Health e-records and the obesity epidemic

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Presentation
• Obesity – ‘heads up’ the evidence production line is out of date
• Health e-records feeding discoveries
• Need e-records to support metabolic health
  – Population
  – Clinical
  – Personal

Health evidence journey

Circa 1800: Laplace then Louis apply probability theory to medical data, showing some treatments to be ineffective - rebuked by medical profession – Quetelet’s concept of ‘the average man’ adds fuel to the fire

Mid 1600s: John Graunt used death and tax data to inform civil action as plague swept London

Mid 1800s: Lister uses statistical arguments and Pasteur’s germ theory to revolutionise surgery with carbolic spray

Mid-late 1800s: Galton, Pearson, Edgeworth and Yule establish Statistics as a discipline

Early/mid 1900s: Fisher advances statistical method and experimental philosophy as Greenwood and Bradford-Hill push Statistics into medical research

Mid-late 1900s: Cochrane pushes for the routine application of randomised clinical trials and leaves the evidence based medicine movement in his wake

Evidence limits showing
• Epidemiology has exhausted the big simple causes of ill health
• Many trials have weak external validity
• Public health interventions unstudied
Many patterns of ill health in society remain unexplained via conventional studies

Meanwhile...
• Biology becoming an information science
• E-Science (integration of data, methods and investigators)
• More data, with more structure
• Inductive ‘mining’ approaches rising
• Triage & brain vs. silicon priorities
Solution?: Health Informatics partnership to build a new biomedical evidence production line

Let's consider the obesity epidemic...

Body Mass Index (BMI)

- Weight for height
- An easy measure of adiposity
- \( \text{BMI} = \frac{\text{Weight (Kg)}}{\text{Height (m}^2\text{)}} \)
- Not ideal for measuring individual adiposity but good for monitoring change over time in populations.

Early warning of rising adiposity of English adults

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Complex biology

- Big mass heart works harder
- Changes of hypertension
- High cholesterol and low HDL:LDL ratio
- Insulin resistance
- Altered hormone metabolism e.g. oestrogens
- Altered liver function
- Damaging stresses on joints, ligaments, tendons and muscles
- Breathing impairment
- Altered intestinal function

Just starting to understand the interaction of these factors in pathologies such as metabolic syndrome:
- Central obesity + dyslipidaemia + hypertension + diabetes
- Causes early death & strongly predicted by childhood obesity

Personal health impact

- Early death 'from all causes'
  - Obesity takes around a decade off your life
  - More if you smoke
  - Less if you take regular exercise
- Suffering and disability through:
  - Cardiovascular disease
  - Diabetes
  - Osteoarthritis
  - Low self-esteem and social functioning
  - Some cancers (colorectal, ovarian, endometrial)
  - Liver and intestinal disorders
  - Sexual dysfunction
  - Sleep apnoea

Population health impact

Estimate for the obesity impact in the Northwest:

- Bringing everyone in the Northwest to a body mass index less than 30, i.e. eliminating obesity, would result in 7,000 fewer deaths per year (95% CI = 2,000 to 14,000)
Extraordinary social problem

Energy balance
in (eating)
out (physical activity)
depends on families, friends, co-workers etc.
can’t be isolated and treated in individuals
‘passive obesity’

Discovery from e-records

Where are the signals coming from?

Research archives

Health Survey for England...

Early warning of rising adiposity of English adults

Trends in Body Mass Index from Health Survey for England 1993 to 2002

Women and not men from low-income households are fatter in England

Data from Health Survey for England
Women from low-income households and men from high-income households are fatter in Greater Manchester.

Information utility

- E-records in UK Data Archive
  - But: wait 2+ years after collection
- Large national sample
  - But: only 0.02% of population therefore difficult to study small areas/sub-groups
  - Sampling of children not random
- Some objective measurements by nurse
  - But: non-validated questionnaires lead to unexpected results that might reflect response bias more than real trends

Intelligence from routinely-collected but not routinely analysed data:

Obesity in Wirral 3-yr-olds, 88 to 03...

Rising fatness of Wirral 3yr olds from 1988 to 2003

Body Mass Index (BMI) trend in Wirral 3y-olds from 1988 to 2003

There are similar child health data in other localities...
International Obesity Taskforce classification applied to Manchester school children 2000 to 2004

Girls were 1.55 (95% CI 1.29 to 1.87) times more likely than boys to be overweight or obese

Typical recent trend: Liverpool 10yr olds

Routine data - stimulating science:
At what age do signs of the obesity epidemic appear?

Birth-weight and BMI at 3 years for children born on Wirral between 1985 and 2000

Strongest trends: Rise in