number of those in the dental profession. The Childsmile project includes [29]:

- Universal distribution of toothpaste and toothbrushes
- Supervised tooth brushing programme through nursery schools
- Community fluoride varnish programme
- Changing the dental contract to a more prevention focused care
- Registering children from birth through referrals from health visitors

Although the aspect of registering children from birth assumes compliance on the part of parents it resonates well with the themes established in this paper as this removes the barriers associated with finding a dentist and supports parents from the beginning with dental health. Additionally, community fluoride varnish programmes and changing the contract to promote preventative care rather than treatment when things have progressed too far were also strongly voiced by the participants in this study. Both initiatives were considered to have the potential for change from a dental perspective.

**Conclusion**

The ideas in this paper bring together Marmot’s ‘Proportional Universalism’ which tackles health issues in a universal sense but with a greater intensity in proportion to the level of need i.e. those who are most deprived. [13]. This could be seen through a combination of both ‘universal’ and then more ‘targeted interventions’ ‘Universal’ interventions can include looking at oral health supported via health visitors registering children with the dentist
within their first year and making specific connections with Sure Start centres and nurseries to get a simple and consistent message across. This does not need to be just within oral health but under the common risk factor approach incorporate health related behaviours around diet, exercise, etc.

Targeted interventions with this particular group could look at carrying on a more consistent message and support within the community in groups where the need is most apparent. Certainly some messages still appear to be mixed or not completely understood with parents not associating fizzy drinks with sugar and issues with oral health and the importance of keeping primary teeth caries free. Initiatives could include positive sessions with families to discuss diet and oral health or through more direct distribution of information and supportive techniques such as oral health kits, plaque display tablets, toothbrush timers etc. Such interventions could take place both before and after the operation with additional preventative support using treatments such as fissure sealants [30] or fluoride varnish [31].
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Chapter 9

A Tale of Two Pathways: An Evaluation and Qualitative Exploration of Child Dental Referrals Treated along Two Distinct Pathways
**Foundation and Summary of Chapter 9**

While Chapter 8 focused on the individuals perspective of potential interventions that could reduce the need for Dental General Anaesthetic (DGA) extractions i.e. behavioural change techniques, various community services or interventions which may impact. Chapter 9 explores DGA extraction from the perspective of the various services offered to treat children with severe decay. This occurred as while the research was being conducted a new triage and treatment pathway was piloted in Greater Manchester. This involved a primary care facility assessing and potentially treating children initially referred from their own dentist into secondary care, possibly for a GA extraction. It was hypothesised a number of children could be seen and treated through this alternative pathway.

In order to determine if this facility was able to treat any of the children referred a service evaluation was conducted. At a similar time a service evaluation of a traditional GA pathway was also conducted and presented here as a reference. It should be noted, however, the two service evaluations cannot be used as a direct comparison as one might in an RCT. Along with the service evaluation qualitative interviews were conducted with parents, referring dentist and operating dentists through both pathways recognising the opinions and perceptions of those involved. The interviews also allowed a greater understanding of the impacts on patients, which a normal service evaluation or trial could not provide.

While this is not a direct comparison between one service and another it does provide an insight into the usefulness of an alternative pathway and its potential impact on patients. This chapter highlights the potential difference a change in service provision could have on the number of DGA extractions carried out each year.

**Authors Contributions**
Anonymised data were provided by dental teams. MG recruited participants for qualitative interviews and then conducted the analysis, interpretation and manuscript. IAP and CS contributed to the protocol, manuscript and supported analysis and interpretation.
Abstract

Background
Presently, there is a considerable wait for children for Dental General Anaesthetic (DGA) extraction throughout certain areas of the North West of England. One region piloted an alternative pathway to relieve the wait list and ascertain if any children referred could be treated within a primary care setting.

Methods
This evaluation looked at patients referred along two specific pathways for dental treatment. The first involved a more 'traditional route' for those referred for an extraction into secondary care utilising General Anaesthetic (GA) for extraction. The second trialled an alternative pathway, which endeavoured to treat children in a primary care rather than secondary care setting. This evaluation was supported by qualitative interviews involving; parents, referring dentists and those providing services throughout both pathways.

Results
While the majority of case notes provided basic details, there was a lack of previous dental history, adequate explanation of the reason for referral and what procedures had already been attempted. There was also strong evidence of a difference in treatment plan between the referring Dentists and Dentists who triaged the patients. In the traditional GA pathway, this was specifically in regards to primary teeth requested for extraction and planned for extraction by the surgeon, with more teeth extracted than requested (z = 4.621, p = 0.00002, r = -0.32. Median = 4 and 3 respectively).

Conclusion
It is clear for certain patients GA extraction is a valuable and important service. However it should be employed only as a last resort and there is a lack of evidence demonstrating that dentists are attempting alternatives before referring. These data highlight the importance of a pre assessment system in order for both parents and children to understand the options and for appropriate provision of a service made with all relevant information. This work indicates an interface service between referring dentists and GA extraction could be useful for reducing the numbers referred into the GA system and validating the need for a GA treatment.
Introduction

Despite the notable improvement in oral health following the introduction of widespread fluoride toothpaste use over 30 years ago [1] England and particularly the North West still has a significant problem in relation to caries in young children [2]. When decay is advanced one option is to extract the teeth under a general anaesthetic. A recent survey from the Dental Health Observatory confirmed throughout 2008/2009 over 15,000 children in the North West were admitted to hospital for an extraction [3]. Extractions for carious teeth carried out within hospitals have risen dramatically over the past 10 years. From 1997 to 2006 extractions in hospitals increased by 66% [4], particularly since 2002, when policy restricted the use of General Anaesthetic (GA) to hospital only settings [5, 6]. More recently data from HSCIC (Heath and Social Care Information Centre) has shown an increase in the last 4 years (2010 to 2014) for children referred to hospital for caries [7].

There are a number of reasons associated with the decision to refer children for an extraction under GA, including; the number of teeth that need to be extracted, acute pain experienced, the age of the child or the behaviour i.e. anxiety or needs of the child [8]. Previous studies have indicated the majority of Dental General Anaesthetics (DGA) are primarily for caries with studies showing this figure is as high as 94% [8, 9]. While these studies looked primarily if caries were the reason for referral reasons given by dentists were further broken down and incorporated oral conditions that come under the PUFA index such as acute abscesses [8, 10]. Earlier studies have indicated a high number of referrals can be considered inappropriate for GA extraction given a lack of adherence to GDC guidelines and also poor correlation between service requested and treatment plans determined by the surgeon, one specific study showed only an 18% correlation which involved either correct teeth requested for extraction under GA or IHS for restorative treatment and extraction [11]. It is important that referring dentists produce a full, detailed rationale for the referral of a child for GA extraction and to have exhausted other treatment alternatives.

Presently there is considerable waiting time for GA across North West's hospitals, at times up to 9 months [12]. This is partly as a result of the high numbers being referred, and that limited operations can be carried out per session due to restrictions on hospital bed space and time of other members of staff needed (such as the Anaesthetists) [13]. In order to alleviate this pressure and to assess if other methods could be used to treat certain patients in a Primary Care setting, a new triage and treatment pathway was proposed and piloted at a primary care facility in an area of the North West of England.
**Aim**

A service evaluation was conducted to understand the number of children who were effectively treated in each setting and the populations involved. This was supported by qualitative interviews with patients, dentists and key stakeholders involved to understand their views and experiences of the services. It is important to recognise the experience of both patients and key players involved in delivering child dental treatment and referral to help understand if pathways are appropriate. Additionally, the impact on patients and potential problems and benefits of both pathways can be explored not only from the perspective of those who proceed through the pathway but also those who carry out and commission the services. It is important to note that the authors are not advocating one treatment route over another, nor denying the need for a GA service. Rather, this service evaluation of both pathways assesses the extent to which the pilot scheme facilitated treatment for children, whether that resulted in treatment either restoration or extraction within primary care or if they still required treatment under GA.

**Method**

This evaluation was based on a mixed methods sequential explanatory design, where quantitative data is followed by qualitative [14]. Firstly, a case series descriptive service evaluation was undertaken at facilities in the North West of England. Pathway 1, Primary Care (PC), piloted an alternative care pathway for children, referred for secondary care extractions. Pathway 2, Secondary Care (SC) utilised a traditional GA pathway for children referred for secondary care extractions. Subsequently, parents/guardians of children referred along both pathways were invited to take part in a qualitative interview at pre operative assessments or dental appointments. Interested parents were interviewed individually either over the telephone or at a convenient location such as their home. Additionally, referring dentists, or those who worked within either pathway, were interviewed in order to discuss the process of referrals and their opinions on both GA extraction and the alternate pathway.

**Sample size**

A sample size calculation for the service evaluation was conducted to ensure a representative sample was obtained, based on information gained from Hospital Episode Statistics (HES) and using a ratio of 50:50 (which would provide the largest minimum
sample size) within 10% points of the true population and a 95% confidence level gave a recommended sample size of 96 cases per pathway. As is common in qualitative research this study aimed to achieve a varied sample (i.e. children of different ages and treatment provided) in each group, and to continue recruitment to a point of ‘saturation’ whereby analysis of no new information was being elicited from interviews [15]. This was not possible for both Consultants and GDPs involved in the alternate pathway given the limited number contributing to this area. In total 15 parents and 11 dentists were interviewed (See Table 3.5 and 3.6 for details). There are further details of the sample in Chapter 3 and Chapter 5.

Type of analyses
Descriptive statistics were utilised for data collected during the service evaluation in order to gain an understanding of the population referred and nature of referrals. Given that data violated a number of assumptions needed for parametric tests, non-parametric analyses was utilised when appropriate.

Qualitative interviews were analysed using a qualitative thematic approach drawing on some of the techniques associated with grounded theory, including constant comparison to elicit common themes. This allowed an exploration of the views and experiences of both dentists and parents regarding services, treatment delivered, positives and negatives and impact on children to be elucidated.

The use of a mixed methods design allows quantitative data and subsequent analyses to provide a general understanding of the area being researched. Qualitative analysis is able to explain potential differences, explore participants views and contribute to a deeper understanding of the situation [14, 16].

The service evaluation aspect of this work did not require ethical approval, however as interviews were undertaken with parents and dentists ethical approval was obtained for this section from the NRES Committee North West Preston (11/NW/0503) and all participants gave written informed consent before taking part (copies of these are available in Supplemental File in Appendix 12.3.4).

Results

Quantitative results
Descriptive statistics of data from the service evaluation revealed information provided in referral forms were relatively similar between the different pathways with GDPs providing information on medical history, infection, anxiety and basic demographics (Table 9.1). However when looking at patients referred, the IMD for Pathway 1 was 49.56 with a 95% CI of 46.36 to 52.75, while for Pathway 2 referred patients had an average IMD of 25.57 (95% CI 22.34-28.60) meaning those through pathway 1 had an IMD score twice as high according to the scale.

Figure 9.1 illustrates what actually happened to the patients who were referred through each pathway. In Pathway 1 (Primary Care), 22% were referred on for GA; however, of these, 27% had some treatment at the Primary Care facility involving restoration or prevention to save some of the permanent teeth. If ‘pathway 1 children’ could be treated, this usually took the form of restoration. Consequently, there were a higher median number of primary teeth (3) requested for extraction compared to actually extracted (1.5) at the primary care facility (Table 9.2). For Pathway 2, the traditional GA route, the majority of patients went on to receive a GA extraction (89%). Also, significantly the operating dentist listed more primary teeth for extraction, while there were no significant differences seen between the referring dentist and surgeon in the number of permanent teeth that should be extracted (Table 9.2).

For those referred under the Pathway 1 (PC) the average time a patient had to wait from their referral letter to the end of treatment was on average 21 days (2-89). While those referred under the traditional GA route (Pathway 2 SC) who required an operation in a hospital environment the wait was on average 109 days (2-203) (Table 9.1).

Qualitative results
Qualitative analysis for this paper focused on the descriptions of both pathways from the perspective of patients and dentists involved. The main overall themes that were developed from the entire analysis are reported in Chapter 5 and 8 for the purposes of this paper, the positives and negatives of each pathway through dental treatment have been extracted. Participants are coded as: Parent, GA (those parents whose children had received treatment through the GA pathway), Parent PC (those parents whose children had received treatment through the pathway in Primary Care), Referrer (for dentists who have referred out of their practice) and Provider (for dentists who are treating referred children)

**Positives of Pathway 2 SC (GA):**
Participants, in a number of ways, discussed the positive aspects of general anaesthesia for paediatric dental extraction. One element echoed by both dentists and parents was the desire to distance their regular provider from treatment that might induce anxiety or distress in their child. If this were achieved they believed it could avoid issues with regular and successful dental treatment in the future.

*Because it’s quite beneficial from our side because we’re the nice guys, and then we send you to that place to have teeth out and then you come back to us and it’s all alright (Referrer, Dentist 6).*

*Well having it under local - he doesn’t like injections so having local anaesthetic stuck in your gums is quite uncomfortable even for me so that would deter him from going to the dentist in the future (SC; Parent 800).*

*Yes it was he (own GDP) didn’t want them to be, he said he had children the same age as XXX and XXX despite being a dentist he knew how they felt about going so that way he would rather not do it there (SC; Parent 259).*

After the operation parents expressed their relief at the effective outcome of the treatment. This was not just due to the cessation of pain but also being able to take part in essential everyday activities such as eating food, sleeping and attending school without restriction.

*But she’s actually been better, she’s not choking as much on her food for some reason, so it must have been the pain in her teeth that was making her swallow. (parent discussing child following the operation) No, she’s got no pain with it (SC; Parent 811).*

*His first question was ‘how am I going to eat now I’ve only got gums’. But he’s managing fine. (SC; Parent 806)*

An important factor for both referring and operating dentists is to return a child to a caries free state in order for effective prevention to be introduced. This is also an issue reiterated by parents where severe dental decay was affecting their ability to carry out every day oral health behaviour such as tooth brushing.

*One of the things I try and say to the parents that if there are any other carious teeth*
then we get rid of them all of those and you start from base again and hopefully the prevention will then kick in from that and so we don’t get repeat episodes (Provider, Dentist 1).

(Discussing ability to brush child’s teeth) and then this tooth with the enamel, where it didn’t have any and it started to decay, she lost interest, because of the pain (SC; Parent 810).

Negatives of Pathway 2 SC (GA):

Some parents did indicate the GA could have a negative effect on their child, inducing future anxiety and connecting this to their view of the dentist. However it was often the parents of younger children who disclosed this worry and was in part connected to the fact they had not discussed what was going to happen with their child for fear of upsetting them before the operation. This was also witnessed by the researcher (MG) within the hospital setting, where children who were unaware of what they were going in for became very distressed at waking up following dental extraction.

I think he will associate that, because he had no idea what was going to happen, he just woke up and there was blood everywhere and there were teeth missing, so I think when he came…when he goes back now to the dentist, he will ask himself, what’s she going to do? Is she going to make me bleed again? (SC; Parent 810)

The prolonged wait for GA throughout some hospitals resulted in additional pain and infection and was mentioned by a number of parents as an issue with the GA service. However it should be noted for some parents being aware of a potential extensive wait mitigated the stress and anxiety towards this issue.

We went back to the dentist because it was a long wait process and there was no surgery in sight, he says he’s now got a buccal abscess, he’s been complaining he’s got a bit of gum soreness (SC; Parent 800).

To be honest it’s been quite quick, a lot quicker than I was expecting to be totally honest... when I got the letter through the other day, 23rd, I was like oh! Oh, hello! Okay, that'll do! It was like surprise! (SC; Parent 818)

Wait times could be exacerbated by inappropriate referrals taking up triaging and
operating time. There are a variety of reasons for inappropriate referrals touched upon by operating and referring dentists in their discussions. This ranged from time restrictions and perceived inadequate payment for treating children (dentists stated children can be more complex to treat than adults i.e. pre-cooperative and changeable behaviour) and a lack of alternative options. Referrals could also be misleading with incorrectly charted teeth and information presented.

On the referral form all deciduous teeth should be noted in capital letters, a lot of them still don’t do that and you can get quite a lot of confusion of course there have been cases into the past where wrong teeth have been extracted - so things could be clearer (Provider, Dentist 1)

And the issue really is that we are using the same currency i.e. UDAs, but the GDP is not happy to treat under... there needs to be some complexity (in) payment in terms of maybe per quadrant or per two quadrants, that needs to be recognised somewhere. (Provider, Dentist 13)

… it can be that the easiest option is to just refer them for a GA (Dentist 1)

the problem has been very long waiting lists, but certainly having better gas and air RA facilities would reduce the number of GAs, so I suppose that would be one thing you can put in, if…perhaps if relative analgesia was a bit more sort of readily available. (Referrer, Dentist 16)

Positives of Pathway 1 PC:

The primary care pathway was established to attempt to treat children originally referred into secondary care, within a primary care setting. As with the GA pathway both parents and dentists described a number of positive and negative aspects. Dentists acknowledge a gap in service delivery, with no intermediate provision available to treat young children, only treatment through the GDP or referral onto GA. This is particularly important in relation to behavioural factors such as anxiety. GA is only a temporary solution if children are phobic and unable to receive treatment conventionally. Consequently this issue may reoccur if the underlying reasons are not tackled. Paradoxically when asked specifically about an alternative pathway through primary care most dentists were apprehensive (this is addressed in the negatives of a primary care pathway).
The elephant in the room is, there’s a gap between, in terms of managing anxiety, there’s just been a kind of care in Dentists which is it’s lowest level but quite effective, then there’s all the drugs and stuff like that, and I think in between the onus is like cognitive behavioural therapy, things like that, which it doesn’t happen at all, and I think actually having an effective service like that is better for the patient in the long term, because even if they do go down the GA route, you just basically leave them dependent on medication to have treatment done which you should be able to do routinely. Whereas something more psychological orientated, for the lifetime of the patient, would be beneficial I think (Referrer, Dentist 6).

Parents were interviewed at various intervals throughout the treatment of their child. Some had attended only one session others had attended several. All of those who were interviewed were positive about the outcome of their child's treatment even though some acknowledged they might have had to return for more than one session to correct the dental problem. They also discussed that although pain and infection may not have been alleviated immediately this did occur within a timely fashion.

R: It's fine. There's no pain, no complaining any more.
I: Was that after the first treatment, or did it take ...
R: The second, maybe. (PC; Parent 901)

Yeah, hopefully it will settle. But he finishes his antibiotics today, so really it should've completely gone, but it's not... Yeah, just to let you know. I think it's brilliant. I mean his appointment wasn't supposed to be till...I think it was three weeks away, his next appointment, and they've brought it forward to today. We'd only waited a week. (PC; Parent 912)

Parents also expressed relief that their child's teeth did not need to be extracted. The dentists who performed treatment also mentioned preventing extraction of teeth was a positive aspect of the service.

Well, I was a bit worried maybe they were going to put [her under] anaesthetic or pull anything out. I was quite happy when they said, 'No, no. We can just do that [restoration] (PC; Parent 901)
Yeah but then you do get some that are referred in for that and then are relieved when we say actually we can save these teeth, they are happy that, you know, they are not going to have to have that done. (Provider, Dentist 14)

Negatives of Pathway 1 PC:

While parents and patients did not discuss specific negative aspects in regards the primary care pathway, a variety of dentists both referring and working within the GA pathway described a range opinions from apprehension to frustration at patients being treated this way. These included those who had referred children and felt that a referral had been made in the best interest of the patient and therefore providing treatment in primary care called into question their ability as a dentist. Others who were concerned about the ability to treat children effectively through an primary care pathway, which could ultimately result in a patient returning in pain for a GA a short time later.

To be fair it’s not something that… it’s a light decision. I mean, it’s not like, ‘Oh he’s got a hole, let’s do a GA!’ It’s never like that, it’s always prevention, prevention, prevention… recurrent pain, then come back (Referrer, Dentist 7)

If I referred someone for eight extractions because they’ve got carious teeth at eight and poor compliance and poor oral hygiene and I’ve done my assessments and I feel that this patient is just better off getting them all removed at the one time because they’re in pain and they might end up at (primary care pathway) and they’ve had some pulpal treatment on one tooth and some fluoride varnish for the others and a few months down the line I’m getting the patient back in my chair, in my surgery, with another abscess on the other tooth (Referrer, Dentist 17)

Initially I have quite a lot of anxiety about this service, just from the point of view of introducing unnecessary delays, and children not finding their way appropriately through the system when they were in pain (Provider, Dentist 3)

Similarities between secondary care and primary care pathway:

Interestingly all parents irrespective of what route their child progressed along (PC or SC route) believed this was the best option for their child. Those who had undergone GA through secondary care described this as the only way treatment could have been
administered or that they would have been worried if another option had been attempted

SC pathway:

No, no I wouldn't have been comfortable with the local at all - the general was better with not understanding what is going on even though he is four he has got a good understanding but not enough to understand what that means to have them out (SC; Parent 806)

No I think he's fine with it and I wanted to keep it that way - I didn't want him stuck in a chair with someone with a foot up against his head tugging at his teeth with a pair of pliers while he was conscious (SC; Parent 326)

PC pathway:

I mean if he would've needed general anaesthetic then he would've needed it, but I wasn't very happy with him… I didn't really want him to have it, but you know, if he needed it he needed it. (PC; Parent 912)

One particular parent had already had one child experience a DGA and reflected on the GA process through secondary care compared to the primary care pathway. In this instance this parent hoped they could treat her sons baby teeth and that eventually they would exfoliate naturally.

I think, you know, when they put injection, and the baby go to sleep, my heart was like...I felt my son is dying. The way he go to sleep. So, maybe, if he got treatment, and the tooth, at the end of the day, all the baby teeth will fall off (out), isn't it? (PC; Parent 918)

Another similar aspect between pathways was the parent’s reaction to the treatment experience compared with their own dentist. Many commented on how both the alternative pathway and GA treatment were much more child friendly, with dentists speaking to the children directly and engaging at a level they could understand which had not happened with their referring dentist

PC pathway:

The difference in him from his old practice to coming here is unbelievable, you wouldn't believe it. He's so relaxed when he's here and when he's at his old dentist
"he's very agitated and gets dead upset (PC; Parent 912)

SC Pathway:
He made her balloon stuff out of a glove and stuff. And he was really good with her at the XX (hospital). Because our dentist, you see, it's just a case of like, well get on the chair and open your mouth, and...No, she wasn't a fan of our dentist anyway (SC; Parent 811)

Many dentists discussed the difference in treating children compared to adults with children being a more complex requiring additional time, techniques and energy. This was mentioned previously by a dentist when discussing payment under UDA and is articulated below by one of the operating dentists.

In a child, you can’t really take that approach because you’re dealing with a young, developing, growing being, that may or, depending on age and home circumstances, may or may not be at the stage where they are actually able to cope with dental treatment, whether it be simple or even complex, so paediatric dentistry sets itself apart from the rest of dentistry (Provider, Dentist 3)

Discussion

This article explores data gained from a service evaluation of two separate paediatric dental referral pathways alongside qualitative interviews with patients, their families and key players within the two services provided. While this analysis cannot describe the long-term affects of these services it does provide an indication of the potential impact.

Modification of treatment plans
The data collected from referral notes provided strong evidence suggesting a difference in treatment plan in both pathways, particularly regarding the extraction of primary teeth between the referring dentist and operating dentist. While both pathways differed in the number of teeth that were requested compared to those actually extracted, the outcome was reversed with Pathway 1 (PC) resulting in fewer extractions and Pathway 2 (SC) using GA resulting in more extractions. Specifically for those who progressed through Pathway 2 (SC), there was a change in treatment plan in 30% of cases (a 28% increase in number of teeth extracted). This corresponds to previous studies where a pre general anaesthetic assessment resulted in a change of treatment plan for 35% of patients [17]. This observed change could be for a number of reasons, the most probable is the
surgeon had decided to remove any teeth they deemed were of poor prognosis and may require extraction in the future. Previous research has emphasised a need for this 'radical' treatment in order to avoid potential repeat GA's [18]. This treatment approach was also described by operating dentists interviewed as part of this research with one stating 'if there are any other carious teeth then we get rid of them all of those and you start from base again' (Dentist 1). Conversely, within Pathway 1 (PC) and specifically looking at the treatment provided within the primary care facility the number of primary teeth actually extracted decreased compared to those requested by the referring dentist, with the majority of patients receiving restorative work.

The differences in treatment along these two pathways are perhaps not unexpected when considering the different paradigms used when deciding on a treatment plan. As mentioned previously to avoid repeat GA, treatment may be more aggressive [18]. However given the alternative pathway involved mainly restoration the need to avoid repeat appointments was less stringent and was possibly preferable as treatment became more complicated. Almost a third of patients came back for a second treatment within a short space of time for restorative treatment or extraction under LA. It is also possible that extreme cases that were identified may have been sent through to the GA pathway bypassing the alternate pathway if appropriate.

**Treatment and outcomes**

While parents acknowledged the outcome of the DGA was positive, as their child was now pain free and could continue with day to day activities, many did reflect on the distress it not only caused their child but also themselves. Previous research has shown a large majority of children experience morbidity following dental extraction under GA with one study reporting 92% children complaining of one or more symptoms detailed [19]. This is an important factor as research has shown negative interaction at an early state in life with a dentists and dental anxiety can have an impact on future dental attendance and oral health [20, 21].

It should be noted that often for those who were already proceeding through secondary care utilising GA any discussions of alternative modes of treatment were met with either uncertainty or opposition from parents. This is an interesting finding and can be looked at from two different ways. Firstly It is important for the patient (or carer) to have a level of autonomy and be able to have input into treatment decisions [22] and it is therefore positive that parents felt the treatment being performed was appropriate. Conversely it is important that services provided are needs rather than demand led. This ties into
Maxwell's [23] six dimensions of quality in relation to service design where relevance, effectiveness and accessibility, amongst others, are important aspects of a quality framework within health care. It is postulated that in the case of children being referred for GA extraction, given that treatment can be distressing and has a rare but extremely serious risk of mortality, once the decision to proceed through the GA route has been made it may seem logical from a parent’s position to consider this the only option. This could also be linked to parents feelings of responsibility given children’s caries severity is linked with parents feeling of guilt [24]. Additionally, studies have disclosed not only the guilt parents feel in relation to their child’s GA experience but also parents belief this treatment was now the only option [15].

**Wait times**

Wait time was seen to vary between the two pathways with a wait for GA on average 5 times longer than through the alternative pathway. This was actually described by one of the consultants as a reason for the introduction of the alternative pathway, to alleviate the GA list and bring down the wait times by managing some patients outside of the GA service. While some parents reflected on the difficulty a prolonged wait had caused, potentially contributing to additional pain and infection, the end result of the GA was an almost immediate positive outcome. It allowed children to eat, sleep and resume oral hygiene behaviour such as brushing which may have been affected due to the pain experienced. Parent's in other studies have often reported positive outcomes following their child's DGA and improvements in their child's oral health behaviour [15, 25]

In contrast the alternative pathway allowed patients to be seen in a more timely fashion, however the treatment effect may not have been as instantaneous as extraction under GA. A third of parents and children often had to return for more than one treatment. However again parents who were interviewed did not see this as a significant burden and were happy an improvement was seen while being able to save their child’s teeth. Some parents saw GA as the only viable option for their child and were concerned that treatment any other way would either be unsuccessful or result in a fear of the dentist in the future. Anderson et al., [26] demonstrated parents of children who have had an extraction under GA are often happy to consider another GA in the future if needed. Indeed this may well be the case for a number of children with repeat DGA rates within families (child and their siblings) reported for one study at 47% [27].

**Pathways and Practices**
An interesting aspect of both pathways was the parent’s comparison back to their own dentist. Parents who proceeded through both the secondary and primary care pathway described the family friendly nature of the dentists, in that they engaged with the children, explaining what would happen during the session in a way they could understand. This was at odds with how their own dentists interacted with their child during previous visits. These behavioural techniques can be a vital component in treating children as discussed in Chapter 8. Many dentists commented that treating a child is vastly different from treating an adult and a holistic approach must be taken, considering the understanding, ability to cooperate and also the anxiety of the child in order to carry out effective treatment and prevention.

Similarly parents discussed the benefit of separating treatment, which could potentially be distressing, from their regular dentist in order to reduce dental anxiety relating to future dental visits. This was an interesting concept as dentists also acknowledged this as an advantage of referring children into a different system and that GA dentists can be the 'bad guys' while the GDP can remain a separate element to an invasive procedure and continue to carry out routine treatment in the future. In this way if GA is used for GDPs to separate themselves from more radical treatment, in theory, this could be done simply outside of the usual practice rather than in a hospital setting. However some parents did comment on their fear the DGA would effect how children saw their own dentist in the future, one parent stated ‘when he goes back now to the dentist, he will ask himself, what’s she going to do? Is she going to make me bleed again (810). However, this was preceded by the parent acknowledging the child did not know what was going to happen on the day of the operation. This was a theme running through interviews where children who had not been informed what would occur could become very distressed post operatively.

While it is acknowledged it is vital to find new and effective ways of providing correct messages to parents and addressing barriers that prevent them from taking up these behaviours regarding oral health and diet [15], for those who continue to fall through the net, resulting in a young child with multiple decayed teeth, the options for treatment should be clear and tailored to their long term well being. A useful toolkit already in existence, ‘Delivering better oral health’ [28] is currently being developed into a patient friendly version which will make the guidance within more accessible for the general public.
GDPs who have a specific interest or extended skills such as Dentist with Enhanced Skills (DES) or are more comfortable treating children could be integrated into the GA referral pathway, reducing the burden on this service, for example if simple extractions or restorations are needed which a referring GDP feels unable to complete, a dentist outside of secondary care could provide appropriate treatment. This idea can be seen as an extension on developing child friendly pathways similar to the Childsmile programme employed in Scotland. Part of the programme involves encouraging practitioners to apply fluoride varnish to young children’s teeth who show signs of decay and provide additional advice to parents [29]. Prevention is an important factor but practices associated with prevention were not evident in the notes and referral letters available within this evaluation. Initial reports suggest the programme in Scotland is on course with meeting its objectives in improving health and reducing inequalities for children’s oral health in Scotland [30].

Dentists acknowledged prevention in practice was an area lacking in primary care (although dentists did not personally admit to this but spoke about prevention as a general problem). It has been discussed in previous studies that dentists may defer from using other methods due to time constraints and there is a lack of incentive currently to promote dental care which needs to be readdressed within the UDA system [27, 31, 32]. The payment through UDA was also mentioned by dentists interviewed in this research as a barrier to effectively treating children. A study conducted by Freeman and Carson showed attitudes to providing RA for extractions was predicted by clinical competency, financial worries, time concerns, and availability of the equipment. It has also been suggested the dental profession could make a considerable saving by focusing on prevention where it is needed rather than simply looking to cure problems that occur (although this is based on US data) [33].

**Conclusion**

The ability to see and treat children who have caries and are in pain, quickly and effectively is an important service provided by the NHS. Although children can wait for months to receive treatment under GA it is a valuable service for those who are pre-cooperative, or require multiple extractions, which could be traumatic if completed in primary care. The alternative pathway was not designed to replace a GA service but to help alleviate the pressure and waiting list observed within paediatric secondary care and to assess if a GDP was able to treat those who were able to comply in a primary care setting.
This evaluation has indicated a sizeable proportion (44%) of children could be seen and treated within a primary care setting under this new pathway which could act as an interface between referring dentists and those sent on for a GA extraction. While not all children seen within the primary care setting could be effectively treated and still required referral onto the GA service (31% of those seen), using a clinical assessment in primary care could further validate those needing GA. Although there is evidence to suggest the primary care pathway could treat a number of children, the long-term impacts of this treatment have not been explored or effectively compared it in a controlled setting and therefore any results should be interpreted with caution. The costs of this services have also not been compared, however a previous study in 2007 which reviewed the cost per child at a primary care based sedation service against GA in a hospital setting indicated GA was 46.6% more expensive [13]. It should be noted the authors are not advocating one technique or pathway over another, indeed there is no clear evidence of the most appropriate treatment for children with multiple caries. Care pathways should be reflect what is right for that individual, at that time, in the right setting [23], this may be very different throughout a child’s development. Conflicting research has shown evidence both for and against restorations and extractions with some studies showing no difference in the proportion of extraction if a tooth was restored or unrestored, others indicating untreated decay predicted the presence of dental sepsis [34–36] and suggesting further research is required in this area. At the time of writing the FiCTION dental trial is currently being carried out to look at the effectiveness of restorations vs. biological (sealing-in) management of caries or no restorations [37].

**Future research**

The one major difference in the populations of the two pathways is the IMD score, which was reported as lower in patients seen through Pathway 1 (PC) compared to Pathway 2 (SC). Despite the fact these two services were within 6 miles of each other and the geographic area served was broadly similar, the capture of patients from different areas of deprivation was apparent which is based solely on the catchment area of the two services. Given the difference in deprivation and the fact this was a service evaluation these two pathways should not be directly compared, however it does provide a good basis for further work to be conducted in this area.

The next stage of this work should be to assess the long-term benefits of both of these treatments/pathways, including a clear economic evaluation. Given that feedback from this evaluation for the primary care pathway included treatment failure with further dental
management required by the referring GDP, future work should include aspects, such as; returning pain, whether children's attitudes or opinions have altered for better or worse given the treatment offered by the dentist, and whether extractions are still required in the future. The cost benefit of both these procedures should also be assessed in order for commissioners, dentists, and other relevant professionals in the field to make an informed decision as to whether this alternative pathway is a viable option across differing regions i.e. taking into account local issues such as rural area, transport etc. Further research is needed for 'appropriate pathways' to be informed through a strong evidence base this would ensure decisions are made in the best interest of the patient. The authors are currently involved in a study following children over a period of 12 months to assess some of the aspects described above.
References


3. Davies G: Production of Data about Admission of Children to Hospital for Dental Extractions in the North West Region in 2008/09. The Dental Observatory. The Dental Observatory; 2010.


Appendix 9.1: Descriptive Statistics for Pathway 1 and 2

Table 9.1: Relevant information given on referral forms by pathway

<table>
<thead>
<tr>
<th>If answer is yes...</th>
<th>Pathway 1 n = 137</th>
<th>Pathway 2 n = 106</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address of Patient given</td>
<td>124 (91%)</td>
<td>104 (98%)</td>
</tr>
<tr>
<td>Medical history reported</td>
<td>85 (62%)</td>
<td>83 (87%)</td>
</tr>
<tr>
<td>None</td>
<td>65 (77%)</td>
<td>63 (76%)</td>
</tr>
<tr>
<td>Medical / behavioural difficulties</td>
<td>19 (22%)</td>
<td>18 (21%)</td>
</tr>
<tr>
<td>Dental history reported</td>
<td>12 (9%)</td>
<td>10 (11%)</td>
</tr>
<tr>
<td>Previous extractions / Fillings</td>
<td>3 (25%) / 4 (33%)</td>
<td>4 (40%) / 1 (10%)</td>
</tr>
<tr>
<td>Previous Infection</td>
<td>8 (67%)</td>
<td>3 (30%)</td>
</tr>
<tr>
<td>Infection</td>
<td>39 (29%)</td>
<td>22 (22%)</td>
</tr>
<tr>
<td>Anxiety</td>
<td>32 (23%)</td>
<td>33 (32%)</td>
</tr>
<tr>
<td>Gender (M/F)</td>
<td>48%/52%</td>
<td>48%/52%</td>
</tr>
<tr>
<td>Age Mean (95%CI)</td>
<td>8.45 (7.79-9.11)</td>
<td>7.66 (7.07-8.24)</td>
</tr>
<tr>
<td>Wait time Mean (Min-Max)</td>
<td>21 days (2-89)</td>
<td>109 days (2-203)</td>
</tr>
<tr>
<td>IMD Mean (95%CI)</td>
<td>49.56 (46.36-52.72)</td>
<td>25.57 (22.34-28.60)</td>
</tr>
</tbody>
</table>

Table 9.2: Teeth requested for extraction and extraction outcome via pathway 1 (Primary Care) and pathway 2 (Secondary Care)

<table>
<thead>
<tr>
<th>Pathway 1 - Alternative Pathway</th>
<th>Pathway 2 - GA Pathway</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary teeth X Request</td>
<td>Primary teeth X Request</td>
</tr>
<tr>
<td>0 12(28%)     0(95%)</td>
<td>31(72%) 17(19%)</td>
</tr>
<tr>
<td>1 9 (21%) 1 (2%)</td>
<td>4 (9%) 14(16%)</td>
</tr>
<tr>
<td>2 6 (14%) 1 (2%)</td>
<td>6 (14%) 13(14%)</td>
</tr>
<tr>
<td>3 2 (5%) 2 (5%)</td>
<td>7 (8%) 6 (7%)</td>
</tr>
<tr>
<td>4 2 (5%)</td>
<td>20(23%) 21(24%)</td>
</tr>
<tr>
<td>5 5 (12%)</td>
<td>7 (8%) 13(15%)</td>
</tr>
<tr>
<td>6 2 (5%)</td>
<td>2 (2%) 3 (3%)</td>
</tr>
<tr>
<td>7 2 (5%)</td>
<td>5 (6%) 4 (5%)</td>
</tr>
<tr>
<td>8 1 (2%)</td>
<td>1 (1%) 1 (1%)</td>
</tr>
<tr>
<td>9 1 (2%)</td>
<td>2 (2%) 1 (1%)</td>
</tr>
<tr>
<td>10 1 (2%)</td>
<td>1 (1%) 4 (5%)</td>
</tr>
<tr>
<td>Median 3.0 1.5 2.0</td>
<td>3.0 3.0 4.0 3.0 2.5</td>
</tr>
<tr>
<td>Wilcoxon z = -4.805, p&lt;0.0001, r =0.52</td>
<td>No Significant difference p=0.096</td>
</tr>
<tr>
<td>z = -4.261, p&lt;0.0001, r = -0.32</td>
<td>No Significant difference p=0.665</td>
</tr>
</tbody>
</table>

Pathway 1 = 17 patients excluded as referrers did not state the number of teeth requested for extraction
Pathway 2 = 4 patients excluded as referrers did not state the number of teeth requested for extraction
Figure 9.1: Outcome of referral made through each pathway

Dentist decides to make a referrals for carious teeth

PCO of child - triage pathway

Outcome of referral made

Type of Treatment

1st treatment

2nd treatment

3rd treatment

4th treatment

Pathway 1 - Primary Care pathway

Pathway 2 - Secondary care (GA) pathway

X = Extracted

FTA = Fail to Attend
Chapter 10

Prevention in Practice: Why are Children still undergoing Extraction under General Anaesthetic
Foundation and Summary of Chapter 10

While Chapter 8 explores interventions from a public perspective, Chapter 9 considers the impact on altering the options for a DGA service; Chapter 10 explores what could be done from a practice/GDP perspective to reduce the need for GA extraction. This section uses data collected from participant questionnaires and consultation/dental referral notes and concentrates on preventative advice and treatment provided through GDPs. While data gained this way should be treated with caution, given responder bias, it does indicate a general level of prevention given to this population.

The level of treatment and oral health management provided by a GDP can vary greatly and can obviously be influenced by a number of factors i.e. participants attendance, remuneration and personal opinion on the treatment to be provided. It was important to explore the potential differences in GDP care and prevention throughout the DGA population referred, as this could also be an important factor to concentrate on through both dental training and commissioning in relation to reducing the need for DGA extractions.

Authors Contributions
IAP and CS contributed to the protocol, design and manuscript. GD contributed to the design of the data collection tool. MG contributed to the design, acquisition of data, analysis, interpretation and manuscript.
Abstract

Introduction/ Aim
Caries is a preventable disease yet certain children continue to experience decay that requires multiple extractions under General Anaesthetic (GA). This article explores prevention discussed with parents and the factors that may contribute to their children requiring a Dental General Anaesthetic (DGA).

Methods
The study involved 456 respondents across 6 hospitals in the North-West of England. Over a 2-month period each of these children/families completed a questionnaire and gave access to referral and consultation notes.

Results
Parents/Guardians of children referred for a DGA indicated they had previously received advice on various dental health behaviours including; diet (84%) tooth-brushing (84%) and use of fluoride toothpaste (74%). Data indicated that dentists had previously discussed fissure sealants in 15% of cases and fluoride varnish in 26% of cases according to parents. Regular attendance was a factor in whether information had been given for a number of preventative treatments or advice. Anxiety was a feature within dental referral with dentists documenting this in 22% of cases. The parent or child in 49% of cases also reported child anxiety via the questionnaire.

Conclusions
Data suggests there is a lack of preventative treatment being undertaken that could help alleviate the need for DGA in some children. However, this could be in part attributed to the irregular attendance of a proportion of the population who are referred. Therefore the opportunity to provide treatment and advice at the GA appointment, not only for the referred child, but also for the whole family cannot be missed when opportunities arise, i.e. “making every contact count”. There is clearly a need to address these issues given the high number of repeat DGAs.
Introduction

Treatment for decayed teeth in young children can vary from preventative treatment, for example applying fluoride varnish which can arrest and or reverse early caries [1], through to restorative interventions and extractions. While extractions can occur under local anaesthetic (LA) in some cases the severity of tooth decay or the age of the child results in the need for a General Anaesthetic (GA) within a hospital [2]. Tooth extraction is one of the commonest reasons for young children being admitted to hospital [3].

GA should, in theory, be employed in only the most severe cases (for example the presence of persistent pain and infection) as not only is GA associated with certain morbidities such as nausea, dizziness, etc. [4] but since 2002 it can only be carried out within a hospital setting. This not only restricts the number of procedures that can be carried out but also vastly increases the cost of treatment within the NHS system [5, 6]. Despite the improvement in child oral health over the recent years, child DGA in hospitals has increased. Specifically one report showed an increase in dental extractions carried out in hospital by 66% in England from 1997 to 2006 [7]. Given the change of DGA being carried out purely in a hospital setting since 2002 this could be expected for an initial period. However, this increase has continued beyond this rather than levelling out [7, 8]. The most recent figures (2010) suggest that in the UK each year, more than 60,000 children undergo GA for dental extractions [9]. It is important to consider that, in England, the introduction of the 2006 contract has been widely associated with an increase in referrals to all specialities.

Given the number of DGA extractions’ still being undertaken it is important to further explore this area of service provision, particularly in relation to the preventative treatment and advice received before the procedure. There have been a number of studies that have explored child dental decay and ways of improving children's oral health [10, 11]. Interventions have included addressing individual lifestyle factors and behavioural interventions, to interventions such as professionally applied fluoride varnishes and public health schemes such as water fluoridation. Behavioural interventions have been criticised as ineffective in changing long-term health behaviours and accused of increasing the health inequality gap rather than reducing it, therefore doing little to help oral health inequalities. This could be seen as a particular problem for children who are referred for GA as they are usually young and from areas of high deprivation [7, 12].

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2 Dental contracts changed from Fee for Service, which had a variety of differently priced items for which dentists were paid, to Units of Dental Activity which incudes three bands of treatment. These changes could mean a dentist would be charged the same for carrying out 1 filling as they would for 10 fillings.
Prevention in primary care settings is a key approach for tackling dental decay in young children. There is strong evidence to support the use of fluoride based preventive products applied professionally [13] within primary care as well as a via self care [14]. The application and use of such products is also advocated in national policy documents (Delivering Better Oral Health) [15]. Additionally the use of fissure sealants have been shown to have a substantial positive protective effect against caries [16] (compared to a control or no prevention). It is interesting to consider whether these interventions are less effective in this cohort of patients, or if they are simply not being received.

In certain areas of the UK a number of schemes involving both oral health promotion and fluoride preventative treatments have been introduced on a wide scale. For example Child Smile has implemented an initiative to help improve the health of children’s teeth throughout nursery/schools predominantly in the East of Scotland and Childsmile Practices in the West of Scotland both of which involves twice yearly fluoride varnish applications and toothbrush programs [17].

Public health initiatives such as water fluoridation have been shown to be successful in reducing caries and recent research has indicated schemes can mediate the behaviour impact on tooth decay. Water fluoridation is a passive population based intervention and therefore does not require the same level of behaviour change or uptake as other approaches. A study conducted in England in 2012 showed water fluoridation reduced the social gradient between deprivation and tooth decay therefore while water fluoridation effected dental health throughout social class it was those most deprived who benefited the most [18]. However, water fluoridation remains a contentious issue and has a variety of barriers to implementation associated with legislation, finance and politics. No ‘new’ schemes have been seen in the England for the past 30 years [19]. Approaches such as Child Smile are important to consider when water fluoridation is not an option. However these interventions are also restricted with an ever-increasing pressure on budgets and a need for a strong evidence based before certain elements are introduced.

**Aim**

Severe caries in young children can result in a referral for extractions under GA. This study aims to explore the degree to which prevention is discussed with parents pre-operatively, and the factors contributing to referral for extraction under GA.
Methods

This was an observational study that recruited patients who attended six randomly selected hospitals throughout the North-West of England for DGA extractions. The method and sample size has been described in depth in Chapter 3 and 6.

Data were collected via a questionnaire provided to parents/guardians that examined: prevention discussed with the parent, impact of caries based on the Children’s Dental Health Survey [20] with supplementary questions on school attendance and changes to sleep patterns added following further research [21, 22]. In addition further data were gained from the referral and clinical notes at each hospital for these participants. In order to gain a general understanding of anxiety from both patient and parent, a modified version of anxiety scales such as MCAS and CFSS-DS was produced based on one question and taking into account the age of children [23–25]. Anxiety is a complex area and there are a number of issues in measuring anxiety especially when considering children, their age and cognitive development and understanding. This was a simplistic measure to ascertain a basic understanding of both child and parents generally anxiety towards the dentists and was not a validated instrument to look specifically at the level of anxiety and related problems. This would have required an additional element to the questionnaire which was not considered necessary for the primary aim of this research.

The questionnaire and other documents used within the study can be found in the supplementary files (See appendix 12.3.2).

Full ethical approval for this study was obtained from the NRES Committee North West Preston (11/NW/0503) and all participants gave informed consent before taking part. (Throughout the rest of this paper parent/guardians will be referred to as parents).

Results

There was a relatively even split between males and females receiving DGA (54:46%) with an average age of 6.78 years old, although this ranged from 1.5 up to 16.42 years old. Dentists referring patients mentioned pain in 45% of cases, infection in 39% of cases with 78% of patients having no relevant medical history to report (Table 10.1).

Table 10.2 shows the breakdown of the number of teeth extracted, looking at just primary, permanent and all teeth extracted within the mouth. On average 5.93 teeth were extracted
per child, however this could range up to a full clearance of all remaining teeth. This was also seen when restricting analysis to primary teeth alone. When exploring permanent tooth extraction separately from primary there were on average less permanent teeth (2.72) extracted than primary (5.91) see Table 10.2.

Table 10.1: Demographics and basic information from referral notes.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Total n = 456</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex Male/Female</td>
<td>244/211</td>
</tr>
<tr>
<td>Age Mean (Min-Max)</td>
<td>6.78 (1.5-16.42)</td>
</tr>
<tr>
<td>Child relocated since birth within UK</td>
<td>44 (12%)</td>
</tr>
<tr>
<td>Regular attender (every 6 months/once a year)</td>
<td>50 (11%)</td>
</tr>
<tr>
<td>Pain (Yes)</td>
<td>168 (45%)</td>
</tr>
<tr>
<td>Anxiety (Yes)</td>
<td>77 (22%)</td>
</tr>
<tr>
<td>Infection (Yes)</td>
<td>144 (39%)</td>
</tr>
<tr>
<td>Medical History reported (Yes)</td>
<td>82%</td>
</tr>
<tr>
<td>If Medical history</td>
<td></td>
</tr>
<tr>
<td>No relevant medical history</td>
<td>246 (78%)</td>
</tr>
<tr>
<td>Special needs/learning difficulties</td>
<td>14 (5%)</td>
</tr>
<tr>
<td>Medical</td>
<td>44 (14%)</td>
</tr>
<tr>
<td>Behavioural</td>
<td>9 (3%)</td>
</tr>
<tr>
<td>Combination of medical, behavioural and SP</td>
<td>1 (0.3%)</td>
</tr>
</tbody>
</table>

Table 10.2: Number of teeth extracted during DGA

<table>
<thead>
<tr>
<th></th>
<th>Min-Max</th>
<th>Mean (s.d.)</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>All teeth extracted (n=442)</td>
<td>1-20</td>
<td>5.93 (3.78)</td>
<td>5.58-6.28</td>
</tr>
<tr>
<td>Primary teeth extracted (408)</td>
<td>1-20</td>
<td>5.91 (3.84)</td>
<td>5.54-6.28</td>
</tr>
<tr>
<td>Permanent teeth extracted (78)</td>
<td>1-7</td>
<td>2.72 (1.34)</td>
<td>2.42-3.02</td>
</tr>
</tbody>
</table>

Parents were asked if a professional outside of the hospital had ever provided their child with any of the preventative advice or care (see Table 10.3). It can be seen that, unsurprisingly, the dentist was the most likely to have provided this information or discussed preventative treatment with parents for all areas asked. Only 16% of parents had never been given any information on avoiding sugar in food and drink and tooth brushing advice. However on average, preventative treatment, which would be carried out by dentists, had not been discussed in 84% of cases for fissure sealants and 72% of cases for fluoride varnish (it should be noted that participants may have received these
and not recalled which is difficult to establish as dental notes from referring dentists only mentioned these preventative techniques being applied in 4 cases).

Table 10.3: Prevention advice or preventative treatment discussed with parents

<table>
<thead>
<tr>
<th>Prevention Advice/Treatment (n=456)</th>
<th>No one</th>
<th>Dentist</th>
<th>Health care visitor</th>
<th>School</th>
<th>Other</th>
<th>Multiple sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoid sugar (food /drink)</td>
<td>72 (16%)</td>
<td>219(48%)</td>
<td>11 (2%)</td>
<td>29 (7%)</td>
<td>5 (1%)</td>
<td>113(25%)</td>
</tr>
<tr>
<td>Tooth brushing</td>
<td>71 (16%)</td>
<td>227(51%)</td>
<td>11 (2%)</td>
<td>22 (5%)</td>
<td>6 (1%)</td>
<td>112(25%)</td>
</tr>
<tr>
<td>Family fluoride toothpaste</td>
<td>117 (26%)</td>
<td>226(50%)</td>
<td>8 (2%)</td>
<td>15 (3%)</td>
<td>4 (1%)</td>
<td>79 (18%)</td>
</tr>
<tr>
<td>Use of mouth rinse</td>
<td>264 (59%)</td>
<td>143(32%)</td>
<td>4 (1%)</td>
<td>6 (1%)</td>
<td>1 (0.2%)</td>
<td>29 (7%)</td>
</tr>
<tr>
<td>Sugar free chewing gum</td>
<td>364 (81%)</td>
<td>64 (14%)</td>
<td>4 (1%)</td>
<td>1 (0.2%)</td>
<td>1 (0.2%)</td>
<td>9 (2%)</td>
</tr>
<tr>
<td>Fissure sealants</td>
<td>377 (84%)</td>
<td>63 (14%)</td>
<td>-</td>
<td>3 (1%)</td>
<td>2 (0.5%)</td>
<td>4 (1%)</td>
</tr>
<tr>
<td>Fluoride varnish</td>
<td>324 (72%)</td>
<td>113 (25%)</td>
<td>-</td>
<td>6 (1%)</td>
<td>1 (0.2%)</td>
<td>5 (1%)</td>
</tr>
</tbody>
</table>

As the majority of people would only receive information from the dentists if they actually attended appointments, we explored results for those who (self reported) attended the dentist regularly (at least once a year) to irregular attenders using chi-square. Table 10.4 shows that a difference can be seen between those who regularly attend and those who do not for information received on tooth brushing $\chi^2(2) = 29.355, p = 0.0001$, fissure sealant $\chi^2(2) = 7.076, p = 0.029$, fluoride toothpaste $\chi^2(2) = 23.100, p< 0.0001$ but not fluoride varnish $\chi^2(2) = 4.058, p = 0.131$.

Table 10.4: Tooth-brushing information given for regular and non-regular dental attenders

<table>
<thead>
<tr>
<th>Discussion regarding:</th>
<th>Attender</th>
<th>Discussed with</th>
<th>Chi square statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>No one</td>
<td>Dentist</td>
</tr>
<tr>
<td>Tooth-brushing</td>
<td>Regular</td>
<td>47 (14%)</td>
<td>275(81%)</td>
</tr>
<tr>
<td></td>
<td>Irregular</td>
<td>26 (23%)</td>
<td>63 (57%)</td>
</tr>
<tr>
<td>Fluoride Varnish</td>
<td>Regular</td>
<td>239 (70%)</td>
<td>94 (27%)</td>
</tr>
<tr>
<td></td>
<td>Irregular</td>
<td>86 (78%)</td>
<td>24 (22%)</td>
</tr>
<tr>
<td>Fissure Sealant</td>
<td>Regular</td>
<td>277 (81%)</td>
<td>58 (17%)</td>
</tr>
<tr>
<td></td>
<td>Irregular</td>
<td>101 (92%)</td>
<td>9 (8%)</td>
</tr>
<tr>
<td>Fluoride toothpaste</td>
<td>Regular</td>
<td>81 (24%)</td>
<td>247 (73%)</td>
</tr>
<tr>
<td></td>
<td>Irregular</td>
<td>38 (57%)</td>
<td>57 (52%)</td>
</tr>
</tbody>
</table>

*Dentist alone or in combination with others
Regular attender = Child attends at least once a year, Irregular attender = child attends less than once a year or only when they have trouble with their teeth

Table 10.5 shows the distribution of child and parent anxiety in relation to visiting the dentist. In total 49% of children (based on a parent's perception) and 44% of parents reported anxiety in regards to the dentist. A Kappa statistic indicated a significant but only slight/fair agreement between parents reported anxiety and child anxiety. Although it should be noted due to the age of the child, the parent may have answered this question therefore these results should be interpreted with caution.

Table 10.5: Child and parental dental anxiety

<table>
<thead>
<tr>
<th>Parent Anxiety</th>
<th>Very anxious</th>
<th>A little anxious</th>
<th>No</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child Anxiety</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very anxious</td>
<td>26 (6%)</td>
<td>22 (5%)</td>
<td>45 (10%)</td>
<td>93</td>
</tr>
<tr>
<td>A little anxious</td>
<td>24 (6%)</td>
<td>45 (10%)</td>
<td>52 (12%)</td>
<td>121</td>
</tr>
<tr>
<td>No</td>
<td>27 (6%)</td>
<td>49 (11%)</td>
<td>146 (34%)</td>
<td>222</td>
</tr>
<tr>
<td>Total</td>
<td>77</td>
<td>116</td>
<td>243</td>
<td>436</td>
</tr>
</tbody>
</table>

Kappa is weighted using quadratic weighting given the difference between categories are not equivalent. Kappa indicates a significant but slight to fair agreement with a value of 0.1930, $p < 0.0001$. No significant difference was observed for anxiety of parent and child dental attendance $\chi^2 (2) = 2.621$, $p = 0.270$ or child anxiety and their dental attendance $\chi^2 (2) = 2.475$, $p = 0.290$

Data indicated 22% of children were attending for a repeat dental GA. When considering siblings a total of 42% of families were attending a repeat GA. In total 48 families in the study had all their children experience a DGA.

Those who had a medical reported issue: either special needs, learning difficulties or other medical problem, were significantly more likely to have had a previous GA $\chi^2 (1) = 6.106$, $p = 0.013$. With 32% of those who had an earlier GA also having a medical problem compared to 18% having a previous GA with no medical problem. Therefore participants were had a greater probability of having had a GA in the past if they had some medical, behavioural or special needs recorded (relative risk ratio 1.75).
analysis indicated there is a strong evidence of a difference between previous GA in family and IMD using Mann Whitney U = 17,607, x = 2.338, p<0.019.

Of those who responded on the question on infant feeding practices, 91% (409) of parents reported using a baby bottle for their child (Table 10.6) for an average of 23.74 months (s.d. 12.79). This ranged up to 96 months although it should be noted that the 5 children with the longest bottle use had some form of special needs, learning disability, or medical issue and in a number of cases this was the reason expressed by the parent for the long bottle use.

Table 10.6: Parents reported use of child’s baby bottle content

<table>
<thead>
<tr>
<th></th>
<th>No</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>204 (50%)</td>
<td>201 (50%)</td>
</tr>
<tr>
<td>Milk</td>
<td>22 (5%)</td>
<td>383 (94%)</td>
</tr>
<tr>
<td>Squash</td>
<td>306 (76%)</td>
<td>98 (24%)</td>
</tr>
<tr>
<td>Fruit Juice</td>
<td>306 (76%)</td>
<td>98 (24%)</td>
</tr>
<tr>
<td>Other:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tea</td>
<td>387</td>
<td>18 (4%)</td>
</tr>
<tr>
<td>Hot chocolate</td>
<td>401</td>
<td>4 (1%)</td>
</tr>
<tr>
<td>Fizzy drinks</td>
<td>403</td>
<td>3 (0.75%)</td>
</tr>
<tr>
<td>Other mixture</td>
<td>388</td>
<td>19 (4%)</td>
</tr>
</tbody>
</table>

(409 parents responded they used/ use a baby bottle. 405 responded to what was put in the bottle)

Tooth brushing habits were recorded via the questionnaire, 26% of parents indicated their child only brushed their teeth once a day or rarely. The majority (82%) of children under 7 years old had their teeth brushed by their parent or under their parent’s supervision at least some of the time (Table 10.7).

Table 10.7: Brushing habits: When your child was under 7 who brushed their teeth?

<table>
<thead>
<tr>
<th>When your child was under 7 who brushed their teeth</th>
<th>Frequency of brushing (per day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parent</td>
<td>89 (20%)</td>
</tr>
<tr>
<td>Child on own</td>
<td>77 (17%)</td>
</tr>
<tr>
<td>Child supervised</td>
<td>109 (24%)</td>
</tr>
<tr>
<td>Mixture of supervised and on own</td>
<td>161 (36%)</td>
</tr>
<tr>
<td>Doesn’t brush</td>
<td>5 (1%)</td>
</tr>
</tbody>
</table>
Household income was also recorded to assess social determinants of health alongside other factors such as IMD (reported in Chapter 4). Of the parents who responded 48% indicated their household income was less than £12,999 a year (Table 10.8). It should be noted while income is a valuable variable approximately half of participants refused to answer this question and therefore cautious interpretation of these results is indicated. IMD and income had a negative but low correlation, $r = -0.3$, $p < 0.05$ (as income increased deprivation decreased). One potential reason for the low correlation could be due to the poor response for those reporting household income meaning the information could be skewed in those who decided to answer this question and therefore results should be treated with caution.

Table 10.8: Household income of attending families

<table>
<thead>
<tr>
<th>Frequency (%)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>3100-4699</td>
<td>25 (9%)</td>
</tr>
<tr>
<td>4700-6199</td>
<td>25 (9%)</td>
</tr>
<tr>
<td>6200-7799</td>
<td>18 (7%)</td>
</tr>
<tr>
<td>7800-10399</td>
<td>30 (11%)</td>
</tr>
<tr>
<td>10400-12999</td>
<td>33 (12%)</td>
</tr>
<tr>
<td>13000-15599</td>
<td>20 (7%)</td>
</tr>
<tr>
<td>15600-18199</td>
<td>19 (7%)</td>
</tr>
<tr>
<td>18200-20799</td>
<td>17 (6%)</td>
</tr>
<tr>
<td>20800-25999</td>
<td>20 (7%)</td>
</tr>
<tr>
<td>26000-31199</td>
<td>22 (8%)</td>
</tr>
<tr>
<td>31200-35399</td>
<td>13 (5%)</td>
</tr>
<tr>
<td>37000+</td>
<td>34 (12%)</td>
</tr>
<tr>
<td>Total</td>
<td>276</td>
</tr>
</tbody>
</table>

**Discussion**

This study explored reasons for child referral to GA extraction services. Three areas formed the focus of the work:

1) The dental treatment or advice provided before the operation, which could impact on decay and the subsequent need for GA
2) The age, medical and behavioural element that may have contributed to referral
3) The lifestyle factors and social determinants that could effect oral health and need for GA
Firstly, it can be seen from these data that some preventative dental advice was provided to the vast majority attending for GA. Only 16% of families had no advice on tooth brushing and diet in relation to dental health. This advice came from a variety of sources but was generally from their dentist, either alone or in conjunction with other organisations such as schools. Very few parents stated they had received any advice from health care visitors. However as the average age of the child was 6.8 years old there may be an element of recall bias in what parents could remember being told when their child was very young [26].

While general advice on good oral health behaviour was indicated, such as use of appropriate fluoride toothpaste and tooth brushing, there were very few children who had fissure sealants and fluoride varnish provided, or even discussed. Both of these treatments have been shown to have a significant protective effect within clinical trials [1]. It is acknowledged that for fluoride varnish, patients need to be regular attenders [13, 15] in order to receive the intervention in a therapeutically effective manner, but this is not the case for fissure sealants. Therefore data were examined to determine differences between self-reported regular and non-regular attendance. A difference was observed between regular and regular attendance for information given on tooth brushing, use of fluoride toothpaste and fissure sealants.

A greater proportion of regular attenders received advice on oral hygiene and fissure sealants. There are a number of ways of interpreting this data. It could be that by not attending the dentists regularly there is not the opportunity to relate the importance of oral health messages and provide certain preventative treatments. Conversely, dentists could be more likely to treat and give advice to patients who they saw as proactive and likely to engage with the messages they impart if they regularly attended. Previous research has shown that regular attendance is conducive to good oral health with irregular attenders have significantly more decay and significantly fewer filled teeth [27]. This same study also showed that those from a deprived background are more likely to be irregular attenders. A separate study which examined the inequalities in dental treatment provided to children found that disadvantaged children (who were regular attenders) were more likely to have an extraction than children from a more affluent background, irrespective of caries experience [28]. This raises concerns over consistency of care provision and treatment throughout services.
The use of fluoride varnish in relation to a public health approach through different settings is an area that is still debated [29]. However it has been shown to be highly effective within clinical trials [13], its use is advocated in the latest ‘Delivering Better Oral Health’ Toolkit for the UK [15] and it is a major component of the national programme Childsmile designed to improve oral health of children in Scotland. Despite this no significant difference was detected for the use of fluoride varnish between regular and non-regular attenders.

There are a variety of reasons why dentists may not engage in preventative treatment. These range from the remuneration through UDAs (which is currently are less supportive of prevention due to the manner in which dental activity is reimbursed) to personal preferences and opinions about what is best for the patient and help them maintain good oral health (these issues were discussed and analysed in Chapter 5).

While oral health advice concerning diet and oral hygiene is important it is known information alone does not result in positive behaviour change in regards to health, with outcomes of behavioural interventions around education of parents being mixed [30, 31]. However this does not mean oral health information should not be given but suggests better quality research is required. There are a complex multitude of factors as to why people engage in positive health behaviour but one of the fundamental components for beneficial health behaviours to take place is the basic knowledge of what can contribute towards developing tooth decay and conversely how to maintain good oral health. Conflicts between oral health and general diet advice remain widespread [32] and recent studies have also indicated a specific message around diet and oral health vary among dentists and the delivery of that advice could be improved with props and additional materials [33]. The Delivering Better Oral Health Toolkit presents specific guidelines on advice around diet and sugar consumption. Additionally population based interventions to alter diet have shown to be amenable to change given appropriate support i.e. the introduction of policy guidelines [34]. Therefore diet and sugar consumption can be tackled in a number of ways which is important given the need to avoid a solely victim blaming/downstream approach and move to an upstream approach to promote oral health and incorporate risk factors which spread through a number of issues i.e. obesity, using the common risk factor approach [35].

The second theme explored in this paper is the referral characteristics of the population including medical behaviour and other factors, which may contribute to extraction under general anaesthetic. The majority of referrals (82%) documented medical history and in
almost (78%) of cases 'No Relevant Medical History' (NRMH) was noted. Of those cases referred with relevant medical history (22%); conditions ranged from medical issues such as allergies, to behavioural issues and learning difficulties which may have restricted the ability to treat children and perform preventative measures before caries progressed.

The referring dentist reported anxiety in approximately a fifth of cases (22%). While almost half of children (49%) and 44% of their parents reported anxiety towards the dentist. Anxiety can be a barrier to not only receiving appropriate and timely treatment but also maintaining oral health by avoiding regular dental visits [36]. Anxiety within children can develop into a vicious cycle as those too afraid to receive treatment at an early stage by delaying dental visits due to the child's or even parent's phobia may mean the severity of caries progresses to such an extent the only option is treatment under General anaesthetic. Unfortunately GA does little to address the underlying anxiety and therefore does not give children the opportunity to acclimatise in practice and for behavioural techniques to be utilised to encourage positive dental outlook for the future.

Given a GA for tooth extraction can also be a traumatic experience [37, 38], if this is the only exposure to the dentist this treatment could lead to further anxiety and contribute to continued dental avoidance with additional dental problems, exacerbating dental fear [39, 40]. Similarly to other studies, a correlation between parent anxiety and child anxiety was noted [39]. Anxiety noted within families can indicate another difficult cycle to break if maternal or paternal dental fears are passed on during the social learning process [41]. In order to effectively treat children this may mean dentists need an understanding of the parent anxiety to decide how best to manage the anxiety of their patient.

Lifestyle factors and social determinants are the final theme of this article. Dahlgren and Whitehead proposed a model of Determinants of Health, which showed layers of factors that can potentially determine health. These include lifestyle factors, social and community issues, living condition and general socio economic and environmental factors [42]. Risk factors such as diet, infant feeding practices and tooth brushing are strongly linked with tooth decay. While this research was not testing predictive factors against, for example, a control group to determine the cause of caries, the authors were interested in parents responses given these risk factors to determine patterns of diet and reported oral hygiene within this population. The information is presented here to give an indication of lifestyle influences. Diet, particularly infant feeding practices such as bottle use has been shown to play a major role within caries development [43]. Bottle use was shown to be widespread with 91% of parents using a bottle for an average of two years. While milk was the main
drinks consumed, other mixtures including, juice, tea, fruit juice and even fizzy drinks were given to children in their baby bottle. Extended bottle use could be a contributing factor as studies have shown using a training cup from the age of 8 to 12 months can greatly reduce caries [44]. Additionally, while fruit juices can be seen as a beneficial nutritional element to a child’s diet, they have the potential to cause damage to the teeth due to the levels of sugar and acidity [45].

Socio-demographics and deprivation have been shown to be related to the risk of caries [46]. Not only has deprivation been linked to caries experience but also extraction of teeth has been shown to be more likely for children from deprived areas irrespective of caries experience. This indicates children from deprived areas could be at risk of having inequality on top of inequality [47]. Chapter 4 showed children who were seen for GA extraction were; according to their IMD score more deprived in comparison to the rest of the population within the catchment area. Deprivation can be measured in a number of ways within a population, all subject to certain flaws, however IMD has become popular as a means of describing deprivation at Local Super Output Area geographic level [48]. Another way to explore deprivation is to look at the low-income threshold. Again there are a variety of ways to define this, one is to use 60% of the contemporary household median income [49]. The latest figures indicated for the UK the median households income was £23,300 60% of this would be £13920 [50]. Therefore 48% of the participants attending for GA are within this low-income threshold.

It was noted 12% of children had moved into a different area of the UK since birth, this is an important fact particular when thinking of public health measures and community or preventative measures [35, 51], which require consistent application or prompting for effective impact on oral health in children. A leading example of this was shown in a study conducted throughout Manchester where movement in and out of the area was one of the primary causes for non involvement in an oral health promotion program resulting in almost half of children unable to take benefit from the intervention [52].

**Conclusion**

This article has described a population of children attending for a dental general anaesthetic and identified a number of areas in which support and interventions could impact on the oral health within this group.
It appears there is little preventative treatment within primary care, although as this was parent reported, results should be treated with caution, additionally it is acknowledged many of these treatments can only have a significant impact if the child regularly attends the dentist. However the opportunities to implement evidenced based preventative treatment such as fissure sealants [16], when a child does attend however should not be missed. Unfortunately it may be the case one of the first times to do this is when a child is referred for GA; however this is still a vital time to start prevention in order to avoid repeat GA’s in the future. It is also important that dental professionals who provide health promotion interventions are suitably remunerated in order to carry out proactive (prevention) rather than reactive (extraction) treatment.

While oral health advice and diet advice was acknowledged by parents a proportion of those asked did indicate irregular brushing habits and feeding practices that could have contributed towards GA. It is recognized that information alone is often not enough to evoke behaviour change. Therefore families at high risk of caries may require additional tailored information and techniques in order to instigate good oral health. Qualitative interviews with participants reported in Chapter 5 and 8 suggested aids such as plaque disclosing tablets to encourage appropriate brushing and further advice on toothpaste with appropriate fluoride levels were readily welcomed by parents and had provoked a change in behaviour (although it is unknown how long this behaviour change continued for).

Importantly along with downstream approaches, focusing on high-risk populations, such as education and clinical prevention, there should be additional focus on upstream approaches at local and national levels to promote oral health. Interventions that look at population based approaches have shown to be successful and a combination of high risk and population-based approaches are needed to tackle oral health problems in children. This can include if appropriate; water fluoridation schemes [18], encouraging schools to be part of healthy programs [53], changing policy to encourage dietary change [54], changing environments and other community based interventions which incorporate a common risk factor approach [35].

Children referred for GA extractions can be a challenging group when attempting to maintain good oral health. Often children can return in a short space of time for repeat GAs or with siblings also needing multiple extractions. It may be GA referral can be used as an indicator of future caries experience within a family and more could be done during pre operative assessment or following a GA to continue to provide evidenced based treatment and advice. Previous research has shown support provided through services
such as the community dental service has not been well attended by families following a GA [55]. Therefore this may require a more proactive, innovative approach to target high-risk children, again tailored to their needs and addressing some of the challenges faced. Furthermore research has indicated the need to take into account cultural factors and target the whole family in relation to diet and oral health advice [12].

In conclusion it can be seen that from a service provision perspective children are still requiring GA extraction for a number of reasons, which could in part be addressed by the dental profession:

• Lack of preventative treatment: Children should receive appropriate preventative treatment. For irregular attenders where fluoride varnish may be ineffective if frequent applications are not possible, prevention such as fissure sealants should be utilised.

• Unclear messages regarding brushing and oral hygiene: Over half of parents did not supervise children consistently up to the age of 7 years old when brushing their teeth and over a quarter stated they had not had the use of fluoride toothpaste discussed with them. Again with irregular attenders a consistent message is made more difficult to establish, however every contact should count with a dental health professional and efforts should be made to reiterate the basic but key dental messages at each opportunity. One difficulty regarding advice is the potential inconsistent message given by the dental profession. One recent paper showed an unacceptable diversity in the recommendation of tooth brushing techniques by dentists which needs to be addressed [56].

• Continue to reiterate messages on diet and bottle use: children were on average using a baby bottle for two years with a mixture of juices, squash and other beverages that could contribute towards dental decay.

• Anxiety: If anxiety is a contributing factor towards the need for GA often the only option is to treat using this method due to pain or infection being experienced, however efforts should be made after the operation to acclimatise children to a dental setting, this could be incorporated into preventative treatment and guidance given post operatively.
• Further exploration of treatment decisions of referring dentists to determine if the most appropriate preventative treatment and alternative options have been explored before referring.

• Continuous movement of the population can make continuous and consistent message difficult, one of the options are increased nationwide policies and strategies to improve oral health. A recent strategic collaboration looking at improving the health of the poorest in the North of England, called ‘Well North’ which is beginning in 2015 to identify those at risk of illness and attempting to solve rather than manage these problems in the future (well north). Further work nationwide including Change4life has begun to address general health issues such as obesity by using social marketing to alter parent’s attitudes from wanting their child to be simply happy to being both happy and healthy [57].

In conclusion, children continue to be referred for, and receive, extraction under GA for a number of complex, and interlinked reasons. Commissioners, service providers, clinicians, parents, and others need to adhere to a consistent, simple, evidence based preventive approach. There may be a need to utilise GA referral, as an indicator of high need to ensure that a more proactive prevention programme is undertaken. While one GA extraction can be considered a poor outcome, repeat GAs both for a single child, or within a family are disastrous for the individuals affected and the health care system as a whole.
References


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Chapter 11

Discussion
Main Findings

The studies in this thesis have focused on understanding the complex causal networks and reasons behind a Dental General Anaesthetic (DGA) referral, as well as exploring potential interventions, which may have a positive impact in this area. The thesis looked to answer three intertwined research questions concerning DGA, which ultimately could positively impact on the DGA pathway, looking at best practice and reducing the numbers seen for these operations. This work can be broken down into three distinct phases; first outlined in the introduction and referred to by colour code throughout the thesis, illustrated in Figure 11.1.

*Figure 11.1: The three phases of the thesis*

This work commenced, by describing the uncertainty around both the known factors of a DGA population and appropriate interventions, which may have an impact in reducing the number of operations. The research aims were addressed through the corresponding chapters outlined in Figure 11.2 and included understanding the DGA service and differences across regions, understanding the DGA population and barriers to maintaining good oral health in this group and finally incorporating their views on both the service and future interventions with previous research within this area.
Figure 11.2: Flow diagram of the aim and outcome of the research and corresponding chapters

Aims and issues to be addressed with the thesis

Outcomes and solutions described throughout the thesis

- Understanding the DGA service & the difference and impact of these services including wait times and repeat GAs
- Are different targeted interventions necessary for children who are attending DGA
- What interventions are suitable to impact on this area of DGA extractions and this group who require this treatment
- Interventions needed conform to the idea of universal proportionalism. Including both policy change as an upstream intervention tackling sugar consumption and prevention techniques (F/S) to intensive targeted interventions and support to engage this population

DGA Services vary across regions. A reference standard DGA service was suggested incorporating alternative options/pathways to tackle wait times. Prevention to tackle repeat DGA and play specialist and child friendly environments to address child experiences.

There are distinct groups, which have been labeled: 'Troubled Families', 'Hard to Reach', and 'Additional Needs' who may require diverse, patient centered treatment and management to remain caries free in the future including fissure sealants, utilising various media such as text messages and online support and addressing issues such as engagement and compliance.
The first phase of this work (Figure 11.1) involved two reviews; a literature review detailing caries experience in young children and subsequent General Anaesthetic (GA) extraction and a broad scoping review describing interventions connected by the common risk factor approach. These reviews gave a comprehensive background and helped to define the research area more clearly. While DGA was noted as a vital procedure for those who were unable to undergo treatment by another means [1] and resulted in positive outcomes i.e. improved oral health and ability to resume day to day activities, given the reasons for referral (usually multiple extractions of carious teeth) along with the morbidity [2] and cost [3] associated with these procedures there was significant need to explore this area. The literature review also highlighted the various networks and pathways that can, in isolation or jointly, result in a DGA extraction. Subsequently, this also informed the potential opportunities for implementing interventions, a theme that continued throughout the thesis. Possible interventions include those downstream to target individuals and families; as well as upstream actions to change policy or regulation.

The scoping review provided a different approach to traditional systematic reviews in categorising previous interventions. The matrix illustrated the key areas that have worked in the past and also gaps in the literature in relation to behaviour change interventions, which are connected to improving oral health in young children. The findings of the review suggest education, as a behaviour change component alone would be ineffective. This is supported by previous research indicating behaviour change is a complex area, and often information alone has a limited effect [4]. Studies that combined an educational component with other behavioural functions such as training or environmental change, did produce significant improvements in the primary outcome, whether it is oral health, diet or BMI. Specific information from the review has been combined with themes developed from qualitative interviews, discussed later in this chapter.

The second stage of this thesis consisted of understanding the population referred for DGA in the North-West of England, and the services provided. The quantitative phase included data collected from parental questionnaires and dental referral/consultation notes. This information elicited a number of topics and issues for consideration. A difference between services was noted throughout the North West; this ranged from the way patients were referred, the support and guidance throughout the process to the length of time they had to wait. These differences were explored further in qualitative interviews with parents and children describing both positive and negative aspects of the services. The information was combined to produce a reference standard DGA service, which incorporated tailored services to children, clearer guidance on the referral
process/treatment on the day and incorporating a preventative element into the DGA service. It was noted for a proportion of the children one of their first experiences with a dentist may be for DGA. Therefore this experience should be as positive as possible and in keeping with ‘making every contact count’ [5] this referral should be treated as an opportunity to intervene and addresses any issues in maintaining good oral health.

This phase, also highlighted the unacceptably long delay some children experienced in receiving their treatment. The impact of these wait times was explored and data indicated an impact on a child’s quality of life, specifically affecting school attendance (26% absent due to dental issue), sleeping at night (38% suffering sleepless nights) and with pain experienced (in 67% of cases) throughout the wait. These issues highlighted the need to not only reduce the number of children being seen for DGA but for effective management of pain and infection to be addressed during a prolonged wait for treatment.

A further issue, which emerged following data analysis, were the high number of repeat DGAs, not only for the child referred but also when looking at a family as a whole with between 33% and up to 59% of families having experienced DGA extraction previously across regions. One of the opportunities to reduce the high number of DGAs would also be to look at the population referred as it is likely a substantial proportion will return within a relatively short time for a repeat extraction [6].

The final aspect to understanding the DGA population was to assess if any subgroups may require tailored interventions. While these data should be treated with caution, given it was an exploratory technique and did not provide precise conclusions, it does illustrate that for a proportion of the population DGA may be the only treatment option given medical or behavioural indicators. The mapping also highlighted there were a proportion of those referred who could be defined as “difficult to reach” given their tendency to relocate to different areas, irregular attendance patterns and where English was not their first language. These aspects need to be taken into consideration when developing interventions and also highlight difficulties in relation to utilising the guidance given in Delivering Better Oral Health [7] which requires regular attendance at a dental practice in order to receive the preventative advice and treatment recommended.

The third phase considered the opportunities and potential interventions that may impact on the number of DGAs provided in the future. This information was gained through both quantitative and qualitative analysis and was combined with the evidence presented in the health interventions matrix described in Chapter 2. When considering potential solutions
to reducing the number of DGA’s there were three distinct techniques, which should be considered and these are described in Figure 11.3.

**Figure 11.3: Opportunities for interventions to impact on the number of DGAs seen**

Parents discussed by the time they got to the dentist the dental decay experienced by their child was already too severe and information or management was required earlier. None seemed to make the connection that registering with a dentist during the early years of the child’s development may have made an impact, therefore to remove this barrier all children should be registered with a dentist through a health visitor, as is currently being trialled in Scotland [17].

GDPs to engage outside of practice with areas of high need i.e. sure start centers, nurseries, etc. given irregular attenders and age of attenders.

Increase preventative techniques appropriate to patients i.e. fluoride varnish or fissure sealants given the known benefits [18]. These could be applied both in and out of dental settings i.e. dentists travelling to areas of high need where families are more likely to attend. Dentists looked to policy and government to change payment/incentives to increase prevention and caries management. Indeed interventions have shown that preventative work is closely linked with payment [19]. If increased preventative treatment were to be addressed, remuneration could be a simple way to achieve this behaviour change effectively [20].

Introduction of an alternative pathway to triage and treat a proportion of children out of the hospital setting (Chapter 9)

Prevention sessions offered, prior to the operation to fissure seal the remaining teeth (if appropriate) and offer prevention advice and training for parents and children.

Use of play specialists/dental teams experienced in working with children and child friendly environments to promote positive encounters within a dental environment and encourage further engagement with dentistry in the future.

Interventions either targeting individuals or via the community (sure start, vaccination appointments) using repetitive, behavioural change functions i.e. training or enablement combined with education (oral health toolkits containing age appropriate items such as a training cup have been shown to be beneficial) (Chapter 2).

Target ‘hard to reach families’ using alternative methods e.g. utilising technology. Studies have indicated both web based interventions [14] and mobile phone text messages on oral health [15] have proven to be effective and given the ability to translate messages and online content, may also help with any barriers in regards to a parent’s first language.

Tackle issues that go beyond dental health interventions addressing the broader challenges within family life i.e. parental training, support and environmental restructuring discussed in chapter 8. Equipping parents with the skills required to adapt as children develop and start to gain independence and modify routines [16].

Policy change and national guidelines tackling diet (common risk factor approach). Environmental changes to encourage sugar free food and beverage consumption i.e. healthy menu choices made available.
The patient/public interventions in Figure 11.3 focus on behavioural change as a function. Behaviour change is not limited to targeting individuals but ranges from these downstream approaches to upstream interventions such as policy change, which could impact in a broader sense, benefiting the population and impacting not only on oral health but health in general. These suggestions have been formulated using ‘triangulation’ as a methodology, combining information from qualitative interviews in regard to what parents and dentists would find beneficial and quantitative data in respect to the population characteristics. Additionally, previous research described in the health intervention matrix produced in Chapter 2 detailing various interventions and the underlying function behind them were included.

One of the main themes that emerged throughout the interviews was the need to target parents and children at an early stage. Therefore interventions based within schools were viewed as less beneficial, given many of the children were preschool or had recently started school with 25% of children under 5 years old when they undergo the operation and over half of children operated on being no more than 6 years old. This indicated the majority of disease had occurred at a young age. Therefore opportunities when children are below 5 years old have been specifically considered. This is thought provoking in relation to the NICE guidelines, which largely target school based interventions in a section of guidelines around child oral health. While some children would benefit from this there are a significant proportion of this group who require intervention much earlier [8]. Parents discussed interventions through Sure Start centres and nurseries when considering targeted approaches. In addition GP practices, community activities and even as one parent suggested job centres could be potential sites to base interventions when looking at a wider approach. Various approaches have shown to be effective within these settings including, nutritional education activities at nursery [9], tooth brushing at nursery [10] or giving out oral health kits at vaccinations [11].

Upstream interventions through policy change and national guidelines are where the greatest and most significant impact could be made. This was discussed from both the parent and dentist’s perspective and is supported by evidence from the health intervention matrix (Chapter 2). A change in policy can include; communication/marketing i.e. media campaigns around diet, fiscal changes i.e. taxing sugar or sugar based foods, legislation i.e. prohibiting the sale or use of certain foods or drinks, environmental/social planning therefore changing the physical environment in such as way to encourage a desired behaviour, this could be a change in lunch menu choices at nurseries and schools, availability of sugar free food and drink through vending machines and food outlets and
service provision that could be the increase in preventative techniques being employed not only through dental clinics but across other appropriate settings [12]. The studies within the health intervention matrix indicated those using a combination of environmental changes, enablement and education could be successful in changing dental health, diet or weight. Dentists also expressed a need to tackle from a policy perspective the issue of sugar within diet and provide a consistent message nationally, while placing fiscal restrictions on food and beverages containing high amounts of sugar and companies who promote beverages or food, which may be detrimental to children’s health.

Reflections on the Thesis

The progress throughout my PhD has provided numerous opportunities, not only in conducting research using a variety of methods, being able to attend and contribute at conferences but also working within an area I not only find of great importance but also one which evokes strong emotion. There are a number of distinct stages within a PhD from initiation, deciding to undertake a research project of this magnitude, through the trials and breakthroughs to the final write up. This PhD began with the discussion of the number of Dental General Anaesthetics carried out in the North West for children, which had been documented by the Dental Observatory. I decided this was an area I would like to pursue as my PhD Thesis, looking at potential ways to reduce the high number of young children seen for this procedure.

Various occasions throughout the thesis have provided the opportunity to study new methods and acquire additional skills. One such example was the use of Multiple Correspondence Analysis which I became aware of while organising an educational day for early career researchers and discussing the project with members of the Cathie Marsh Institute for Social Research. Additionally I was able to view the police intervention matrix, which became the basis for Chapter 2’s scoping review at a Campbell Collaboration conference and incorporated the ideas discussed there into my thesis.

The project was a steep learning curve, not only in the subject matter, as I was relatively new to dentistry as a research field but also in the processes and procedures required to conduct research within the NHS. Finding my way through ethics applications, amendments, site specific information (given the number of different hospitals attended) were lengthy and at times frustrating but this has equipped me for further studies I am now working on which has been vital for the smooth running of new projects.
There were no drastic changes or issues throughout the thesis. However there were some challenges and at times small modifications had to be made. The main change revolved around the qualitative research. There were two issues in this area. Firstly it was my desire to interview both parents and children, as the main impact of requiring a DGA to extract carious teeth would be on the child and their views and opinions have been absent from previous research. Unfortunately there were a number of obstacles to including children in the interviews. Firstly parents were reluctant for their child to be involved. This could have been due to the age of the child (some as young as three were unable to take part in interviews) to parents being apprehensive about the interview effect on their child, as it would involve discussing the operation.

When children were involved they were often very young (4 or 5 years old) and it was a challenge to engage them in the interview regarding their visit or day-to-day activities, which may impact on oral health. Often parents would heavily prompt children or interrupt and therefore many of the interviews with children were not useable. While it would have given a different perspective on DGA extractions, from a child’s point of view, losing the children from the majority of interviews did not negatively impact on the conclusions that could be drawn in a substantial way. This is because, given the age of the children, it is the parents who hold control over their diet, routines and oral health behaviours and therefore the parents who need to be supported in this area.

The second matter regarding qualitative interviews was the difficulty in recruiting parents to take part. While quantitative data collection managed to achieve a high recruitment rate through hospitals with the majority of parents completing the questionnaire; asking parents to give up a substantial amount of their time (approximately an hour) to take part in the qualitative interview meant most declined to take part. This could have affected the range of parents we wanted to include and it is possible a proportion of families may not be represented in our sample, for example there were few parents with children under 5 who took part in the qualitative interview. However, generally the spread of families who did take part appeared to capture a range of those who are referred with an assortment of children of different ages and requiring a number of extractions.

Implications for Policy and Further Research

Policy:
There are a number of implications for policy and service design from this work. As discussed in Chapter 5 and 6 a ‘reference standard’ DGA service has been illustrated
which incorporates elements of prevention and management throughout the process (see Figure 5.3). This not only advocates best practice which could be shared across hospitals but also addresses to some extent the issue of repeat DGA with additional prevention. It is also suggested that remuneration around preventative treatment needs to be addressed. While prevention is paid for within the NHS there is still an issue with an apparent lack of preventative techniques being applied and dentists unaware or unhappy with the payment provided in primary care for the delivery of prevention.

Two of the key points that have emerged from this work are the disparity between this particular population referred for DGA and the advice and guidance given both through Delivering Better Oral Health (DBOH) and NICE guidelines. While DBOH is a tool kit for clinical dental teams and is a vital evidence informed publication for prevention, a proportion of children will not realise the benefit if they do not attend regularly or relocate and prevention advice is not continued. Along this theme the new guidance from NICE places a substantial emphasis on school based prevention. Once again a proportion of children within this population will already have severe decay by the time they attend or are in their first year of school. While school-based programs are an important part of providing for and supporting oral health in children, interventions at this stage would be too late for a substantial proportion of children referred for DGA. Elements from DBOH and guidance from NICE can be integrated to benefit this population. Models such as Childsmile in Scotland, pursuing early prevention with preschool children and ‘Baby Teeth DO Matter’ in Greater Manchester, focusing on early child development, could also positively impact and future work could build on these bases to benefit both those referred for DGA and child oral health in a broader sense.

Future Research:
Based on the information gained throughout the thesis it was apparent that, within certain regions of the North West of England, repeat General Anaesthetics either for the child referred or for other children within the family were surprisingly high (up to 59%). It was clear that children or families could fall into a cycle of poor oral health and return for a second (or third) DGA in the future. Therefore it was decided to apply for funding (through RfPB) to conduct a targeted intervention for families who have a child attending hospital for a DGA

Intervention
A Targeted Intervention to Reduce General anaesthetic Extractions of children’s teeth (TIGER teeth).
The intervention is based on studies demonstrating a benefit through the health intervention matrix (Chapter 2). Results indicated education, along with some form of enablement such as an oral health toolkit, could prove successful in impacting on behaviour change. The intervention consists of posting out a toothbrush and 4 tubes of toothpaste per child living at the family home every three months. An information leaflet will also provide simple key messages on the ‘golden hour’ before bed; therefore encouraging brushing, no food during this hour and establishing a routine. Text messages will be sent every 2 weeks to reinforce simple oral health messages as repetition has also been noted as a factor in successful interventions.

Design
A randomised control trial will be used to test the intervention, with families allocated to either receive the intervention or receive no additional preventative oral health advice or treatment (usual care). Several studies have shown the average time between repeat GA’s is 2 years. Follow up would therefore occur over 2 years to monitor and compare the number of DGA’s carried out on individual children in eligible families.

Study flow - RCT

Participants
Inclusion criteria
Consenting individuals and their families attending for a routine extraction of one or more teeth under general anaesthetic at one of the North West Hospital sites (Manchester Royal Children’s Hospital, Bolton Hospital, Trafford Hospital, Stepping Hill Hospital). Families are unit of randomisation and subjects are those children aged less than 10 years at recruitment.
Recruitment

The sample size calculation based on a 95% confidence level, 80% power and an equal RCT of families allocated to the intervention and control scenario would mean given a 30% repeat rate in the control a drop to a 20% repeat rate in the intervention arm would require 818 families (409 in each group) to detect a statistical significant difference.

However secondary analysis should be conducted to see if any significant difference occurs on an individual level taking an occurrence of GA for one child in this way the team can also examine if the intervention works more effectively within different age groups i.e. younger siblings.

Statistical Plan

This will be an intention to treat (ITT) analysis. The number of referrals, within each family unit, for DGA in each group will be compared as the primary outcomes and total number of referrals for all children enrolled in the study as a secondary outcome.

The primary outcome is based on a GA occurrence within the time frame established (6 months to 2 years after enrolment in the study) within a family unit. Therefore clustering will not be an issue for the primary outcome. The relative risk (RR) will be calculated as a straightforward comparison of the propositions in each group, calculated using the proportion experiencing the event on the intervention arm divided by the proportion in the control arm. Chi-square will be the statistical test used.

ITT analysis with dichotomous data is more problematic than when a score is available for a participant, which can be carried forward. Cochrane suggests either assume all missing participants either experienced the event or did not experience the event.

Clustering in family units will be controlled for using robust standard error methodology. Poisson regression with robust standard errors can give correct SE and p values for risk ratios for clustered data within families.

The above study details one intervention that can be pursued following the initial work conducted for the thesis. Further work to be considered also involves following the alternative pathway participants over 12 months determining the on-going impact of being treated in a primary care facility and the health economic component of this service and pathway and whether this could supplement the GA pathway. Additionally, following the data on the apparent lack of prevention, future work could also address opportunities for
prevention either prior to the DGA operation or shortly after. The use of fissure sealant is one of the most viable options given the nature of the population involving irregular attendance, as this would protect the tooth for the longest period of time. This work could look at fissure sealing teeth during a prevention session given shortly before or after a DGA operation and determining the effects. An additional element could look at incentives and payment for specific prevention such as fissure sealants. Further work could be to investigate interventions targeting early years services for pre prevention in high risk areas such as sure start centres or the distribution of toothpaste and brush to toddlers and young children as seen in the NIC-PIP trial currently being conducted in Northern Ireland [13]. This could include using DGA referral patterns or geo-demographic distribution of caries in populations to indicate which regions to tackle.

**Closing reflections**

It is only through the use of multiple health improvement strategies both targeting upstream approaches, including policy change, through community interventions involving a variety of behaviour change functions from environmental restructuring, training and enablement to specific support for individuals that a substantial impact on those who suffer from the most severe decay and ultimate extraction under General Anaesthetic can be improved.
References


Chapter 12

Appendices: Supplementary File
Information
Appendix 12.1.1: Review Methods and Strategy

Given the nature of the intended research; using a mixed methods approach combing both quantitative and qualitative methodologies, a similar approach has been taken in respect to the literature search and review conducted. In allowing findings from different methods to be included this gave the ability to review papers that detailed not only the social determinants of caries leading to GA extractions and the procedures connected to this but also how this occurs. Looking at areas in more depth, qualitative work can also contribute to the reasons why differences are seen between studies and to greater understand the underlying inferences.

Table 12.1.1: Literature Review search terms used within the Cochrane Library and using OVID

<table>
<thead>
<tr>
<th>Database</th>
<th>Search Strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Via Ovid</strong></td>
<td></td>
</tr>
<tr>
<td>Embase</td>
<td>Tooth extraction/</td>
</tr>
<tr>
<td></td>
<td>((tooth or teeth or molar$ or incisor$ or canine$) adj</td>
</tr>
<tr>
<td></td>
<td>(extract$ or remov$)).mp.</td>
</tr>
<tr>
<td>Global Health</td>
<td>(oral adj (surgery or surgical)).mp.</td>
</tr>
<tr>
<td>Psychosocial</td>
<td>(dental adj (surgery or surgical)).mp.</td>
</tr>
<tr>
<td>Instruments</td>
<td>exodontia.mp.</td>
</tr>
<tr>
<td>Maternity and</td>
<td></td>
</tr>
<tr>
<td>Infant Care</td>
<td></td>
</tr>
<tr>
<td>Ovid MEDLINE</td>
<td></td>
</tr>
<tr>
<td>PsycINFO</td>
<td></td>
</tr>
<tr>
<td><strong>COCHRANE LIBRARY</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>MeSH descriptor Tooth extraction explode all trees</td>
</tr>
<tr>
<td></td>
<td>((tooth near/3 extract*) or (tooth near/3 remov*) or (teeth near/3 extract*) or</td>
</tr>
<tr>
<td></td>
<td>(teeth near/3 remov* or (molar* near/3 extract*) or (molar* near/3 remov*) or</td>
</tr>
<tr>
<td></td>
<td>(canine* near/3 extract*) or (canine* near/3)</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>MeSH descriptor Dentition, primary explode all trees</td>
</tr>
<tr>
<td></td>
<td>(&quot;primary dentition&quot; or &quot;primary teeth&quot; or &quot;primary tooth&quot; or &quot;deciduous</td>
</tr>
<tr>
<td></td>
<td>teeth&quot; or &quot;deciduous tooth&quot; or &quot;milk teeth&quot; or &quot;milk</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>MeSH descriptor Anaesthesia, General explode all trees</td>
</tr>
<tr>
<td></td>
<td>(&quot;general anaesthetic&quot; or &quot;general anaesthesia&quot; or &quot;general anaesthetic&quot;)</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

302
remov*) or (incisor* near/3 extract*) or (incisor* near/3 remov*))

((oral near/2 surgery ) or (oral near/2 surgical*))

((dental near/2 surgery ) or (dental near/2 surgical*))
exodontia*
tooth* )

(preschool or preschool or infant or toddler or "early childhood" or baby or babies or child*)

GA in Title, Abstract or Keywords

The search strategy developed as searching progressed and was allowed to be as flexible as possible in order to obtain all the most relevant information. Multiple sources have been used as well as multiple methods including; databases, pearl growing (using a citation source to develop terms for further searchers), contacting experts, Cochrane and Grey Literature.

Table 12.1.2: Final number of records used within Literature Review

<table>
<thead>
<tr>
<th>Database:</th>
<th>Date searched:</th>
<th>Number of records found:</th>
<th>Selected based on abstract (protocol only, removed)</th>
<th>Final numbers (Removed dated before year 2000 for GA related studies)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Via OVID</td>
<td>04.07.11</td>
<td>457</td>
<td>154</td>
<td>94</td>
</tr>
<tr>
<td>The Cochrane Central Database of Controlled Trials (CENTRAL)</td>
<td>04.07.11</td>
<td>95</td>
<td>79 Clinical trials</td>
<td>25 clinical trials</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5 systematic reviews</td>
<td>5</td>
</tr>
<tr>
<td>TOTAL (after duplicates and previous search results removed)</td>
<td></td>
<td></td>
<td>124</td>
<td></td>
</tr>
<tr>
<td>Other search Engines, Google scholar, Web of Knowledge, PubMed, Grey literature using pearl growing and expert advice</td>
<td></td>
<td></td>
<td>64</td>
<td></td>
</tr>
</tbody>
</table>
Appendix 12.2.1: Pilot Study

Introduction

The aim of this pilot study was to find the most appropriate balance between sensitivity of the electronic searches keeping the results down to a reasonable number in order to make efficient use of resources.

Materials and methods

A preliminary rapid scoping exercise was carried out. Studies were identified by both an electronic search of Medline, Embase and Google scholar and further by the reference sections of suitable studies. Five papers were then selected based on the predefined inclusion criteria following assessment of title, abstract, methods and results.

Those meeting the inclusion criteria


These five studies were used to refine the search strategy, as it is important to have both sensitivity and precision when developing a search strategy. In order to do this reviews should be constructed to maximise recall and deal effectively with factors not relevant to the research question by refining the research strategy [35].
Results

The first search used the Medline (via Ovid) database and initially used terms developed from the research questions, these were refined as more studies were identified and search terms were explored (through guided MeSH/Emtree subject searching). Three trial searches were carried out as set out in Table 2.2.2. The results are presented in Table 2.3 and 2.4 for Medline and Embase respectively. The search terms used the field code m_titl to include words present in the title of the study as mp. (multipurpose) produced results that were too vast to review. The most appropriate search terms for both were using version 3 as this the most successful search in terms of the number of key studies it returned but also balanced with the total number of studies to review (sensitivity and specificity). These search terms were therefore used for the final scoping review.

Table 2.2.2: Search terms in Medline and Embase

<table>
<thead>
<tr>
<th>Version 1</th>
<th>Version 2</th>
<th>Version 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>infant$ or toddler$ or child$ or schoolchildren and Dental decay or DMF or DMFT or DMFS or decay$ or caries or carious ECC or early childhood caries or Oral Health or obesity or obese or diet$ adj2 sugar or Healthy eating or Health services and intervention</td>
<td>pre?school$. or child$ or ((parent or mother or farther or guardian or carer or care giver) adj3 (toddler$ or child$ or infant)) and decay$ or caries or carious ECC or early childhood caries or Oral Health or Healthy eating or diet$ or nutrition or feeding adj habit or health services or oral or dental and intervention or program or health program/ or education program or prevention program</td>
<td>Preschool child or baby or babies or infant$ or toddler$ or pre?school$ or pre school$ or child$ or kindergarten$ or ((parent or mother or farther or guardian or carer or care giver) adj3 (toddler$ or child$ or infant)) or schoolchildren or minor or primary dentition or primary t##th or deciduous t##th or milk t##th) and (Health intervention or (health adj3 (promot$ or prevent$ or educat$ or intervent$)) or primary prevention or (parent$ adj3 (program$ or train$ or educat$ or promot$ or intervent$)) or Health behavio?r or (behavio?r$t and Motivation) or (behavio?r$t and Opportunity) or (behavio?r$t and Capability) or (behavio?r$t and (chang$ or modif$)) or community health planning or community health services or (national adj (policy or policies or strateg$ or program$)) or media or community network or community health centre$ or health services or social environment or behavio?r$t Therapy or Social Support or Community</td>
</tr>
</tbody>
</table>
intervention$ or health promoting school$ or (school$ adj3 program$) or (parent$ adj3 (behavio?r or involve$ or control$ or attitude$ or educat$ or program or promot$ or intervention$)) or (Health adj2 Policy) or (Nutrition adj2 Policy) or (preventive measure$ or preventative measure$) or coercion or training or enablement or modelling or environmental or restrictions or education or persuasion or incentive or sure start or head start or family intervention or Home visit or Group based interventions or Primary care interventions or (community adj3 program$) and (Dental decay or (DMF or DMFT or DMFS) or (dental adj3 (pain or toothache)) or (decay$ or caries or carious ECC or early childhood caries) or Oral Health or Oral Hygiene or (bmi or body mass index) or (obesity or obese) or (weight gain or weight loss or underweight or overweight) or (weight adj2 change$) or (sugar adj2 intake) or (diet$ adj2 sugar) or (sugar$ adj2 food$) or (sugar$ adj2 beverage$) or (sugar$ adj2 drink$) or (carbonated adj2 beverage$) or (carbonated adj2 drink$) or soft drink or (high fat$ or low fat$ or fatty food$) or Healthy eating or Healthy eating or Dietary Carbohydrat$ or Feeding Behavio?r or diet$ or nutrition or (food adj habit$) or (feeding adj habit$) or type 2 diabetes or hospitalisation or dental general anesthetic or (Health services adj2 (GDP or GP)) or secondary care attendance or primary care attendance

Table 12.2.3: Trial searches in Medline, Results

<table>
<thead>
<tr>
<th>Search strategy</th>
<th>Medline v1</th>
<th>Medline v2</th>
<th>Medline v3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of results returned</td>
<td>267</td>
<td>3100</td>
<td>1113</td>
</tr>
<tr>
<td>Met inclusion criteria</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>de Silva-Sanigorski et al., 2010</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Neumann et al., 2011</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Antonio et al., 2007</td>
<td>x</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Taylor et al., 2007</td>
<td>x</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Shelton et al., 2007</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>

✓ Returned in search
x Not returned in search
### Table 12.2.4: Trial searches in Embase, Results

<table>
<thead>
<tr>
<th>Search strategy</th>
<th>Embase v1</th>
<th>Embase v2</th>
<th>Embase v3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of results returned</td>
<td>707</td>
<td>5949</td>
<td>1464</td>
</tr>
<tr>
<td>Met inclusion criteria</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>de Silva-Sanigorski et al., 2010</td>
<td>X</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Neumann et al., 2011</td>
<td>X</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Antonio et al., 2007</td>
<td>X</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Taylor et al., 2007</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Shelton et al., 2007</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

**Figure 12.2.4: Example of Medline search Version 3**

![Example of Medline search Version 3](image)
Appendix 12.2.2: Health Matrix extraction sheet.
<table>
<thead>
<tr>
<th>Title (Year)</th>
<th>Author Ref</th>
<th>Study population (group)</th>
<th>Number of Cases</th>
<th>Intervention type</th>
<th>Theory</th>
<th>Methodology</th>
<th>Outcome</th>
<th>Successful (Yes)</th>
<th>Bias problems etc.</th>
<th>Grade</th>
<th>Intervento etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Axelsson et al., 1994</td>
<td>222, 12 to 13 year old school children in Brazil who regularly brush their teeth</td>
<td>Intervention group 1 children were trained around needs related oral hygiene habits (self diagnosis) using the 'Linking method' (After performing oral hygiene exercises asked to include in daily routine) Intervention group 2 received oral hygiene instruction on how to clean teeth Control – no intervention</td>
<td>Motivational program linking behaviour to routine</td>
<td>Motivational</td>
<td>3 arm randomly assigned</td>
<td>Outcome: Caries (into dentin)</td>
<td>Yes difference between group 1 and other 2 groups with means of 2.3 (0.29 vs 4.7 (0.59 and 5.3 (0.68) )&lt; 0.001</td>
<td>No difference in just training in oral hygiene had to have a behavioural component i.e. exercises and linking this to routine</td>
<td>++</td>
<td>Only included those who already had a good tooth brushing routine so does not look to change behaviour of those who display habits which might be detrimental to oral health. No mention of blinding of dentists</td>
</tr>
<tr>
<td>4</td>
<td>Bean, Wilson, Thornton, Kelly, &amp; Mazzeo, 2012</td>
<td>(n =46) or control ( =50)</td>
<td>Virginia USA</td>
<td>NOURSH - Group based intervention, focused on parent skills and role modelling to improve health behaviour vs. information received regarding child diet</td>
<td>Social Cognitive theory</td>
<td>Randomised control trial</td>
<td>Outcome: Dietary intake (self reported diet intake)</td>
<td>Mixed - both control and intervention showed improvement in different areas. Intervention sig improvement in calories and sugar intake (p &lt;0.05)</td>
<td>Self report</td>
<td>++</td>
<td>Role modelling</td>
</tr>
<tr>
<td></td>
<td>Study</td>
<td>Population</td>
<td>Intervention/Control</td>
<td>Methodology/Design</td>
<td>Outcome</td>
<td>No Evidence</td>
<td>Education Areas</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
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<td>------------------------------------------</td>
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<td>-----------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Bensley, Anderson, Brusk, Mercer, &amp; Rivas, 2011</td>
<td>Intervention 243 vs. control 534 recruited from 15 women infant and child clinics in Michigan USA</td>
<td>Internet nutrition group 243 vs. traditional nutrition education</td>
<td>N/A evaluating whether online education compares to traditional nutritional education</td>
<td>Juice fruit vegetable consumed (self report)</td>
<td>Yes</td>
<td>Change in juice (0.54, p = 0.001) and veg (0.59 p = 0.044) consumed between internet and traditional group</td>
<td>++</td>
<td>Large loss of participants No Confidence intervals shown</td>
<td>Education (via internet)</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Brotman et al., 2012</td>
<td>186 2-5 year olds USA (at risk for behaviour problems) and their family. Follow up average of 5 years after intervention</td>
<td>Randomly assigned to family intervention or control Family intervention promoted effective parenting (responsiveness control) preventing behavioural problems in early childhood (did not concentrate on diet or physical health) using 2 hour sessions each week over 6 months</td>
<td>Cluster Randomised control trial</td>
<td>BMI</td>
<td>Yes lower BMI relative to control group for both girls OR= 0.20, confidence interval (0.05, 0.81), P = .002 And boys OR 0.32, confidence interval (0.11, 0.92), P = .03</td>
<td>++</td>
<td>Follow up – not originally intended to explore role on obesity. Males not represented due to drop out. Issues around missing data</td>
<td>Enablement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Delamater et al., 2013</td>
<td>8 to 12 yr. old overweight children (USA) referred by a physician 18 families returned for follow up</td>
<td>Web based behavioural intervention for obesity, no comparison Education on health lifestyle, assessment diary and goal setting</td>
<td>no comparison just pre / post test of intervention</td>
<td>z-BMI, healthy eating, intrinsic motivation and self-efficacy</td>
<td>Yes Improvements in intrinsic motivation, (p=0.05), self-efficacy (p=0.025), and healthy lifestyle behaviours (p=0.001)</td>
<td>+</td>
<td>Just a pilot so small sample size and no control</td>
<td>Education, Training (motivation and self efficacy)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>Study</td>
<td>Participants</td>
<td>Intervention</td>
<td>Comparison</td>
<td>Outcome</td>
<td>Notes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----</td>
<td>--------</td>
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<td>8</td>
<td>Elizondo-Montemayor et al., 2014</td>
<td>101 obese, Hispanic, low-socioeconomic school-age children Mexico</td>
<td>Individualized, face-to-face dietetic intervention. Child attended one session every 3 weeks with their caregiver over 1 year.</td>
<td>Individualised diet plan and daily menus</td>
<td>BMI and dietary intake</td>
<td>Yes – BMI sig fell -3.0 (CI -4.27, -1.75) p &lt;0.05 and various significant reduction in consumption such as sweetened beverages, deserts etc.</td>
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<td>9</td>
<td>Friedman, Greene, &amp; Stokes, 1990</td>
<td>25 (8-9 year old children) recruited from a class, following snack selection 8 continued to be involved in the three phases</td>
<td>Baseline snack choice was then followed by education on nutrition and snack selection. A third phase involved correspondence training where a reward for choosing a eating nutritional snack i.e. fruit resulted in a prize</td>
<td>Reward will instigate a change in snack choice</td>
<td>Snack choice</td>
<td>Yes Baseline choice process food 40% of time. With reward chose nutritional snack 100% of time</td>
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<td>10</td>
<td>Harrison, Wong, R.L., &amp; T., 2003</td>
<td>7-year project. Vietnamese preschool children in Canada (followed from 12 month until 60 months of age) final number 16 experimental, 14 baseline and 9 additional comparison</td>
<td>One to one counselling (with Vietnamese health counsellor) with gift with each message i.e. toothbrush trainer cup supported by community activities</td>
<td>MRC development as first they identified gaps in knowledge such as baby bottle use and developed counselling based on this feedback</td>
<td>Carious or none carious (if cavity into dentine)</td>
<td>Yes only 6.2% of experimental children had caries compared to control 50% difference, p &lt;0.05 behaviours recorded were reduction on sleep time with bottle and daytime comfort bottle use</td>
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*Incentivisation*
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<tr>
<th>11</th>
<th>Hindin, Contento, &amp; Gussow, 2004</th>
<th>35 Parents at USA head start centres</th>
<th>Pre test post test - 4 week food safety followed by 4 week media literacy education</th>
<th>Increase knowledge and awareness of advertising specifically food for young children</th>
<th>Conveniences, repeated sample (pre test post test design) food safety pre-test acted as the control</th>
<th>Behaviour s, reading food labels (understanding) and psychosocial factors self efficacy etc.</th>
<th>Yes Media literacy education improved parents understanding of TC advertising and ability to read and understand food labels (p &lt;0.001)</th>
<th>+</th>
<th>Small sample with same participants given both information but control ‘safety around food came first</th>
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<tr>
<td>12</td>
<td>Horodynski, Hoerr, &amp; Coleman, 2004</td>
<td>38 low income families with toddlers (12 - 36 month) from Head start (USA)</td>
<td>NEAT program (intervention group and control group) promoting adult toddler interaction and healthy meal time environment using three, 90 minute lessons</td>
<td>Increased knowledge would result in behaviour change</td>
<td>Quasi experimental longitudinal design (pre test post test) convenience sample</td>
<td>Diet, feeding knowledge perception of diet and practices of diet</td>
<td>No after 6 months no significant differences found between groups for any outputs. Education alone was not enough to change behaviour</td>
<td>+</td>
<td>No randomisation of groups, small sample size however there was 100% attendance at Education Training (empowerment)</td>
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<td>Class</td>
<td>Study Details</td>
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<td>13</td>
<td>Hystad et al., 2013</td>
<td>Children aged 7-12 yrs. old referred by GP to obesity clinic Norway. 47 children randomized to TLG and 52 to SHG. Family based child obesity trial. Interventions 1) therapist lead group and 2) self help group both groups focused on stabilizing regular meals in increase fruit and veg. TLG group enhance competence around targeted lifestyle changes across 10 sessions. SHG based on mutual help around own experiences no education. Blinded randomised control trial 24 month follow up of effectiveness. BMI and body fat. Yes both groups significantly decreased their BMI over 24 months (p&lt;0.05). ++ No actual control group therefore difference could have been seen by parents being referred to centre, ready to make a change and not intervention. Education and Enablement.</td>
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<td>14</td>
<td>Ilett &amp; Freeman, 2004</td>
<td>33 mothers of Pakistani origin with toddlers (average 13 months old) found to be anaemic living in Yorkshire, England. Intensive home based one to one dietary education via 6, one hour visits with a link worker focusing on health weaning and iron rich foods (native speaking taking into account language). Education. Prospective within group study, pre and post test data collection. 24 hour recall diet diary and maternal dietary knowledge. Yes although only raw numbers are presented no statistical test are presented in the paper. + Pre and post test used as control while the study states significantly more mothers gains knowledge following interventions and changed diet the results were not presented in the paper. Education.</td>
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<td>15</td>
<td>Janicke et al., 2008</td>
<td>71 overweight children (8 to 14 yrs. old) and their parents from rural areas of the US (from the original 93)</td>
<td>Intervention delivered by weekly group session for 8 weeks then bi weekly for following 8 weeks and involved implementing strategies for changing eating and exercise, skills and training related to nutrition and set goals for each week.</td>
<td>Educating and modelling</td>
<td>3 arm randomised control clinical trial. 1) behavioural family based, 2) behavioural parent based and 3) wait list. 10 month follow up from start of intervention</td>
<td>BMI</td>
<td>Yes both the family based (0.115, 0.003 to 0.220) and parent based (0.136, 0.018 to 0.254) groups saw significant drop in mean BMI compared to control (no difference between family and parent)</td>
<td>+++</td>
<td>Well designed study</td>
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<td>16</td>
<td>Janicke et al., 2011</td>
<td>31* Children aged 6 to 12 and parents in USA</td>
<td>Intervention included 12 weekly, 90-min sessions over the course of 3 months to change diet and increase exercise using the stoplight system</td>
<td>Education</td>
<td>Randomised control trial, 9 month follow up</td>
<td>BMI</td>
<td>No difference between groups (ANCOVA F(1,32) = 0.90, p=0.77) however it appeared intervention was different by race with African Americans benefiting less</td>
<td>++</td>
<td>Pilot study, poor attendance therefore low numbers</td>
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<tr>
<td>17</td>
<td>Julien &amp; M.G., 1994</td>
<td>10 year old children across 16 classes in Canada</td>
<td>Intervention included dental hygienist attending schools to give advice and a contract between child and program director to encourage commitment</td>
<td>Education</td>
<td>Cluster randomised control trial, one year follow up</td>
<td>DMFS and Loe &amp; Silness plaque and</td>
<td>No - significant difference in plaque score (mean difference 0), DMFS score not discussed</td>
<td>+</td>
<td>No mention of DMFS scores at follow up</td>
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<tr>
<td>No</td>
<td>Study</td>
<td>Participants</td>
<td>Intervention Details</td>
<td>Method</td>
<td>Results</td>
<td>Limitations</td>
<td>Notes</td>
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<td>18</td>
<td>Kavanagh, Cohen, Heinig, &amp; Dewey, 2008</td>
<td>38* parents of infants (1/2 months old) participated in California USA through Women Infant and Children clinic</td>
<td>Intervention received education (through a class) promoting awareness of cues from child and discouraging bottles of more than 6 ounces</td>
<td>Education</td>
<td>gingival index through oral examination and gingivitis worse in intervention group after activities had stopped (2 years after start of program)</td>
<td>+++</td>
<td>Large amount of drop out 104 to 38 parents but well designed study</td>
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<td>19</td>
<td>Kohler 1994</td>
<td>58 (33 intervention and 25 control) mothers with their children in Germany</td>
<td>Intervention group - parents received oral hygiene instruction, dietary instruction and dental treatment if needed. This occurred from when their child was 15 months until 3 years old. Children were then examined at 7 years old</td>
<td>Preventative information for parents about their own oral health will impact on children. Mothers recalled at 4 month intervals for 3 years</td>
<td>Caries free children: Yes 9% vs. 23% caries free p &lt;0.01 (control vs. intervention)</td>
<td>+</td>
<td>No discussion as to how participants were selected very little information on study so difficult to determine what bias or limitations</td>
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<td>20</td>
<td>Moens, Braet, E., &amp; C., 2012</td>
<td>461 Families of children aged 6-12 who are overweight recruited through health examinations throughout schools in an area of Belgium</td>
<td>Intervention group – Parent training 6 group meetings over 5 months providing information both dietician giving advice on meal times and psychologist helped to understand eating habit and lifestyle</td>
<td>Parent training</td>
<td>BMI: Yes significant decrease in intervention group and not for control t(30) = 2.44, p = 0.21</td>
<td>+++</td>
<td>RCT - Areas of biased addressed ITT analysis performed addressing</td>
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<tr>
<td>Study</td>
<td>Sample Description</td>
<td>Intervention Details</td>
<td>Research Design</td>
<td>Outcome Measures</td>
<td>Findings</td>
<td>Strengths and Limitations</td>
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<td>21 Munsch et al., 2008</td>
<td>56 obese children between 8-12 years old attending children’s outpatient clinic in Switzerland were invited to take part</td>
<td>Two groups – one group had 16-session cognitive behavioural therapy for parents and one group for both parents and children. Utilized the TAKE program tailoring treatment to specific problems identified in parent child regarding weight</td>
<td>Randomised control trial (blind) - 6 month follow up</td>
<td>BMI/ % overweight</td>
<td>Yes both treatment groups reduced % overweight over 6 months (p &lt;0.001 linear trend)</td>
<td>+++ RCT – raters were blinded</td>
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<td>22 Mohebi et al., 2009</td>
<td>242, 12 to 15 month old children and mothers in Iran randomised to intervention and control through 18 public health centres</td>
<td>Intervention group ‘A’ received oral health advice at vaccination including feeding habits, sugar intake, transmission of bacteria and oral hygiene and were called at 2 month intervals to remind them of messages. Intervention group ‘B’ just received the information at vaccination</td>
<td>3 arm blinded, cluster randomised control trial, 6 month follow up</td>
<td>% teeth with dental caries (WHO criteria for caries diagnosis)</td>
<td>Yes significant difference between those with pamphlet and reminders vs. control 7% vs. 29% with caries 0&lt;0.01 but not information once vs. control (17% p 0.14)</td>
<td>+++ Well designed study few limitations drop outs were acknowledge and differences were incorporated into analysis</td>
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<td>23 Park et al., 2014</td>
<td>202 parents of overweight children in England participants approached from wider national child measurement program</td>
<td>No intervention parents received info about their child’s overweight status and related health implications.</td>
<td>Cohort – sample from a larger survey. Follow up after one month of information being given</td>
<td>Assessed intention to change health behaviour s and self reported positive change in health</td>
<td>Mixed There was a reported change in both behaviours and intention to change behaviour this was more likely in those who acknowledged their child was overweight OR 11.2 (4.49 to 27.93) but</td>
<td>+ No control only tested within group of overweight children not against ‘no feedback given’ only a small number of overweight</td>
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<td>Model used to identify different stages of behaviour change.</td>
<td>Behaviour</td>
<td>Children within sample selected and low response rate (202/18000)</td>
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<td>24 Penny et al., 2005</td>
<td>Difficult to tell if feedback made a difference</td>
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<td>377 babies (187 Intervention and 190 control) and parents from Lima</td>
<td>Enhance quality and coverage of nutrition education – therefore improving the service rather than individual service providers</td>
<td>Well designed analysis by intention to treat, no mention of blinding</td>
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<td>Intervention area included services with improved information given out through heath services</td>
<td>Cluster randomised control trial over 2 years</td>
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<td>24 hour dietary diary feeding practices at 6, 9, 12 and 19 months old</td>
<td>Yes, improvement across areas of feeding practices and diet (38% vs. 49% p = 0.043) and resulting child growth (16% vs. 5% p = 0.001) in intervention group</td>
<td>Enablement Environmental (Service provision)</td>
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<td>25 Plutzer &amp; Spencer, 2008</td>
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<td>441 pregnant women took part approached in antenatal clinics in Australia</td>
<td>Anticipatory guidance could provide foundation for good oral health</td>
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<td>Intervention group received 3 rounds of information on child oral health (anticipatory guidance – advice based on needs of child at a particular stage in their life) and had structured telephone consultations with intervention group using 18 questions as prompts to look at oral health and diet of infants</td>
<td>Blinded Randomised control trial At the age of 20 ± 2.5m children from all intervention and control groups were examined by a dentist</td>
<td>Blinding of examiners discussed</td>
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<td>Anticipatory guidance could provide foundation for good oral health</td>
<td>Clinical examination S-ECC (one or more upper incisor teeth surfaces = carious – either non cavitated or cavitated)</td>
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<td>Yes – incidence of S-ECC was 1.7% (intervention) vs. 9.6% (control) p &lt;0.001</td>
<td>Well designed analysis by intention to treat, no mention of blinding</td>
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<td>No.</td>
<td>Author(s), Year</td>
<td>Sample Size</td>
<td>Intervention Details</td>
<td>Comparison</td>
<td>Outcome Details</td>
<td>Study Design</td>
<td>Comment</td>
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<td>26</td>
<td>Raj et al., 2013</td>
<td>538 mothers with children aged 23-72 months attending selected centres</td>
<td>Intervention included an oral hygiene training package over 7 months including diet, use of fluoride toothpaste</td>
<td>Short term</td>
<td>Pre/ post test</td>
<td>Oral health, oral habits (brushing) caries (synder test)</td>
<td>Yes difference pre and post intervention for brushing 4.1% to 9.9% (p &lt;0.0001), plaque 75.5 to 66.5% p &lt;0.05 and caries 48.2% to 32.2% (p = 0.01)</td>
<td>++</td>
<td>Article acknowledged this was a short term intervention but no control</td>
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<td>27</td>
<td>Seow et al., 2003</td>
<td>107 children (44 boys, 63 girls) attending community child health centre in metropolitan Brisbane. Mean age at examination was 20.5+16.5 months. Children: 79% dentate, 22% pre-dentate.</td>
<td>Single dental health education session &amp; tooth brushing instructions to mothers.</td>
<td>“Before and after” (no control group).</td>
<td>Mutans streptococci infection (by swab) Frequency of tooth brushing (by questionnaire)</td>
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<td>28</td>
<td>Sharma, Hebbal, Ankola, &amp; Murugabupathy,</td>
<td>N= 143 mothers of preschool children (mean age 3.3 yrs. old) in an area of India from one preschool.</td>
<td>Intervention 1) health message through text message</td>
<td>RCT</td>
<td>Self complete questionnaire of</td>
<td>Yes - significant increase in practices and plaque scores (p&lt;0.001) in both</td>
<td>+</td>
<td>Short study (4 weeks) so unclear if results would be long lasting. Difficult to extrapolate outcome to real life intervention</td>
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Education and training
<table>
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<tr>
<th>Year</th>
<th>Study</th>
<th>Sample Size</th>
<th>Intervention Details</th>
<th>Health Practices</th>
<th>Carried Out by</th>
<th>Control Group Details</th>
<th>Findings</th>
<th>Notes</th>
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<tbody>
<tr>
<td>2011</td>
<td>Shelton et al., 2007</td>
<td>N=43</td>
<td>Families with a child aged 3-10 with a BMI&gt;85th percentile (i.e. NHMRC definition of overweight)</td>
<td>21 messages were sent over 7 days every week for four weeks</td>
<td>health practices carried out by mother and VPI</td>
<td>N=15</td>
<td>It has been found that parenting style and inconsistent discipline influence child behaviour. Therefore, improving parenting behaviours may be an effective way to reduce childhood obesity.</td>
<td>+ Anova analysis revealed a significant treatment group by time interaction (p&lt;0.05) indicating that children in the intervention group decreased their BMI compared with control group children.</td>
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<td>29</td>
<td>(Shelton et al., 2007)</td>
<td>--&gt; Pilot study (1yr)</td>
<td>Los Angeles</td>
<td>Families randomly assigned to either intervention or wait list control group.</td>
<td>RCT with a three month follow up</td>
<td>Standardized BMI scores, waist circumference</td>
<td>Yes</td>
<td>Small sample size and short follow up but well designed</td>
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<td>30</td>
<td>Slusser et al., 2012</td>
<td>--&gt; Pilot study (1yr)</td>
<td>Los Angeles</td>
<td>Group 1) n=44, The intervention group – Mothers participated in 9 x 90-min sessions over 15-17 weeks. Incorporated healthy nutrition and physical activity messages based on Social learning theory</td>
<td>BMI z-score outcomes</td>
<td>Yes BMI z score difference for the intervention group =-0.20 (SE 0.08), whereas for control</td>
<td>++</td>
<td>Small sample number, High drop out with no ITT analysis</td>
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<td>Study (Strippel, 2010)</td>
<td>Description</td>
<td>Control</td>
<td>Outcome</td>
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<td><strong>Intervention</strong> - Kassel, central Germany. Included all children attending 30 specialist paediatric practices n = 2040 Control = Kiel and Rendsburg, Northern Germany. Comparable region to control n = 2100</td>
<td>Adding consultations devoted specifically to oral health to the current health program delivered to children during the first two years of life. Paediatricians delivering the messages were given a 2-day training course, and required to learn a script by heart. They were contractually obliged to mention 7-8 oral prevention topics at each appointment and to spend at least 15mins for SC-OHE (Think this is Structured comprehensive paediatric oral health education supported by written info). Leaflets given out and the use of fluoride salt or F-supplements were recommended.</td>
<td>Controlled prospective intervention. Knowledge, attitude and behaviour of the parents</td>
<td>Mixed Intervention not delivered as described in methods section. % of 7m old children who never received a bottle containing cariogenic content during the day was significantly higher in the intervention group than control group (p&lt;0.001); however there was no significant difference in those receiving such a + They didn't deliver the intervention stated. The method stated that the paediatricians were contractually obliged to mention 7-8 oral prevention topics per appointment; however, the results section shows that they did not –</td>
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Control received conventional oral health education only.

The reported percentage of 7-month-olds receiving baby food with added sugar was significantly less in the intervention group than the control group (p<0.001); however, no significant differences between intervention and control groups in the cariogenic food/drinks consumed by 24-month-olds.

Only pt. reported outcomes were measured – dmft or other physical characteristics were not mentioned.

Authors claim increase in knowledge, but display no tables to back this up.

<table>
<thead>
<tr>
<th>Study</th>
<th>Population</th>
<th>Group 1</th>
<th>Methodology</th>
<th>Outcome</th>
<th>Design</th>
<th>Initial Knowledge</th>
<th>Follow-up</th>
<th>p-value</th>
<th>Stat. Significance</th>
<th>Comments</th>
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<tbody>
<tr>
<td>Tershakovec et al.</td>
<td>261 hypercholesterolemia 4-6 months</td>
<td>Nutritional Intervention group</td>
<td>Practitioner RCT</td>
<td>Knowledge</td>
<td>Mixed</td>
<td>+++</td>
<td>ITT analysis</td>
<td>Education</td>
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10 year old children were enrolled into 1 of 2 intervention groups or a control group.

81 children were enrolled into the not-at-risk control group. Not clear where the children were from.

### Groups

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<th>Group</th>
<th>Description</th>
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<tr>
<td>1. Parent-child auto tutorial program</td>
<td>- audiotaped stories, picture books, paper-pencil activities, parents manual (n=88)</td>
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<tr>
<td>2. Nutritional intervention group</td>
<td>- Parents &amp; children attend a 45-60min counselling session with a registered dietician (n=86)</td>
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<td>3. At-Risk Control group (n=87)</td>
<td></td>
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<tr>
<td>4. Not at risk control group (n=81)</td>
<td>(=children with normal cholesterol levels)</td>
</tr>
</tbody>
</table>

Initiated intervention as an alternative approach to nutritional education. Within subject measurements were modelled across time. Intervention effects were evaluated 3, 6, & 12 months post baseline.

The increase in knowledge of the children in intervention group (1) was significantly different (greater) to the knowledge gain at the at-risk control group (3).

- The increase in knowledge of the children in intervention group (2) was greater than that of the at-risk control group, but not significantly so.

Both intervention groups demonstrated lower fat intakes than the control groups, but it is not clear whether the difference is significant or not.

- Significant within-group decreases in LDL cholesterol levels were observed both intervention used. Successful study however limited information on blinding.
<table>
<thead>
<tr>
<th></th>
<th>(Thompson et al., 2012)</th>
<th>Education – via Touchscreen computer containing child nutrition and feeding modules</th>
<th>The educational computer-based programs were based on 3 learning theories – Behavioural, Cognitive and Humanistic.</th>
<th>Pilot study. 2 arm, RCT (block randomisation, 10-per-block)</th>
<th>Knowledge (measured by response to questionnaire (administered verbally))</th>
<th>Yes – the mean total summed knowledge scores were greater in the intervention group than control (90.8% vs. 72.3, P &lt;0.001)</th>
<th>++</th>
<th>Pilot study – only small sample size but well conducted</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baltimore, Maryland during a 6m period in 2010. Most children from Spanish speaking Latino immigrant families, with low level of education.</td>
<td>Intervention arm (n = 80)</td>
<td>Control arm (n=80)</td>
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<td></td>
<td>(Vazir et al., 2013)</td>
<td>Mothers and infants (3m old) were followed for 12m.</td>
<td>Teaching caregivers appropriate complementary feeding, and strategies for how to feed and play responsively through home-visits would increase children's dietary intake, growth, and development compared to home-visit</td>
<td>Cluster randomised trial</td>
<td>Dietary interaction, iron status, growth and development</td>
<td>Yes – intervention groups had significantly(p&lt;0.05, but exact value not reported) increased median intakes of energy, protein, and certain vitamins and minerals.</td>
<td>++</td>
<td>Only larger villages selected so not necessarily applicable to population of that are. Potentially too many messages or combination of messages difficult to distinguish element that contributed to intervention</td>
</tr>
<tr>
<td></td>
<td>sample size required calculated to be 600 pregnant women in rural India</td>
<td>Three groups 1) Control – received only the routine services 2) In addition to routine services, mothers received nutritional education messages on complimentary feeding received 2-4 times / month 3) In addition to routine messages, mothers received group education on complementary feeding and also messages and skills on responsive feeding.</td>
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<td>Page</td>
<td>(Whittle et al., 2008)</td>
<td>Recruited: N = 501; 251 = control, 250 = intervention.</td>
<td>Using health visitors to provide oral health education.</td>
<td>No theoretic model mentioned explicitly.</td>
<td>RCT – stratified by ethnicity and location.</td>
<td>ds, ms, fs and dmfs.</td>
<td>No significant differences found for ds, ms or fs between the groups at three years. (1.84, 0.34 and 0.01 for control and 1.92, 0.07 and 0.04 for intervention)</td>
<td>+ The intervention effect was diluted as it was not possible to restrict the info solely to the intervention group - Authors concluded RTC is not a good way to evaluate OH promotion programs and clusters should be used for future studies</td>
</tr>
</tbody>
</table>
and the other children examined in the census. The means (and CI) were 4.84 (3.39-6.29) for the control group, 3.99 (2.94-5.04) for the intervention group and 5.94 (5.55-6.33) for the census group.

64 pregnant women with caries approached through health units in Brazil

Intervention – Mothers received an antimicrobial treatment and restoration
Both intervention and control parents told about their own caries state and received preventive measures including education and an oral hygiene kit from pregnancy and then at 6 and 12 months. Infants assessed at 24 months old and

Caries of mother will be correlated with caries activity of child

Prospective RCT (30 months in duration)

Caries free children

Yes 33% control and 15% intervention children had caries p = 0.08

++ Clinical examination not blinded and 36 out of 100 participants loss to follow up – no ITT analysis

Education Enablement (Service provision)
<table>
<thead>
<tr>
<th>Title (Year) Author Ref</th>
<th>Study population (group) Number of Cases</th>
<th>Intervention type</th>
<th>Theory</th>
<th>Methodology</th>
<th>Outcome</th>
<th>Successful (Yes No)</th>
<th>Grade</th>
<th>Bias problems etc.</th>
<th>Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>37 Angelico et al., 1991</td>
<td>150 children 6/7 years old 5 year longitudinal study cross sectional</td>
<td>Teachers taught nutrition several meetings with parents</td>
<td>Education of the ‘prudent diet’</td>
<td>Longitudinal cohort study following children within a region of Italy over 5 years</td>
<td>BMI</td>
<td>No impact on BMI – although measurement only used PPV and NPV to state if they remained in the same BMI quintiles (not really appropriate)</td>
<td>+</td>
<td>Lots of room for bias, didn’t take into account clustering with schools/ areas no control group</td>
<td>Education</td>
</tr>
<tr>
<td>38 Antonio, Kelly, Valie, Vianna, &amp; Quintanilha, 2007</td>
<td>203 school children in one school in Rio</td>
<td>Oral hygiene Pack each 6 months (5 occurrences) dentist promoted tooth brushing during same period, education for parents, dentist at school twice a week</td>
<td>Education and treatment at school</td>
<td>Oral promotion assessed across different groups 1) before promotion, 2) shortly after promotion 3) 12 months after promotion, 4) 24 months after promotion</td>
<td>Gingival bleeding (BI) Biofilm (DBI)</td>
<td>Yes authors state differences observed 24 months after the education activities stopped (however dentists still visited the school weekly and oral hygiene kits were received DBI (M1 vs. M4 p =0.09) IBI mean</td>
<td>+</td>
<td>No control group, no calibration between examiners</td>
<td>Education and enablement – reducing barriers by providing packs and dentist on site for treatment</td>
</tr>
<tr>
<td></td>
<td>Study Authors and Year</td>
<td>Sample Size and Description</td>
<td>Intervention Details</td>
<td>Education Details</td>
<td>Health Outcomes</td>
<td>Notes</td>
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<tr>
<td>39</td>
<td>Cameron et al., 2014 and Campbell et al., 2013</td>
<td>542 first time mothers from 62 parent groups in Melbourne</td>
<td>Intervention 6 × 2-hour dietician-delivered sessions, DVD and written resources</td>
<td>Education</td>
<td>Diet, BMI</td>
<td>diff 0.74, p=0.08.</td>
<td>+++</td>
<td>Took into account moderators i.e. maternal education strong but mixed results and wide CI</td>
<td>Education and enablement</td>
</tr>
<tr>
<td>40</td>
<td>Chaffee, Feldens, &amp; Vitolo, 2013</td>
<td>715 Participants recruited from 9 intervention and 11 control group health centres in Brazil</td>
<td>Nutritionist delivered a standardized, one-hour training session for physicians, nurses, and administrative staff and posters to display and pamphlets to distribute to pregnant and lactating women</td>
<td>Education</td>
<td>Cares based on WHO protocol</td>
<td>No Health care worker training did not yield a statistically significant reduction in caries overall</td>
<td>+++</td>
<td>Level of counselling not assessed Inter/intra related reliability is good</td>
<td>Education</td>
</tr>
<tr>
<td>41</td>
<td>D’Cruz &amp; Aradhya, 2013</td>
<td>568 participants completed study</td>
<td>Intervention group 1(141 participants) – passive involved one lecture Intervention group 2 (143 participants)– active lecture and participants had to demonstrate tooth brushing Control group (284 participants)</td>
<td>Education and training</td>
<td>RCT double-blind intervention study</td>
<td>Turesky–Gilmore–Glickman modification of Quigley Hein plaque index (1972) and Yes difference in plaque and gingival score and oral hygiene practice and knowledge 22reduction in the mean plaque index scores in experimental</td>
<td>++</td>
<td>Only three schools used despite being randomly selected (doesn’t take into account differences within those schools),</td>
<td>Education and training</td>
</tr>
<tr>
<td>No.</td>
<td>Authors</td>
<td>Study Design</td>
<td>Intervention</td>
<td>Outcome Measure</td>
<td>Results</td>
<td>Notes</td>
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<td>42</td>
<td>Davies, Duxbury, Boothman, Davies, &amp; Blinkhorn, 2005</td>
<td>Children aged 8 to 32 months England. Parents recruited at babies 8 month health check</td>
<td>Intervention – gift bag containing trainer cup, toothpaste, toothbrush and advice – direct intervention</td>
<td>Multi stage health promotion</td>
<td>Caries - BASCD criteria</td>
<td>Yes The intervention group had significantly lower mean DMFT (1.47) than control (1.75) p = 0.09 however no difference was observed across the entire community possibly due to members of the community.</td>
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</table>

Loe–Silness gingival index groups I (22.8%) and II (28.5%), (P < 0.001), and 9.1% difference in control (not significant) Active group better than control therefore education should be given along with practical training.

Health district matched. Examiners were calibrated, analysed as ITT. Despite only one cluster per group a well designed study. |
<table>
<thead>
<tr>
<th>Day et al., 2008</th>
<th>527 students within 10 schools (5 control, 5 intervention 444 remained at follow up)</th>
<th>Intervention promote consumption of fruit and veg within school Environmental change and classroom learning (2 weekly classroom activity and one monthly tasting activity) Control – usual practice</th>
<th>School chosen to represent geographic, SE and size within area</th>
<th>Fruit and vegetable servings, trying new fruit and veg</th>
<th>Mixed – Yes Significant changes for Servings of fruit and veg (2.4) and variety of FV (0.47) between groups Tasting experiences elicit to behaviour change, regular training required to continue implementation</th>
<th>+++</th>
<th>Also measured fidelity and feasibility to the model (if teachers complied with intervention)</th>
<th>Environmen tal change, education</th>
</tr>
</thead>
<tbody>
<tr>
<td>de Farias, de Araújo Souza, &amp; Ferreira, 200</td>
<td>247 schoolchildren (7-15 yrs. old) Brazil follow up conducted 5 months after baseline (4 months of education and one month to allow for any reduction to occur)</td>
<td>Intervention (132) Control (115) Intervention dental health education program, conducted in a classroom with the experimental group, totalling eight 1-hour lesson</td>
<td>Blind randomized control intervention (2 classrooms assigned to C and 2 assigned to I)</td>
<td>Visible plaque index (VPI) and gingival bleeding index (GBI)</td>
<td>Yes significant difference for final plaque (P = 0.014, OR = 0.46, CI = 0.24-0.86) and gingival bleeding (P = 0.013, OR = 0.49, CI = 0.28-0.90)</td>
<td>+++</td>
<td>Undear allocation concealment but blind RCT and reasonable CI</td>
<td>Education</td>
</tr>
<tr>
<td>Year</td>
<td>Authors</td>
<td>Study Description</td>
<td>Intervention Details</td>
<td>Outcome Measures</td>
<td>Results/Findings</td>
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<tr>
<td>2010</td>
<td>A. M. de Silva-Sanigorski et al.</td>
<td>Community intervention within Australia (12,000 children) 3 year follow up when children attended 2 year and 3.5 year health check</td>
<td>Romp &amp; Chomp Community wide, multi setting multi strategy intervention targeting day centres, family services, preschools, maternal child health services</td>
<td>Changes to environment and changing areas of policy using sociological framework</td>
<td>Repeat cross-sectional quasi-experimental design with measures taken pre- and post intervention in the intervention community (i.e., via intervention sample) and comparison communities drawn from local government areas. BMI/diet amongst many others (not all related i.e. TV viewing). Yes - significantly reduction BMI for intervention than in the comparison sample and a difference in prevalence of obesity (a difference of 3.4 percept points lower in intervention and only 0.7 percentage points; in comparison) compared with baseline values. Intervention child-behavioural data showed a significantly lower intake of packaged snacks (by 0.23 serving), fruit juice (0.52 serving).</td>
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<tr>
<td>2011</td>
<td>A. de Silva-Sanigorski et al.</td>
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<tr>
<td>Page</td>
<td>Reference</td>
<td>Population</td>
<td>Intervention</td>
<td>Design</td>
<td>Outcome</td>
<td>Notes</td>
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<td>46</td>
<td>Economos et al., 2007</td>
<td>1178 schoolchildren (grades 1 to 3) from 3 urban cities in USA (1 intervention 2 control)</td>
<td>Intervention - community-based participatory research</td>
<td>Non-randomized controlled trial</td>
<td>BMI z-score</td>
<td>Yes</td>
<td>Average change in BMI z-score was −0.1005 (95% CI, −0.1151 to −0.0859; ( p = 0.001 )) after controlling for covariates</td>
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<tr>
<td>47</td>
<td>Francis, Nichols, &amp; Dalrymple, 2010</td>
<td>11 schools with children in their 6th year primary school randomised in Trinidad to intervention and control</td>
<td>Cluster randomized, controlled trial</td>
<td>Diet and physical activity</td>
<td>Mixed – Regression analysis (adjusted ( R^2 ))</td>
<td>**</td>
<td>RCT but clustered no discussion on taking into</td>
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*Environmetal change*
<table>
<thead>
<tr>
<th>Study</th>
<th>Participants</th>
<th>Intervention Details</th>
<th>Outcome Details</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>48</td>
<td>Herman, Nelson, Teutsch, &amp; Chung, 2012</td>
<td>438 parents, and 112 preschool children. Six large Head Start agencies</td>
<td>6-month educational intervention among head start parents children My Pyramid, food groups, portion control, shopping on a budget</td>
<td>Increase knowledge</td>
</tr>
<tr>
<td>49</td>
<td>Hu et al., 2010</td>
<td>China, children were 4-6 yrs. old preschoolers. Four</td>
<td>Kindergarten education delivered to children and Education</td>
<td>Cluster randomised</td>
</tr>
<tr>
<td>Study</td>
<td>Country</td>
<td>Setting</td>
<td>Intervention Details</td>
<td>Study Design</td>
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<tr>
<td>Kindergartens</td>
<td>USA</td>
<td>Three with 1252 children in interventions and three with 850 to control</td>
<td>Parents over 1 year using illustrated books for children and pamphlets with nutritional information for parents</td>
<td>Cluster randomised study pretest and posttest over the period of a year</td>
</tr>
<tr>
<td>James et al., 2007</td>
<td>England</td>
<td>434 (from original 644) children aged 7-15. Control group 215 intervention group 219</td>
<td>CHOPPS – ditch the fizz (discouraging children from drinking carbonated drinks) intervention over one school year. 2 year follow up</td>
<td>School based intervention education involving children creating songs to promote ditch and fizz and quizzes</td>
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<tr>
<td>51</td>
<td>Johnson et al., 2012</td>
<td>Children aged 4-12 years old from two different regions of Victoria Australia</td>
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<td></td>
<td>Intervention 1726 Control 1183</td>
<td>BAEW intervention – Multi factorial and multi level influences community based intervention i.e. building community capacity for physical activity, school programs for exercise, change in canteen menu networking amongst teachers and parents</td>
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<td></td>
<td></td>
<td>Community wide changes to improve diet and physical exercise and impact on obesity</td>
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<td></td>
<td></td>
<td>Longitudinal cohort study</td>
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<td></td>
<td></td>
<td>BMI</td>
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<td></td>
<td>Yes significant effect of group within the model for BMI while accounting for other confounding factors (-0.070 \text{ (}-0.17 \text{ to } 0.03, p = 0.09))</td>
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<td>++</td>
<td>No randomisation between groups from two different areas, potential for other factors to influence outcome. Relatively simple variables for measuring outcomes, which may not have captured all of the effect i.e., diet from schools. However large numbers were selected using randomisation and other methods are difficult to implement with this type of community</td>
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<td></td>
<td></td>
<td>Environmental and restriction (change in policy in schools for nutrition and exercise)</td>
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<tr>
<td>No.</td>
<td>Author(s)</td>
<td>Sample</td>
<td>Intervention</td>
<td>Education</td>
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<tr>
<td>52</td>
<td>Moskowitz, Abud, &amp; Ram, 2009</td>
<td>12 to 14 yr. old children in Jerusalem n = 443</td>
<td>Intervention is education combined with restorative dental care</td>
<td>Education combined with restorative dental treatment through service provision will improve oral health</td>
</tr>
<tr>
<td>53</td>
<td>Neumann et al., 2011</td>
<td>915* Children from three local government areas (LGA) in Australia who were 7/8 months old were contacted through local child nurses</td>
<td>Intervention delivered by health nurses including an oral health starter kit, information leaflets about early explore to fluoride toothpaste at 7 month check up</td>
<td>Early explore to fluoride will prevent dental caries and health nurses are strategically placed to promote its use and deliver oral health messages</td>
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<tr>
<td>Study ID</td>
<td>Authors, Year</td>
<td>Sample Size and Description</td>
<td>Intervention Details</td>
<td>Methodology</td>
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<tr>
<td>54</td>
<td>Prelip, Kinsler, Thai, Erausquin, &amp; Slusser, 2012</td>
<td>399 children from 8-10 years old from a convenience sample of schools (low income) in US</td>
<td>School based Intervention included LAUSD program, nutrition curriculum, teacher training and parent education workshops on nutrition</td>
<td>Multicomponent education program will impact on fruit and veg consumption using social cognitive theory and theory of planned behaviour</td>
</tr>
<tr>
<td>55</td>
<td>Ransley et al., 2010</td>
<td>2530 children from 129 schools across England took part with children aged 6/7 years old</td>
<td>Initiatives across schools included time spent learning about fruit and veg, schools activities with growing and cooking food (gardens) involvement of parents in promoting fruit etc.</td>
<td>Practical activities and activities through modelling appropriate eating behaviour help diet</td>
</tr>
<tr>
<td>56</td>
<td>Roberts-Thomson et al., 2010</td>
<td>30 Indigenous communities took part preschool children in</td>
<td>Intervention looked at community orientated</td>
<td>Targeted community care</td>
</tr>
</tbody>
</table>

likely to keep up visits making generalizability difficult to population
<table>
<thead>
<tr>
<th>Study Number</th>
<th>Reference</th>
<th>Description</th>
<th>Country</th>
<th>Primary intervention</th>
<th>Impact</th>
<th>Control</th>
<th>Study Design</th>
<th>Outcomes</th>
<th>Findings</th>
<th>Limitations</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>57</td>
<td>Rong et al., 2003</td>
<td>514 three year old children in kindergartens in China</td>
<td>Australia</td>
<td>Primary health care including oral health advice/education, community based oral health promotion, application of fluoride varnish</td>
<td>with remote communities will improve the oral health of children</td>
<td></td>
<td>Stratified Random, examiner blinded clinical trial</td>
<td>Caries – DMFS and health behaviour</td>
<td>Yes difference in DMFS 1.09 (0.27 to 1.19, p = 0.0009)</td>
<td>+++</td>
<td>Well conducted study, duplicate examiners, good inter-rater reproducibility</td>
</tr>
<tr>
<td>58</td>
<td>Ronsley, Lee, Kuzeljevic, &amp; Panagiotopoulos, 2013</td>
<td>Aboriginal school children Living in Remote Coastal Communities located on the northern Pacific Coast of British Columbia, aged from Kindergarten to grade 12.</td>
<td></td>
<td>2-year oral health education in kindergartens including monthly oral health education sessions for children and parents over 6 months. Children brushed teeth twice a day in kindergarten compared to control receiving no oral health intervention</td>
<td>Kindergarten based program will improve oral health knowledge and behaviour and subsequent caries experience.</td>
<td></td>
<td></td>
<td>Yes Significant decrease in zBMI (1.10 to 1.04, p=0.028), and WC (77.1 to 75.0 cm),</td>
<td>++</td>
<td>Control used through one school not participating – not an RCT samples were</td>
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</table>
3 of the 14 schools in the Tsimshian Nation took part.

Based on the Healthy Buddies program previously evaluated in Caucasian children. Program modified to address the needs of aboriginal children.

3 main components:
- Physical activity, healthy eating and healthy body image.
- "Whole-school" approach
  - Older children "buddy" younger children and teach them.
  - to be most effective when initiated early in life.
  - Children spend large prop of time in classroom, therefore schools provide a good setting for PH programs
  - "Whole-school" approach.
  - Program developed incorporating feedback from community members (that it should incorporate: culturally appropriate content & visual aids, peer-teaching, curriculum based and self-esteem promotion.

not implement the program so was used as a control group.

Secondary outcomes: included self esteem, health behaviour and knowledge.

p<0.0001) in the intervention group compared with an increase in zBMI (1.14 to 1.23, p=0.46) and minimal WC change in the control group.

Prevalence of elevated BP did not change in the intervention group and increased from 16.7% to 31.7% in control group (p=0.26)

General linear model analysis reveals a sig. interaction between time, group and zBMI (p=0.001), weight status (p=0.014), nutritious clustered and could not account for variance between students within the same school. Additionally schools adherence to intervention was not recorded.
| Page | Rudolf et al., 2006 | Children in Leeds aged 12.2 (2.0) yrs. n=94 (49 girls, 45 boys). 68 children participated for at least 3m, and 48 for at least 6m. All moderately to severely obese (mean BMI SDS 3.09 (0.45)) with low QoL and self-image scores. During the 12m period of the process evaluation, 61 families attended, 819 clinic apps were kept, 98 (12% were cancelled). WATCH IT - Community based intervention for obese children. Manual developed to be suitable to be delivered by untrained professionals. Aims to achieve wt maintenance – focus on: how to regulate eating behaviour (with a view to prevent wt cycling and binge eating). active lifestyle Emotional wellbeing 3 Components to WATCH IT program: Frequent individual appointments (30min, weekly initially) Weekly 1hr group sessions Group parenting sessions, once individual apps reduced in freq. motivational and solution focused approach. Pt (rather than professional) as the expert. WATCH it set up following survey of pts. and parents referred for obesity; relevant professionals and young people at school. Process evaluation. (Pilot, prior to RCT.) Interviews and focus groups held (detailed results from these reported elsewhere) BMI Yes At 6m, 71% of the children showed BMI SD scores. Mean BMI SD = 0.7 (0.16, p<0.01). Non attendance was much lower than typical general paediatric outpatient DNA rates (12% vs. 20-30%) Qualitative research indicated significant appreciation of ++ Participants invited to enrol – therefore those who sign up are likely to be already motivated to change – therefore unfair to compare results with study’s with more inclusive recruitment? Pilot, therefore small sample size, but results look promising. |  |  |  |  |  |  |  |  | Education, |
| 60 | Sacher et al., 2010 | From 5 UK sites, 117 children were recruited; 116 were randomised into intervention (n=60) or control (n=56) group. At 12m assessments, 42 (70%) remained in intervention group and 38 (68%) remained in control group. Mean age of children in intervention group = 10.3(1.3) yrs., and control group = 10.2(1.3) yrs. | Multicomponent, community-based childhood obesity intervention. 6-month intervention consisting of the 9-week MEND (Mind, Exercise, Nutrition, Do it) Program followed by a 12-week free-family swim pass. The program engages families in the process of weight management by addressing the three components necessary for individual-level behavioural change; (i) education (ii) skills training, and (iii) motivational enhancement. The MEND intervention is an integrated, multicomponent healthy lifestyle program based on the principles of nutritional and sports science plus, from psychology, learning, and social cognitive theories and the study of therapeutic processes. | RCT | Waist circ and BMI. Yes – at 6m both waist circ and BMI were significantly less in the intervention than the control group (p<0.0001). This change was maintained and increased at 12m. ++ | Small sample. (Further research is ongoing to measure the effectiveness of the program when delivered on a larger scale) | Education, training |
| 61 | (Sgan-Cohen, | Mother and child (MCH) centres | Community oral health | Community oral | RCT | Reported | Mixed | +++ | Potential bias | Education |
Mansbach, Haver, & Gofin, 2001)
in Jerusalem – a pair chosen from each of five large Jerusalem neighbourhoods – chosen to ensure a representative of the city’s socioeconomic profile, according to religion, economy, family size, and other social variables. N=727. Infants aged 6-12m.

Program trial. 4 study groups:
Program 1 (n=268)- receiving both health education and tooth brushes and toothpaste (250pp, fluoride), Program 2 (n=187)- Receiving health education, but no tooth brushes/toothpaste. Control 1 (n=133)- receiving toothbrushes and toothpaste(250pp, fluoride), but no organised health education Control 2 (n=139)- Receive nothing. [Authors explained they had difficulties gaining permission from authorities to recruit into the control groups, hence lower numbers]

health
info collected via telephone interviews at baseline (when the infants were aged between 6-12m) and again 6m later (when they were aged between 12-18m). (Interviewers blinded)

bottle feeding habits and tooth brushing.

No significant differences in bottle-feeding habits were found when comparing changes over the study period between the program and control groups. Reported improvement in tooth brushing for those in program1 was greater than those in program2, control1 and control2. (P=0.004, 0.022 and 0.00004 respectively).

of parents responding to health carers for self report. Not possible to given intervention uniformly as there will be individual differences between providers giving oral health but this mimics real life
<table>
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<tr>
<th>Study</th>
<th>Year</th>
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<th>Intervention</th>
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</table>
| 62    | 2010 | 12 – 13 year-old schoolchildren in Mangalore City, India. Calculated a sample size of 400, taking power of the test as 0.85 and s.d. as 0.30. N=415 children. Roughly divided between 6 schools (3 high socioeconomic status and 3 low). | Dental Health Education aimed to improve DH knowledge, practices and status and gingival health. For each of the 2 socioeconomic statuses: A – children given DH education every 3wks for 18wks B - children given DH education every 6wks for 18wks C- No DH education. (i.e. 6 groups in total) | Intervention with control (Not clear if randomised or not) OH related behaviours, bleeding from gums (self reported) and Plaque and gingival index scores. | Yes – significant increases in OH-related behaviours in intervention groups than compared to baseline – authors report p values but not the scores so difficult to interpret | |}
| 63    | 2011 | N=252 (92 dentists, 123 dental hygienists and 37 dental assistants) USA | Continued Education program (Smiles) for dentists, dental hygienists and dental assistants. =4hr, free program – to Improving knowledge of those who provide service to provide health care in young children Pre-test, post-test. Knowledge and reported behaviours | Mixed Suggests successful in increasing knowledge in the short term, but 6m follow-up | ++ | Not all results reported. Potentially biased – self reported | Training / education (Service provision) |
increase their knowledge & confidence in dealing with infant/toddlers. Focus on OH needs, promotion & disease prevention.

suggests that positive behaviours decreases with time. This intervention appears to have increased the knowledge of dentists, dental hygienists and dental assistants – There was a significant increase in mean overall test score from pre-test (58%) to post-test (80%) p<0.001

Authors compared reported behaviour-based practices – post test, and 6m later. Some items showed a

behaviours (What dentists think/say they do may differ from what they actually do)

validity/accuracy of methods used – e.g. individuals are asked if they are familiar with XX – Y/N. An individual claiming that they are does not necessarily mean they actually are.
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<th>Study</th>
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<th>Fluoride Varnish</th>
<th>Advice About Caries Prevention</th>
<th>Community Health Promotion</th>
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<th>NET Caries Increment</th>
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<td>64</td>
<td>(Slade et al., 2011)</td>
<td>Aboriginal children aged 18m-48m from 15 aboriginal communities in remote locations (Australia).</td>
<td>Fluoride varnish was applied to the child’s teeth once every 6m for 2yrs (total of 5 applications)</td>
<td>Baseline examinations carried out on 666 children (Intervention=344; Control=322)</td>
<td>Non dental worker could provide OH advice and FV within the community to improve oral health and combat caries in young children</td>
<td>2-yr, prospective, cluster-randomized, concurrent controlled, open trial (Community leaders were assigned at random to either intervention or control group.)</td>
<td>Community health promotion engaged parents, store owners, community leaders and health care workers about OH and prevention of dental decay</td>
<td>Yes – The net dmfs increment was statistically significantly lower among children in the intervention group compared to the control group by an average of 3.0 surfaces per child (95% CI = 1.2, 4.9)</td>
<td>Difficult to distinguish effect of FV and OH promotion separately. It is also possible children who received fewer doses of FV differed from children who received all intended application and this was not taken into account</td>
<td>***</td>
<td></td>
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<tr>
<td>65</td>
<td>(Taylor et al., 2007)</td>
<td>Pilot Study. Otago, New Zealand. Recruitment took place in 2003 and 2004. (82.6% white, 16.5% Maori and &lt;1% Pacific Islander)</td>
<td>APPLE (A Pilot Program for Lifestyle and Exercise) = 2yr controlled community-based intervention encouraging healthy eating and increased extra curriculum activities for children within a school setting and local community</td>
<td>Extra curriculum activities for children within a school setting and local community</td>
<td>Not-random. Control and Intervention communities were</td>
<td>BMI and waist circumference.</td>
<td>Yes – Mean BMI z-score was significantly lower in non-randomization of groups means susceptible to</td>
<td>Education enablement (service provision)</td>
<td></td>
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</table>
Intervention (n=384), Control (n=346)

levels of physical activity (Focusing on non-curricular activity)

impact on obesity levels

selected from 2 semirural geographical areas.

intervention children than in control children by 0.09 (95% CI: 0.01, 0.18) after 1 yr. and 0.26 (95% CI: 0.21, 0.32) at 2y.

Waist circumference was also significantly lower at 2 y in intervention children (−1.0 cm)

bias – however there was justification for this as community interventions are complex and this was dictated by organization of these within public health

66 (Tolvanen et al., 2009) All 5th & 6th graders (11 and 12 yr. old children) who started the 2001-2002 school year in Pori, Finland (n=1691) and a similar sample of children of the same age in Rauma, Finland (n=807)

Intervention through schools and local community:
(1) only oral health promotion
(2) oral health promotion and individualized intervention
(3) No specific intervention

That education and motivational changes alone are not enough to bring about behaviour change in children and that support from parents, peers and other people in their daily environment is also necessary

RCT
Questionnaires completed at baseline and then again 3.4yr later.

Children’s behaviour, knowledge and attitudes (self reported)

Mixed…
The reported behaviour improved for all 3 groups, although more so for the children in the intervention groups. Significant differences were

+++ ?self reported behaviours - ?accuracy of reporting

Change in caries was not measured

Perhaps the “control” children were
| 67 | (Tubert-Jeannin, Leger, & Manevy, 2012) | NB: This survey follows on from a prev. epi study (2003), and intervention which was executed (in 2005) and evaluated (in 2006). | Background (All in Clermont-Ferrand, France) - 2003: Epidemiological study conducted to evaluate dental status of 5-yr old school children. | School oral health promotion | All schools in one region asked to participate with 6 randomly | dmft | No | No major differences in mean dmft were observed between 2003 | ++ | Survey. Many other unknown factors likely to have contributed to these findings. | Education |
The schools in the original 2003 study were used. Clermont-Ferrand (France). Deprived and semi-deprived schools (n=15); and non-deprived schools (n=6).

Invited to participate = all the 5yr old children (born in 2004) attending these schools. (n=620)

Of these, 77% participated; 478 children were examined.

2005: School based oral health promotion (OHP) program developed. Program aim was to promote a supportive school environment for children in order to reduce oral health inequalities. Focused on improvement of tooth brushing habits/fluoride toothpaste. Included educational activities. Guidelines promoting OH were developed and circulated to carers. Involved schools with moderate-to-high caries levels and situated in deprived or semi-deprived areas as identified by 2003 study.


Object of this study is to evaluate the dental status of 5-yr-old children and measure changes between 2003 and 2009 and to assess the impact of the selected school from other region Controlled pre post test of intervention and 2009 except Mean number of filled teeth (p=0.0005), and Proportion of filled teeth (p=0.0003) increased.

Authors conclude that the results indicate that the OHP program has done little to reduce OH inequalities, and suggest that multidisciplinary collaborative networks may be needed in order to improve the effectiveness of this OHP program.
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<td>68</td>
<td>(Vanobbergen, Decker, Mwalili, &amp; Martens, 2004)</td>
<td>Intervention group, n=4468 recruited, 3291 at end; control n=800 recruited, 676 at end. Children born in 1989, followed between 1996-2001. (Aged 7 at start) Used the Signal-Tandmobiel® data obtained from Flanders, N Belgium.</td>
<td>Oral health education program was delivered to the intervention group. Included a 1hr oral health education session once a yr. Education program to both children and teachers once a year.</td>
<td>6-year longitudinal analysis. Stratified cluster sampling without replacement.</td>
<td>DMFT/S and dmft/s</td>
<td>No – whilst the mean DMFT/S scores in the intervention were lower than control group at the end of the study period, the difference was not significant. ++</td>
</tr>
<tr>
<td>69</td>
<td>(Vichayanrat, Steckler, Tanasugarn, &amp; Lexomboon, 2012)</td>
<td>Experimental group (n=62), mean age (months) 18.00 +9.30; range 6 - 36 control group (n=52) mean age (months) 19.16 +8.74; range 6 - 36</td>
<td>Pilot - 1-year multi-level health intervention on caregivers' oral health practices and their determinants. Experimental group received a multi-level intervention, control received routine health services from local health centres.</td>
<td>Quasi-experimental pretest-posttest evaluations using a comparison group; The criteria for choosing control and experimental sites were based on a comparable population structure, Many, including caries (%), dmft, child’s oral health practices, child snack consumption, caregiver knowledge, social support received by</td>
<td>Many, including caries (%), dmft, child’s oral health practices, child snack consumption, caregiver knowledge, social support received by</td>
<td>No positive effect on dental caries or dmft score; positive effect on tooth brushing, using toothpaste, and fluoride supplements; significant increase in caregiver knowledge, attitudes, outcome expectations and self-efficacy</td>
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<tr>
<td>Total no. health professionals serving child care-centres recruited (n=30). Intervention group (n=20), control (n=10)</td>
<td>Environmental Intervention – Nutrition and Physical Activity in Child Care (NAP SACC)</td>
<td>The Environment and Policy Assessment and Observation (EPAO) was developed as the primary outcome measure.</td>
<td>Well designed – ITT analysis however potential issues identified with measurement used and EPAO was a newly designed scoring strategy. Implementatio</td>
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<td>Final – 29 health professionals and 82 child care centres (56 included in the intervention group, of these, 41 completed most or all of the intervention)</td>
<td>Five step intervention 1) self assessment; 2) action planning; 3) continuing educational workshops, 4) technical assistance, 5) re-assessment.</td>
<td>RCT Conveniences sample – first 30 child-care health consultants to respond to initiation to participate who met the eligibility requirements</td>
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Mixed A significant difference in EPAO nutrition and physical activity scores was not found between the intervention and control groups (p=0.06). However, when centres that failed to

Caries prevalence, and no existing oral health programs at the health centres.

caregiver outcomes evaluated by self-administered questionnaires and oral examination before and after the intervention.

towards these behaviours
<table>
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<tr>
<td>71 (Warren et al., 2003)</td>
<td>218 children recruited. Mean age 6.1 yrs; mean BMI 15.9. 8% of children were overweight and 4% obese. Final number of children = 181.</td>
<td>Pilot 20 week school program aimed at preventing weight gain. Children randomly allocated into 1 of 4 groups: Nutrition group – children taught about eating healthily; Physical Activity Group – promoted activity in daily life; Combined nutrition and physical activity group; and Control – children learnt about food in a non-nutritional sense.</td>
<td>Social Learning Theory (Bandura 1986)</td>
<td>RCT</td>
<td>BMI and nutrition knowledge scores</td>
<td>No – There were no significant differences in BMI between the groups. However, there was a significant increase in the consumption of veg.</td>
</tr>
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<td>72 (Williamson et al., 2007)</td>
<td>586 students mean age 9.2 yrs. old in 4 catholic schools (2 randomly assigned to Wise mind intervention after school environment i.e. changing menu boards to Environmental approach for weight gain –</td>
<td>Cluster RCT</td>
<td>BMI and behavioural changes</td>
<td>Mixed – No difference in BMI between groups</td>
<td>++</td>
<td>Small sample size and short duration.</td>
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<td>73</td>
<td>(Willis, Potratz, Hunt, &amp; Rudolf, 2012)</td>
<td>Deprived areas with high levels of obesity. 12 Sure Start Children's Centres in Leeds; (which collectively reach over 5000 families) 271 staff from varied professional backgrounds were trained, the majority were female (n=267, 98.5%)</td>
<td>Evaluation of the first 12 Children's centres to be trained in HENRY (Health Exercise Nutrition for the Really Young) Aim was to train community and health practitioners to work more effectively and confidently with parents and young families. *See at end of table for more info on HENRY</td>
<td>Inductive research – did not rely on any particular theoretical positions. Focus on the methods and manner by which health messages are delivered</td>
<td>Qualitative: Semi-structured interviews (audio-taped, lasting 30-60 min) and &quot;drop boxes&quot;. (sealed boxes in accessible to all staff to provide) Qualitative – lifestyle effects – confidence in tackling lifestyle change</td>
<td>Yes - Results qualitative indicate that HENRY training was associated with increase in staff confidence in approaching families and better equipped to interact with them around obesity and lifestyle issues. (Reported by</td>
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</table>

training) reflect wise mind foods Pedometers purchased – children allowed to play 10 minutes of every hour p = 0.5458 but a difference was seen in behavioural changes such as food selection for calories, fat intake and saturated fat (p <0.05) behaviour change to translate to weight change or the intervention is too weak to produce significant effect extra activity was not recorded which could have effected results
<table>
<thead>
<tr>
<th>Page</th>
<th>Feedback anonymousl y or by leaving their name if they wish</th>
<th>managers and staff at the centres</th>
<th>Change</th>
</tr>
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<tbody>
<tr>
<td>The 12 Interviews and 106 drop box slips were transcribed verbatim, and thematic analysis was conducted.</td>
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<tr>
<th>74</th>
<th>2 children over the last 5yrs presented to the hospital with severe obesity (BMI &gt; 99.6\textsuperscript{th} centile, Z scores 4.5)</th>
<th>Case report</th>
<th>Weight &amp; BMI</th>
</tr>
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<tbody>
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<td></td>
<td>Removal from the familial obesogenic environment can successfully reduce the BMI of an obese child.</td>
<td>After parents refused to engage with any services despite intensive multidisciplinary medical, dietetic, psychological and social care input court action</td>
<td>Mixed – Difficult to state a definitive outcome as a case report. Both children demonstrated rapid and sustained weight loss.</td>
</tr>
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</table>

(Winckworth & Coren, 2013) | Environmen tal change | | |
| 75 | (Yekaninejad et al., 2012) | 12/13 yr. old children | 3 groups  
1) Student – only targeted children – three, 70 min classroom based activities looking at self efficacy and perceived barriers  
2) Comprehensive – targeted parents, school staff and children. Similar to student group but parents and teachers received information on impact of poor oral health on children and educational materials  
3) Control | Bandura – receiving positive feedback from others will change behaviour - Intervention targeting both parents and school staff impact on child oral health | Cluster RCT with a 3 month follow up | Brushing/ flossing behaviours and gingival health | Yes both intervention groups improved significantly in all areas. Brushing flossing, debris index, calculus index oral hygiene index (p <0.001) | ++++ | ITT analysis / multilevel analysis used addressing missing data |
| 76 | (Yin et al., 2005) | 601 recruited (48% boys, 52% girls; 312 intervention, 289 control, average age = 8.7)  
447 subjects had a 40%+ attendance (Intervention n=182; Control n=265) | Medical College of Georgia – FitKid Project = 8-month after-school program to increase moderate-to-vigorous physical activity in elementary school children during the 2-hr block of time after school | RCT | Primary outcome = percentage body fat  
Also looked at cardiovascular | Y - significant difference in change in %body fat for the children receiving the intervention (reduced). | + | This is the 1st year of a 3 year study. Study was powered to detect a 1.5% change in %bf over a 3-year period. | **Environmental** |
<table>
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<th>77</th>
<th>(Yin et al., 2012)</th>
<th>children (n = 423; mean age = 4.1; 62% in normal weight range) predominantly Hispanic (90%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mirano! Obesity prevention program. 2 interventions to modify daily eating and physical activity behaviours and provide an interactive, supportive learning environment for preschool children. A centre-based intervention included an age-appropriate gross motor program with structured outdoor play, supplemental classroom activities, and staff development. A combined centre- and</td>
<td>Employed theories of early childhood development and a systems approach</td>
<td></td>
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<tr>
<td>Quasi-experimental pretest/posttest design with two treatment groups (centre-based intervention and a home-based intervention) and a comparison group.</td>
<td>Height, weight and BMI. Activity level</td>
<td></td>
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<td>Adjusted change (95% CI)</td>
<td>Fitness, blood pressure, total cholesterol, HDL-cholesterol</td>
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<td>-0.76 (-1.42, to -0.09) p = 0.027</td>
<td>%BF for intervention group decreased; %BF for control group increased slightly.</td>
<td></td>
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<tr>
<td>Yes</td>
<td>All children gained weight, but those in the intervention groups gained significantly less than the comparison children Children in both intervention groups showed increases in outdoor physical activity and consumption of</td>
<td>++</td>
</tr>
</tbody>
</table>
78 (Young, Anderson, Beckstrom, Bellows, & Johnson, 2004)  
Recruited from the 2 subsections of Colorado deemed to be most at nutritional risk: low-income elderly individuals and low-income parents of children ranging from birth to high school age.  
-Low-income parents with children aged 3-7yrs (n = 29)  
-Teachers who work in low-income schools (n = 27)  
-Child care providers who supply service to low-income families (n = 29)  
12-week pilot social marketing campaign.  
Nutrition education program.  
'Try new foods' message and opportunities to try new foods  
Social Marketing to achieve behaviour change.  
Social learning theory  
12 week pilot project  
Accepting new foods  
Mixed – indicate repeated exposure to specific new foods increases acceptability of all new foods  
+  
Only a pilot project so confidence in reliability of outcomes was only used to guide design of intervention  
Education; (social marketing)  

79 (Yusof, Jaafar, 2013)  
3455 (1262=intervention, 2173=control)  
Children aged 6-7yrs old at recruitment.  
Doctor Muda Program (DMP). A child-to-child school-based health promotion program. A selected group of schoolchildren are trained & empowered to give health information as Doctor Mudas.  
Health promoting schools  
Part of a larger retrospective cohort study  
Matched [Each intervention]  
OHRQoL – using the Child OIDP index & a validated questionnaire  
No – The overall prevalence of OIDP in intervention group was lower at 57.8% compared to control group  
++  
Self reported questionnaires  
No mention of records of decay in the results  
Modelling, education, training,
education to their peers and conduct health activities at school. They act as a role model for healthy behaviours and lifestyles. Children were compared after 6yrs of implementation.

school was matched with a non-intervention school, by nearest location in the neighbourhood to ensure that both groups had similar sociodemographic characteristics.

aire on oral health knowledge, attitudes and reported OH behaviour. Decay was recorded at the level of cavitation using a mouth mirror and a WHO/CPI TN probe.

60.8% in the control group but this difference of 3.0% was not statistically significant.
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<th>Ref</th>
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<th>Study population (group)</th>
<th>Intervention type</th>
<th>Theory</th>
<th>Methodology</th>
<th>Outcome</th>
<th>Successful (Yes No)</th>
<th>Grade</th>
<th>Bias problems etc.</th>
</tr>
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</table>
| 80  | Friel et al., 2002  | 32 randomly chosen schools In Ireland including 1534 7/8 and 11/12 year olds | National television campaign and school dental nurse intervention | Behaviour change can be achieved by a combination of media community and individual interactions | Experimental control, pre-/post-design (stratified and randomly chosen) was used for the school nurse intervention, taking into account reported exposure or not to the television campaign | Dental health behaviour i.e., Reported brushing and toothpaste use | Mixed – Media campaign on own has little effect. Intervention resulted in positive dental behaviour change for children who received the nurse visit and saw Den TV, compared with those who only saw Den TV, reported brushing their teeth at least twice per day ($\chi^2 = 3.91, p=0.05$) and used a pea-sized amount of toothpaste ($\chi^2 = 28.33, p < 0.01$) | ++ | Information based on reported viewing of program (recall bias) however difficult to explore media campaign and one of few studies which has shown national policy interacting with community work | Education, modellin (Communication/ marketin)
<p>| Fung et al., 2012 | 10 Intervention schools - APPLE (293 students 85% participation rate) and 150 randomly selected control schools (involving 3396 students (61% participation rate) with students aged 9-10 years old in Canada followed 2 year post intervention start date (intervention still continuing) | Intervention School Health Facilitators established at each school and implement strategies around healthy eating and active lifestyle. Developed cross curriculum links, professional development of teachers and nutritional programs at school, policy implemented on nutrition and physical activity per school day and external community involvement which led to community gardens breakfast and lunch programs | Comprehensive School Health (framework for health promotion) | Annual surveys across schools (stratified random sample design) used to compare against intervention schools | Diet, physical activity and health, nutrition | Yes – interventional effect regression analysis showed children attending intervention schools had better diets compared to baseline which the opposite was true for control with regression showing fruit and veg consumption decrease from baseline to 2 year follow up Intervention effect over time relative to change in control fruit and veg consumption regression, beta 0.55 (-0.02,1.13), | ++++ | Large representative sample – however observational study so intervention schools were not randomly selected Intervention schools chosen due to need of health promotion (disadvantage d areas). Also subject to response bias however given the scale of the study and area of research this was the most appropriate method | Enablement, environmental restructuring, (Guidelines/communication,) |</p>
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<td>82.00</td>
<td>Fung, McIsaac, Kuhle, Kirk, &amp; Veugelers, 2013</td>
<td>All public schools in Nova Scotia with students aged 9-10. 5517 parents provided consent (51%).</td>
<td>National policy implemented (pre- and post-policy implementation) Increase access to and enjoyment of health-promoting, safe, and affordable food and beverages served and sold in public schools</td>
<td>Dietary behaviour and nutrient intake, weight status</td>
</tr>
<tr>
<td>83.00</td>
<td>Khurshid, 2010</td>
<td>Population comprised mainly Hispanic children near US/Mexico border - Texas N = 245 where examinations were conducted and questionnaires received out of a total 1500 students</td>
<td>Dental sealants served as a proxy for prevention in area of Texas compared to caries experience Preventative service will improve oral health</td>
<td>Caries</td>
</tr>
<tr>
<td>Mullally et al., 2010</td>
<td>52 elementary schools implemented a 2006 school nutrition policy in Canada. 11 school took part in a survey to understand food consumption (971 in 2001 and 555 in 2007) with children aged 10 to 12 yrs. old.</td>
<td>Province wide school policy pre and post test policy implementation on children who were 10 to 12 yrs. old in 2001 and those 10 to 12 yrs. old in 2007.</td>
<td>School policy will change food consumption</td>
<td>Servings of low nutrition food (LNF) and consumption of fruits, vegetables, milk etc. from self report food questionnaire</td>
</tr>
<tr>
<td>Page</td>
<td>Rozier et al., 2010</td>
<td>North Carolina. Children aged 6m-3yrs enrolled in Medicaid anytime from Jan 2000 – Dec 2006. n=629,005 (data collected from administrative files)</td>
<td>“Into the Mouths of Babes” [documented in separate paper]. – A program initiated in 2000 enabling dental care to be provided at medical visits, but ideally at well-child visits. The program enables providers to be reimbursed for up to 6 visits for preventive oral health services in primary care medical settings for children during their first 3yrs of life. The following services must all be provided in order to get reimbursement: • Assessments of dental caries and risk • Topical application of fluoride to teeth Parental counselling on the proper ways to take care of their children's oral health.</td>
<td>No recognized “theory” – but thinking behind program is... Poor access to dentists – especially for low-income families. Few dentists (Only 16% in late 1990’s) actively participate in Medicaid and only 1/10 young children receiving Medicaid used any dental services. Believed parents are reluctant to take young children to dentist. Thought that providing preventative dental at the medical centre</td>
</tr>
<tr>
<td>86</td>
<td>(Sealy et al., 2012)</td>
<td>6 representatives reached 161 practices with 1,588 one-on-one interactions and an additional 461 contacts were made through group presentations. High-need communities in New York City.</td>
<td>Qualitative piece describing the research and development and results of a public health campaign = “Obesity in Children” Key recommendations for the campaign strongly urge paediatric healthcare providers to: Assess all children &amp; adolescents for overweight and obesity using BMI percentile-for-age to identify at risk patients early. Educate all children, adolescents, and their families about healthful eating and physical activity, and reinforce messages at each visit. Work with families to set realistic goals for healthy eating and exercise. 4 to 6 weeks between initial and follow up visit.</td>
<td>Patient-provider-partnership. People with low levels of literacy and health Literacy (i.e. having the skills necessary to make healthy choices and recognize when they or their child are overweight) are likely to make it difficult for parents to follow healthcare provider recommendations and may not adequately understand the extent of which excess weight contributes to health risks. Qualitative: health care provider in-depth interview and parent focus groups. Self reported adoption of key recommendations through intervention. Yes After the campaign there was a significant increase in the percentage of physicians self-reported use of key recommended practices: e.g. use of BMI percentile-for-age to assess for overweight/obesity at every visit increased from 77%-88% (p&lt;0.01) counselling about healthy eating and physical activity increased from 67% to 85% (p &lt; 0.01) counselling.</td>
</tr>
</tbody>
</table>
**Seo & Lee, 2012**

N=246 parent-student dyads from 9 public sector secondary schools in Indiana (3 from each of urban, suburban and rural areas); 3 public middle schools and 2 public high schools in 2008-9.

27% in grade 6; 31% in grade 7; 14% in grade 8;

This is a cross-sectional survey (but findings could be used to influence future interventions)

That children consume up to 50% of daily caloric intake in school, therefore school nutrition policy may make an instrumental impact on childhood obesity.

Cross-sectional survey

Used/adapted previously validated questionnaires (Youth Risk Behaviour Outcome variable was child’s obese status (binary).

Variables of interests were:

| Mixed - | Cross-sectional, therefore causal inference cannot be made. Underpowered |

| + | + |

Reducing sugar-sweetened beverages increased from 63% to 78% (p < 0.01)
Clinical tools such as a soda bottle showing sugar content, paediatric plate planners, and goal setting posters were widely adopted (62%, 78%, and 41% respectively)
and 28% in grades 9-12.  
65% were female & 84% were Non-Hispanic White.  
Mean BMI of students was 21.97 (SD = 4.79). Mean age of children = 13.9 (sd=1.9)  
83% of the parents who provided survey data were the biological mothers, 9% the biological fathers, 3% the stepmothers, & 2% the guardians. Mean age of the biological mothers were 40.7 years (SD = 6.7).

Hypothesis: The following are inversely associated with children's obese status: 1) presence of school nutrition policies that prevent students from consuming junk foods 2) parental control over children's intake and physical activity 3) The frequency of family mealtimes.

Survey Questionnaire and Behavioural Risk Factor Surveillance System Questionnaire). Anonymous. Two-stage stratified cluster sampling used to select schools. Logistic regression analyse were performed to examine the odds ratios if different levels of school nutrition. - Individual school nutrition policies - Parental control over children's intake and physical activity - Frequency of family mealtimes. bivariate analysis. However, in the multivariate analysis "children who attended schools where soda pop and non-low-fat salty snacks could be purchased were more likely to be obese than those at schools where such items were not sold. However, the link between availability of junk foods at schools and student's obese status did not reach sig."

BMI calculated from reported height and weight, therefore? Accuracy. Frequency of family mealtimes, Parental control over child's eating and Physical activity were all measured through questionnaires – so there could be over/under reporting. The authors have separated soda pop, non-low-fat salty snacks and "junk
| 88 | (Veugelers & Fitzgerald, 2005) | N=5200 grade 5 students in Nova Scotia. 3656 (70.3%) attended a school without a nutrition program, 1350 (26.0%) attended one with a nutrition program and 133 (2.6%) attended a school participating in the Annapolis Valley Health Promoting Schools Project (AVHPSP) | Population-based investigation comparing weight of children in schools with nutrition programs in place with those without. | Survey. Multilevel regression methods | Rate of overweight and obesity | Yes - Rates of overweight and obesity were significantly lower in schools that are part of the AVHPSP than rates among students from schools without a nutrition program. | ++ |
|---|---|---|---|---|---|---|---|---|
| 365 | | Policies, parental control over child’s intake and physical activity and freq of family mealtimes. | | | | | | |
| 3656 | | | | | | | | |
| 1350 | | | | | | | | |
| 133 | | | | | | | | |

They discuss how there is a sig ass. Between soda pop and non-low-fat salty snacks, but not "junk food" – but in my opinion they are all junk food?
and heights and weights of students. From schools with a nutrition program were somewhat lower than those of students from schools without a program, but not significantly so.
## Table 12.2.5: Studies relating to Health Behaviour Matrix (Figure 2.3)

### National/ Upstream based interventions

<table>
<thead>
<tr>
<th>Study (Reference)</th>
<th>Title</th>
<th>Journal Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>88 Veugelers PJ, Fitzgerald AL</td>
<td>Effectiveness of school programs in preventing childhood obesity: a multilevel comparison.</td>
<td><em>American journal of public health</em></td>
</tr>
<tr>
<td>Year</td>
<td>Author(s)</td>
<td>Title</td>
</tr>
<tr>
<td>------</td>
<td>-----------</td>
<td>-------</td>
</tr>
<tr>
<td>Citation</td>
<td>Reference</td>
<td></td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Number</td>
<td>Reference</td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
</tbody>
</table>

370

### Individual/ downstream based interventions

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>Moens E, Braet C: <em>Training parents of overweight children in parenting skills:</em></td>
</tr>
<tr>
<td>No.</td>
<td>Reference</td>
</tr>
<tr>
<td>-----</td>
<td>-----------</td>
</tr>
<tr>
<td>31</td>
<td>Strippel, H: Effectiveness of structured comprehensive paediatric oral health education for parents of children less than two years of age in Germany. <em>Community Dental Health</em> 2010:74–80.</td>
</tr>
<tr>
<td>---</td>
<td>------------------------------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
Appendix 12.3.1 Interview schedule: Parents and Children

Questions relating to oral health and hygiene related to other day-to-day activities

• Firstly can you just describe your household to me - how many people live there, what ages etc?

• Please describe your day-to-day activities - what is your normal routine with you and your children ... how does oral health fit into this in the morning and evening.

• Are aspects such as getting everyone to brush their teeth in the morning or night a habit or is it something you have to consciously remind yourself to do?

• What are the difficulties or challenges do you face in keeping to a routine?

• Has anyone given any really good advice that you would offer to other parents?

• What behaviors are the biggest challenges for you to try to change for your child and/or your family?

Questions relating to influences on diet

• Were/ have you ever been given any information about diet and how food and drink can affect oral health (or any aspects of health) - if yes where did you get this information from (probe- did you believe it/ did it make you change your habits

• Thinking back to your first child what were your views and opinions on food did these change throughout your child growing older (if yes how)

• Are there any types of food or drink that you know can affect your/ your child’s teeth- were you aware of the impact of these things in your child’s diet early on - where did you get information from

• Do you ever discuss diet with other friends and family - what impact if any do you think this has

• Many parents report that their kids put pressure on them to buy specific foods. What kinds of foods do your kids ask you to buy that you are not sure you should?- How do you deal with these requests?

• Does your school have any policies on food - do they send any information about diet - what do you think of this (pros and cons)

• What are the challenges you face to controlling your and your child’s diet?

Questions relating to baby bottle use
• Were you given information about baby bottle use when your child was first born?
• Can you describe what this information was, where did it come from, did it change what you did.

**Question relating to the dental visit/ hospital visit in question**

• Can you describe what/ the reasons for your child visiting the dentist/ hospital today (or for the appointment in question)?

• How did/ do you feel about the treatment?

• Did you feel you were given all the information? What were the alternatives - were there any?

• How did you (the child) feel after the treatment? (Probe still in pain )

• Did the treatment have any positive or negative impacts?

• How did you feel about how quickly you were seen?

• Has the operation or treatment affected or changed the way you see the dentist - if yes how *prompts - anxiety, happier, regular, irregular attender - how often did you see the dentist in the past - how often do you plan to see the dentist now

• Do you think you will alter any habits or behaviour after this visit to/with the dentist - if yes in what way?

• Were you given any preventative (dental) advice? > How did you feel about this advice how likely are you to follow this now

**Question relating to previous dental visits**

• Can you tell me about some of your previous dental visits for both your self and your child?
  o What have you visited the dentist for - (probe describe the experience how did it make you feel did you change any behaviour after the visit)
  o What has your child previously visited the dentist for (probe ask child to describe the experience how did it make you feel did you change any behaviour after the visit)

• Have you or your child ever had any anxiety about visiting the dentists - have you discussed this with the dentists - was anything done after this discussion (probe behavioral management, acclimatization)

**Questions relating to interventions**

• What services or activities could be made available to help with managing your child’s oral health and diet
• How would you want to learn about the issues and problems (probe - mobile phone message - reminders, leaflets - where would you get information from - sure start centers

THANK YOU FOR GIVING YOUR TIME TO DISCUSS THESE ISSUES
# Appendix 12.3.2. Self report questionnaire for parents/guardians of children referred for DGA

<table>
<thead>
<tr>
<th>Questionnaire</th>
<th>Area code</th>
<th>ID number</th>
<th></th>
<th></th>
<th>Please tick relevant boxes</th>
</tr>
</thead>
<tbody>
<tr>
<td>All questions which ask about your child, relate to the one that is about to undergo the operation for having their teeth extracted.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. **Ethnicity**
   - White
   - Black/Black British
   - Asian/Asian British
   - Chinese
   - Other (please state) __________________________________________

2. **Number of Visits in the past for this child, for a General Anaesthetic for dental problems**
   - 0
   - 1
   - 2
   - 3
   - 4
   - 5+

3. **Does this child have any conditions/medicines which may affect oral health**
   - Yes (please state what medical/behaviour condition or medication) __________________________________________
   - And/Or
   - Have they taken medication for their current dental problem
   - Yes (please state i.e. antibiotics, paracetamol) __________________________________________

4. **How often does this child usually visit the dentist**
   - Regularly (at least once a year)
   - Occasionally (less than once a year)
   - Only when trouble with their teeth
   - Not sure
   - Other (please state) _______________________________

5. **Has a professional outside of this hospital ever provided this child with any of the**
   - Dentist
   - Healthcare visitor
   - School
   - Other health person
   - Avoid sugar in food or drink
   - Tooth brushing

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| following preventative advice or care (tick all that apply for each person stated): | Use of fluoride toothpaste |  |
| Use of mouth rinse |  |
| Sugar free chewing gum |  |
| Fissure sealants (plastic coatings on teeth) |  |
| Application of fluoride varnish on teeth |  |

| 6 Has this child as a result of this tooth decay/ dental problem had problems with: (tick all that apply) | Pain –please state when your child was last in dental pain |  |
| Chewing or talking |  |
| Self confidence |  |
| Emotion (irritable) |  |
| Social behaviour i.e. playing and speaking |  |
| Time off school (please state number of days) |  |
| Sleepless nights (please state number of nights) |  |
| Other (please state) |  |

| 7 When your child was under 7 or if they’re under 7 who brushes/ brushed your child’s teeth | Parent |  |
| Child (on own) |  |
| Child (supervised) |  |
| Does not brush |  |
| Don’t know |  |

| 8 How many times does your child brush their teeth a day | Rarely (on average less than once a day) |  |
| Once a day |  |
| Twice a day |  |
| More than 2 times a day |  |

| 9 How many children (under 16) live in your house | Please state |  |
| How many adults (over 16) live in your house | Please state |  |

| 11 How many other children in your house have had an extraction under General Anaesthetic | Please state |  |

<p>| 1 How many adults (over 16) are in … | Full time employment |  |
| Part time employment |  |
| Full time education |  |</p>
<table>
<thead>
<tr>
<th>Part time education</th>
<th>Unemployed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other (please state) __________________</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>How many years have you been a resident in this area (i.e. Bolton) and in the UK</th>
</tr>
</thead>
<tbody>
<tr>
<td>In this area (i.e. Bolton, Liverpool etc.)</td>
<td>UK</td>
<td></td>
</tr>
</tbody>
</table>

| 1 | 3 | If your child has lived in another country please state which country |

<table>
<thead>
<tr>
<th>1</th>
<th>4</th>
<th>Is your child anxious about attending the/their dentist?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes very anxious</td>
<td>Yes a little anxious</td>
<td>No</td>
</tr>
<tr>
<td>Don’t know</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>1</th>
<th>5</th>
<th>Are you anxious about attending the/your dentist?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes very anxious</td>
<td>Yes a little anxious</td>
<td>No</td>
</tr>
<tr>
<td>Don’t know</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>1</th>
<th>6</th>
<th>Has your child ever used a baby bottle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>No</td>
<td>Don’t know</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>1</th>
<th>7</th>
<th>If yes what did you put in the baby bottle (tick all that apply)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>Milk</td>
<td>Squash</td>
</tr>
<tr>
<td>Fruit juice</td>
<td>Other (please state)______________________________</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>1</th>
<th>8</th>
<th>If yes how long did you use a baby bottle for</th>
</tr>
</thead>
<tbody>
<tr>
<td>________years ________months</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<p>| 1 | 9 | What is your first/main language |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>0</td>
<td>How many sweets or sugary snacks (i.e. chocolate) does your child have a day and a week</td>
<td>Day</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Week</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>Is this your</td>
<td>1st Child</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2nd Child</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3rd Child</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4th Child</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>5th+ Child</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>Please state your household income</td>
<td>Less than £60-89 per week/ £260-389 per month/ £3,100-4,699 pa</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>£90-£119 per week/ £390-519 per month/ £4,700-6,199 pa</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>£120-£149 per week/ £520-649 per month/ £6,200-7,799 pa</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>£150-£199 per week/ £650-869 per month/ £7,800-10,399 pa</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>£200-£249 per week/ £870-1099 per month/ £10,400-12,999 pa</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>£250-£299 per week/ £1,100-1,299 per month/ £13,000-15,599 pa</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>£300-£349 per week/ £1,300-1,499 per month/ £15,600-18,199 pa</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>£350-£399 per week/ £1,500-1,699 per month/ £18,200-20,799 pa</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>£400-£499 per week/ £1,700-2,199 per month/ £20,800-25,999 pa</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>£500-£599 per week/ £2,200-2,599 per month/ £26,000-31,199 pa</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>£600-£699 per week/ £2,600-2,999 per month/ £31,200-35,399 pa</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>£700 or more per week/ £3,000 per month/ £37,000 or more pa</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Don’t know/ not stated</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Could we contact you about this research in the future? | Yes |   |
|   | No |   |   |

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Appendix 12.3.3. Clinical and Referral note data collection information

<table>
<thead>
<tr>
<th>Query number</th>
<th>CMUH FT audit of referrals - how complete were the referral letters or pro-formas to Dept Child dental Health, UDHM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Audit number</td>
</tr>
<tr>
<td>2</td>
<td>Date information entered into database</td>
</tr>
<tr>
<td>3</td>
<td>Referral type (0 = none given, 1 = GP, 2 = health visitor, 3 = A&amp;E, 4 = Clinic (salaried sites), 5 = Access centres from outside of manchester, 6 = other, 999 = no answer given)</td>
</tr>
<tr>
<td>4</td>
<td>Complete address of practice given (0=no, 1 = yes)</td>
</tr>
<tr>
<td>5</td>
<td>Is Postcode of practice given (0=no, 1 = yes)</td>
</tr>
<tr>
<td>6</td>
<td>Postcode of practice (only answer if answer '1' given at column E)</td>
</tr>
<tr>
<td>7</td>
<td>Name of Referrer given (0=no, 1= yes)</td>
</tr>
<tr>
<td>8</td>
<td>Referrer's name (if given)</td>
</tr>
<tr>
<td>9</td>
<td>Referral letter dated (0=no, 1 = yes)</td>
</tr>
<tr>
<td>10</td>
<td>Date of referral letter (dd/mm/yyyy)</td>
</tr>
<tr>
<td>11</td>
<td>Patient gender (0 = male, female = 1)</td>
</tr>
<tr>
<td>12</td>
<td>DOB of patient (dd/mm/yyyy)</td>
</tr>
<tr>
<td>13</td>
<td>Age at time of referral letter</td>
</tr>
<tr>
<td>14</td>
<td>Full address of patient given (0=no, 1= yes)</td>
</tr>
<tr>
<td>15</td>
<td>Postcode of Patient (if given, 999 = no postcode)</td>
</tr>
<tr>
<td>16</td>
<td>Telephone number of patient included ( 0 = No, 1 = Yes)</td>
</tr>
<tr>
<td>17</td>
<td>Medical History reported ( 0 = none, 1 = mentioned/ too short, 2 = satisfactory)</td>
</tr>
<tr>
<td>18</td>
<td>Details of Relevant Medical condition reported (0=none, 1= Yes, special needs 2 =Yes, behavioural problems, 3 =Yes, learning disabilities, 4 = Yes, medical i.e asthma 5=yes combination of conditions)</td>
</tr>
<tr>
<td>19</td>
<td>Dental History reported ( 0 = none, 1 = mentioned/ too short, 2 = satisfactory)</td>
</tr>
<tr>
<td>20</td>
<td>Is a clear request given (0 = none, 1 = GA, 2 = LA, 3 = sedation, 4 = combination of all above)</td>
</tr>
<tr>
<td>21</td>
<td>If yes - Justification given? ( 0 = No, 1 = Yes)</td>
</tr>
<tr>
<td>22</td>
<td>Justification (free text)</td>
</tr>
<tr>
<td>23</td>
<td>Has LA been offered/attempted? ( 0 = No, 1 = Yes)</td>
</tr>
<tr>
<td>24</td>
<td>Has IH sedation been offered/attempted? ( 0 = No, 1 = Yes)</td>
</tr>
<tr>
<td>25</td>
<td>Is GA patient demand/request? ( 0 = No, 1 = Yes)</td>
</tr>
<tr>
<td>26</td>
<td>Is there another reason for provision of GA? ( 0 = No, 1 = Yes)</td>
</tr>
<tr>
<td>27</td>
<td>If yes to Q28, state reason</td>
</tr>
<tr>
<td>28</td>
<td>Anxiety reported ( 0 = No, 1 = Yes)</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>29</td>
<td>Details of recent dental history attached? (0=No 1=Yes)</td>
</tr>
<tr>
<td>29a</td>
<td>0 = no, 1=previous extraction</td>
</tr>
<tr>
<td>29b</td>
<td>0 = no, 1=previous infection</td>
</tr>
<tr>
<td>29a</td>
<td>0 = no, 1=fillings provided</td>
</tr>
<tr>
<td>29b</td>
<td>0 = no, 1 = others</td>
</tr>
<tr>
<td>31</td>
<td>If other at Q31d please state</td>
</tr>
<tr>
<td>32</td>
<td>Carious teeth charted? ( 0 = No, 1 = Yes)</td>
</tr>
<tr>
<td>33</td>
<td>Degree of urgency reported? ( 0 = No, 1 = Yes)</td>
</tr>
<tr>
<td>34</td>
<td>Main reason for referral (0= not GA extraction, 1 = GA extraction,</td>
</tr>
<tr>
<td>35a</td>
<td>0= no trauma, 1= trauma</td>
</tr>
<tr>
<td>35b</td>
<td>0 = no dental anomalies, 1 = dental anomalies</td>
</tr>
<tr>
<td>35c</td>
<td>0= no oral medicine, 1 = oral medicine</td>
</tr>
<tr>
<td>35d</td>
<td>0 = no anxiety/phobia, 1= anxiety/phobia</td>
</tr>
<tr>
<td>35e</td>
<td>0 = no caries, 1 = caries</td>
</tr>
<tr>
<td>35f</td>
<td>0 = no erosion, 1 = erosion</td>
</tr>
<tr>
<td>35g</td>
<td>0 = no ADHD, 1 = ADHD</td>
</tr>
<tr>
<td>35h</td>
<td>0 = No Medical condition, 1 = Medical condition</td>
</tr>
<tr>
<td>35i</td>
<td>0 = no TMJ, 1 = TMJ</td>
</tr>
<tr>
<td>35j</td>
<td>0 = no delayed eruption, 1 = delayed eruption</td>
</tr>
<tr>
<td>35k</td>
<td>12 = no other, 1 = other</td>
</tr>
<tr>
<td>36</td>
<td>If other at Q35 please state</td>
</tr>
<tr>
<td>37</td>
<td>Radiographs included (0 = No, 1 = Yes)</td>
</tr>
<tr>
<td>38</td>
<td>Presence of infection (0 = No, 1 = Yes, 999 = no information)</td>
</tr>
<tr>
<td>38</td>
<td>Presence of pain (0 = No, 1 = Yes, 999 = no information)</td>
</tr>
<tr>
<td>39</td>
<td>Number of primary teeth requested for extraction (999 = no information)</td>
</tr>
<tr>
<td>40</td>
<td>Number of quadrants requested for primary tooth extraction (999 = no information)</td>
</tr>
<tr>
<td>41</td>
<td>Number of permanent teeth requested for extraction (999 = no information)</td>
</tr>
<tr>
<td>42</td>
<td>Number of quadrants requested for permanent tooth extraction (999 = no information)</td>
</tr>
<tr>
<td>45</td>
<td>Need for interpreter noted? ( 0 = No, 1 = Yes)</td>
</tr>
<tr>
<td>46</td>
<td>If yes - was preferred language specified (string)</td>
</tr>
<tr>
<td>52</td>
<td>Date of procedure</td>
</tr>
<tr>
<td>53</td>
<td>Type of extraction (0 = none, 1 = GA, 2 = LA, 3 = sedation, 4 = combination of all above)</td>
</tr>
<tr>
<td>54</td>
<td>Number of primary teeth extracted (999 = no information)</td>
</tr>
<tr>
<td>55</td>
<td>Number of quadrants for primary tooth extractions (999 = no information)</td>
</tr>
<tr>
<td>56</td>
<td>Number of permanent teeth extracted (999 = no information)</td>
</tr>
<tr>
<td></td>
<td>Description</td>
</tr>
<tr>
<td>---</td>
<td>-------------</td>
</tr>
<tr>
<td>57</td>
<td>Number of quadrants for permanent tooth extractions (999 = no information)</td>
</tr>
<tr>
<td>58</td>
<td>Additional free text information</td>
</tr>
</tbody>
</table>
Appendix 12.3.4. Information Sheet & Informed Consent Form
Consent form for Stage 1 - Dental Extractions

Parent/ Guardian Consent form

Parent/ Guardian (& child if appropriate) to complete (please use capital letters & write in ink):

AREA CODE          ID NUMBER          RESEARCH STAGE

PARENT/ GUARDIAN NAME

RELATIONSHIP TO CHILD

PARENT/ GUARDIAN ADDRESS

CHILD NAME

CHILD ADDRESS (if different from above)

GENDER OF CHILD: MALE 1 FEMALE 2

DATE OF BIRTH: (OF CHILD)      DAY        MONTH        YEAR

Print participant's name and instruct them to initial the box appropriate to their decision:

I have read the information sheet and had the opportunity to ask questions

I understand that my/ my child’s participation is voluntary and that they may withdraw at any time without it affecting my/their rights

I understand that relevant sections of any data collected during the study, may be looked at by responsible individuals from the University of Manchester, from regulatory authorities or from the NHS Trust, where it is relevant to my taking part in this research. I give permission for these individuals to have access to my/ my child’s data

I agree to take part in this research

I agree to possibly being contacted in future about the next stage of the research

Name and Signed ________________________________ Date ______________

(To be signed by the participant - Parent/ Guardian)

Name and Signed ________________________________ Date ______________

(To be signed by the participant – Child – if appropriate)

Researcher ________________________________ Date ______________


Parent/ Guardian Consent form

Parent/ Guardian (& child if appropriate) to complete (please use capital letters & write in ink):

AREA CODE    ID NUMBER    RESEARCH STAGE

PARENT/ GUARDIAN NAME
___________________________________________________

RELATIONSHIP TO CHILD_____________________________________________________

PARENT/ GUARDIAN ADDRESS ________________________________________________

CHILD NAME _______________________________________________________________

CHILD ADDRESS (if different from above) ________________________________________

GENDER OF CHILD:              MALE  1              FEMALE  2

DATE OF BIRTH:                DAY     MONTH     YEAR
(OF CHILD) ____________________________

Print participant’s name and instruct them to initial the box appropriate to their decision:

I have read the information sheet and had the opportunity to ask questions

I understand that my/ my child’s participation is voluntary and that they may withdraw at any time
without it affecting my/their rights

I understand that relevant sections of any data collected during the study, may be looked at by
responsible individuals from the University of Manchester, from regulatory authorities or from
the NHS Trust, where it is relevant to my taking part in this research. I give permission for
these individuals to have access to my/ my child’s data

I agree for the interview to be recorded, transcribed & for anonymised direct quotes to be used

I agree to take part in this research

Name and Signed ________________________________ Date ______________
(To be signed by the participant – Parent/ Guardian)

Name and Signed ________________________________ Date ______________
(To be signed by the participant – Child – if appropriate)

Researcher ________________________________ Date ______________
Dear Parent or Guardian

I am a researcher at the University of Manchester and we are conducting a study looking at the process and number of extractions carried out on children under General Anaesthetic in the North West. In this research we are hoping to talk to 560 parents/guardians and their children and ask them 20 questions relating to this area. This questionnaire is mainly for you as the parent or guardian however if you wish, your child may answer the questions with you. If your child is over the age of 11 we will also ask if they agree to participate – in this case both of you would need to agree to take part before we can begin.

Before you can agree for both you and your child to participate I would like to give you some information about the background of the study. Thank you for reading this

What is the purpose of the study?
This part of the study is to try and gain information about you and your child (who has been referred for the operation) in order for us to be able to understand more about the need for teeth being extracted in a hospital setting and to aid the next stage of the research where we will be asking some parents and children to come in and talk to us in a more in depth interview.

Why have I and my child been chosen?
You are being invited to take part in this study as we would like to gain a greater understanding about hospital operations involving the removal of teeth, the process which has resulted in a referral for a tooth extraction and believe you and your child are in a good position to offer insight into this area and comment on experiences you have had.

What will participation involve?
We would like to ask you 20 questions in the form of a short questionnaire during your consultation which should take around 10 minutes to complete. If you agree to take part, you are free to withdraw at any time from this research and do not have to answer any of the questions if you do not wish. You can choose to say no and any services that you and your family receive at this centre will not change. You will also be asked if it would be ok to contact you in the future about this research, you do not have to answer yes if you answer the following 20 questions presented in the questionnaire.
All your responses will be anonymised and therefore you will not be able to be identified from the research when it is analysed. If you agree we will combine this data from information from your child’s referral notes and this consultation.

**What happens if there is a problem?**

If you have a concern about any aspect of this study, you should ask to speak to the researchers who will do their best to answer your questions. If they are unable to resolve your concern or you wish to make a complaint regarding the study, please contact the University Research Office on 0161 2757583 or 0161 2758093 or by email to research-governance@manchester.ac.uk.

If there are any parts that you want more information on you are welcome to ask me now or to stop as we go through the questionnaire and I will take time to explain. If you have questions later, you can ask them of me or of another researcher.

Contact for Further Information

**Chief Investigator**

Michaela Goodwin
School of Dentistry
michaela.goodwin@manchester.ac.uk
0 161 2756121

**Supervisors**

Iain Pretty
School of Dentistry
lain.A.Pretty@manchester.ac.uk

Caroline Sanders
Department of Primary Care)
caroline.sanders@manchester.ac.uk
Dear Parent or Guardian

I am a researcher at the University of Manchester and we are conducting a study into the process and number of extractions carried out under General Anaesthetic in the North West. In this research we talked to 560 parents/guardians and their children and asked 20 questions relating to this area. We would like to ask you the same questions and then if appropriate ask you if you would like to take part in a more in-depth interview. You will only be asked to do this if you agree, are eligible and are randomly assigned to the group after completing the questionnaire. This questionnaire is mainly for you as the parent or guardian however if you wish your child may answer the questions with you. If your child is over the age of 11 we will also ask if they agree to participate – in this case both of you would need to agree to take part before we can begin.

Before you can agree for both you and your child to participate I would like to give you some information about the background of the study. Thank you for reading this

What is the purpose of the study?
This part of the study is to try and gain information about you and your child (who has been referred for the operation) in order for us to be able to understand more about the need for teeth being removed in a hospital setting and to aid the next stage of the research where we will be asking some parents and children to come in and talk to us in a more in depth interview. The information from the questionnaire will be used to understand if you are eligible to participate in the next stage of the research

Why have I and my child been chosen?
You are being invited to take part in this study as we would like to gain a greater understanding about hospital operations involving the removal of teeth, the process which has resulted in a referral for a tooth extraction and believe you and your child are in a good position to offer insight into this area and comment on experiences you have had.

What will participation involve?
We would like to ask you 20 questions in the form of a short questionnaire during your consultation which should take around 10 minutes to complete. If you agree to take part, you are free to withdraw at any time from this research and do not have to answer any of the questions if you do not wish. You can choose to say no and any services that you and your family receive at this
centre will not change. You will also be asked if it would be ok to contact you in the future about this research, and possibly ask you to participate in a more in-depth interview.

All your responses will be anonymised and therefore you will not be able to be identified from the research when it is analysed. However your personal details (name and address will be kept in a separate data base in order for us to contact you again if necessary). If you agree we will combine this data from information from your child’s referral notes and this consultation.

**What happens if there is a problem?**

If you have a concern about any aspect of this study, you should ask to speak to the researchers who will do their best to answer your questions. If they are unable to resolve your concern or you wish to make a complaint regarding the study, please contact the University Research Office on 0161 2757583 or 0161 2758093 or by email to research-governance@manchester.ac.uk.

If there are any elements that you want more information on you are welcome to ask me now or to stop as we go through the questionnaire and I will take time to explain. If you have questions later, you can ask them of me or of another researcher.

Yours Sincerely

Michaela Goodwin

Contact for Further Information
**Chief Investigator**
Michaela Goodwin
School of Dentistry
michaela.goodwin@manchester.ac.uk
0 161 2756121

**Supervisors**
Iain Pretty
School of Dentistry
lain.APretty@manchester.ac.uk

Caroline Sanders
Department of Primary Care
caroline.sanders@manchester.ac.uk
Hello, my name is Michaela and I am looking at operations carried out in hospitals to remove children’s teeth. Please have a look at this leaflet as we would like to ask you to be involved in this research by answering some questions with your parent or guardian. Thank you for reading this.

What is the study about?
- We would like to understand more about the need for teeth being taken out in a hospital and what things can affect the need for having teeth removed, such as, what we do in our day to day lives, visiting the dentist, etc.

Why have I been chosen?
- You have been chosen so we can learn more about this area and think you and your family are in a good position to tell us about this and talk about your experiences.

What will happen in this part of the research?
- We will ask you and your parent or guardian 20 questions which will be about you, your family and some questions about the dentist and looking after your teeth and health in general.

Can I stop answering questions?
- You do not have to answer any questions you don’t want to.
- You can pull out of the study.

Will the things I tell you be kept secret?
- No one will know who you are as your answers will be put into a computer and your name will be kept separate.

If you are under 16 and would like to take part we also need your parents consent.

If you would like any more information please feel free to contact me
Michaela Goodwin
0161 2756121
michaela.goodwin@manchester.ac.uk
25th May 2011

Dear ____________

I am writing to you as you recently filled out a questionnaire about you and your child when visiting ______ Hospital for a tooth extraction. This was in relation to the research being conducted regarding process and number of extractions carried out under General Anaesthetic in the North West. In the initial stage of the research we have talked to 560 parents/guardians and their children and asked a number of questions relating to this area. We are writing to you as you have been randomly selected to take part in the next stage of this research which is an in-depth interview with both you and your child. You do not have to decide today if you want to take part in the rest of this study. One of the researchers at the University will contact you within the next week to establish whether you would still like to take part in this research.

If you have questions, you can ask them of me or of another researcher.

**What is the purpose of the study?**
You have already answered at set questionnaire around this area and now we would to invite you to take part in the second stage which will examine the process of arriving at the need for extraction under General Anaesthetic and interventions that may work in the future. We will be combining this with data collected from specific dentists and hospitals to determine if policy, referrals or the way information is given and distributed needs to change.

**Why have I and my child been chosen?**
You are being invited to take part in this study as we would like to gain a greater understanding about extractions carried out in hospitals and the process which has resulted in a referral for an extraction. We believe you and your child are in a good position to offer insight into this area and comment on experiences you have had.

**What will participation involve?**
We would like to ask you and your child (who has undergone the operation) to meet us at a convenient location i.e. a library or community centre near to your home to take part in
an interview which will take approximately 40-50 minutes. It is intended as an opportunity for you and your child to

express your views as to the process of extraction under General Anaesthetic and to discuss the elements that lead to the need for this operation and future interventions which may work on a wide scale. Your child will take part in a discussion with yourself and a researcher who has had particular training within this area.

The interview will be tape recorded and later transcribed into text form. The information recorded is confidential, and no one else except the Researcher and Principal Investigators (Michaela Goodwin, Dr Caroline Sanders and Dr Iain Pretty) will have access to the information documented during your interview). As part of the presentation/analysis your words may be used in text form, however they will be anonymised so that you will not be able to be identified from what you have said. All of the research data will be stored at the University of Manchester in a secure location for 5 years (as per University policy).

If you agree to take part along with your son/daughter, you are both free to withdraw at any time from this research and do not have to answer any of the questions if you do not wish. You can choose to say no and any services that you and your family receive relating to this operation will not change.

At the end of the study, we will be sharing what we have learnt with the wider community. We will also publish the results in order that other interested people may learn from our research. If you wish to see a copy of the report we would be happy to provide this at the end of the study.

If there are any elements that you want more information on you are welcome to ask me now or to stop as we go through the questionnaire and I will take time to explain. If you have questions later, you can ask them of me or of another researcher. I have also included a information sheet for your child which you can use to talk through the study with them if you wish.
Kind Regards

Michaela Goodwin
Research Assistant
The University of Manchester
Room 1.001 - 1st Floor, Coupland III
Oxford Road
Manchester, M13 9PL
Tel: +44 (0)161 2756121
Contact for Further Information
Hello, my name is Michaela and I am looking at operations carried out in hospitals to remove children’s teeth. Please have a look at this leaflet as we would like to ask you to be involved in this research by being taking part in an interview. Thank you for reading this.

What is the study about?

- It is to understand your experience of going to hospital, how you feel about what happened while there and if we can help make the process better.
- It is to try and understand how you arrived at needing your teeth removed and how we can prevent this in the future.

Why have I been chosen?

- You have been chosen so we can learn more about this area and think you and your family are in a good position to tell us about this and talk about your experiences.

What will happen in the interview?

- You will come along with your parent or guardian and you will be asked some questions about your how you feel /felt about the operation on your teeth, what improvements could be made and what you usually do day to day which may impact on your health.
- This can take place somewhere near where you live, possibly in a room in a library or community centre.
- If you agree, it will recorded on an audio tape.
- Your words will be used but not your name so no one will know who you are.

Can I stop the interview?

- You can stop the interview at any time.
- You do not have to answer any questions you don’t want to
- You can pull out of the study.

Will the things I tell you be kept secret?

- No one will know who you are but if you tell me something that indicates you or another child are at risk of serious harm then I may need to tell someone to keep you safe.

What if I would like more information or support?

- You can ask me for any further information if you would like or who to go to for more support, if anything bothers or upsets you in the interview we can stop straight away and you can talk with me, your family or whoever you choose.

If you are under 16 and would like to take part we also need your parents consent.

If you would like any more information please feel free to contact me

Michaela Goodwin
0161 2756121
michaela.goodwin@manchester.ac.uk

Reducing the number of General Anaesthetics required for tooth extraction for children in the North West of England - A multi staged approach
- Information letter (5) for qualitative interviews – Children over 10 years old
Hello, my name is Michaela and I am looking at when children have to have their teeth taken out in a hospital. Please have a look at this hand-out as we would like to ask you to take part in this research by answering some questions with your parent or guardian. Thank you

What will happen if I take part in the study?

1) We would like for you to talk to us and help us know more about having your teeth taken out in a hospital.
2) We will talk with you and your parent/guardian in a private room close to where you live, such as a library.

3) To help us we may show you books, toys or pictures to help to understand how you feel or what you do most days, for example when you brush your teeth.

You can ask me or anyone else any questions you would like about this research before we begin. You do not have to answer any questions that you don’t want to.
## Appendix 12.3.7 Completeness of Questionnaire

<table>
<thead>
<tr>
<th>Questions</th>
<th>Percentage completed by participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethnicity</td>
<td>97%</td>
</tr>
<tr>
<td>Number of Visits in the past for this child, for a General Anaesthetic for dental problems</td>
<td>99%</td>
</tr>
<tr>
<td>Does this child have any conditions/ medicines which may affect oral health</td>
<td>99%</td>
</tr>
<tr>
<td>Have they taken medication for their current dental problem</td>
<td>94%</td>
</tr>
<tr>
<td>How often does this child usually visit the dentist</td>
<td>99%</td>
</tr>
<tr>
<td>Has a professional outside of this hospital ever provided this child with any of the following preventative advice or care (tick all that apply for each person stated):</td>
<td>99%</td>
</tr>
<tr>
<td>Has this child as a result of this tooth decay/ dental problem had problems with: (tick all that apply)</td>
<td>100%</td>
</tr>
<tr>
<td>When your child was under 7 or if they’re under 7 who brushes/ brushed your child’s teeth</td>
<td>98%</td>
</tr>
<tr>
<td>How many times does your child brush their teeth a day</td>
<td>97%</td>
</tr>
<tr>
<td>How many children (under 16) live in your house</td>
<td>98%</td>
</tr>
<tr>
<td>How many adults (over 16) live in your house</td>
<td>96%</td>
</tr>
<tr>
<td>How many other children in your house have had an extraction under General Anaesthetic</td>
<td>97%</td>
</tr>
<tr>
<td>How many adults (over 16) are in …</td>
<td>89%</td>
</tr>
<tr>
<td>How many years have you been a resident in this area (i.e. Bolton) and in the UK</td>
<td>85%</td>
</tr>
<tr>
<td>If your child has lived in another country please state which country</td>
<td>100%</td>
</tr>
<tr>
<td>Is your child anxious about attending the/ their dentist?</td>
<td>96%</td>
</tr>
<tr>
<td>Are you anxious about attending the/ your dentist?</td>
<td>97%</td>
</tr>
<tr>
<td>Has your child ever used a baby bottle</td>
<td>99%</td>
</tr>
<tr>
<td>If yes what did you put in the baby bottle</td>
<td>99%</td>
</tr>
<tr>
<td>If yes how long did you use a baby bottle for</td>
<td>93%</td>
</tr>
<tr>
<td>What is your first/main language</td>
<td>100%</td>
</tr>
<tr>
<td>How many sweets or sugary snacks (i.e. chocolate) does your child have a day and a week</td>
<td>90%</td>
</tr>
<tr>
<td>Child birth order</td>
<td>96%</td>
</tr>
<tr>
<td>Household income</td>
<td>61%</td>
</tr>
<tr>
<td>DOB</td>
<td>98%</td>
</tr>
<tr>
<td>IMD</td>
<td>94%</td>
</tr>
</tbody>
</table>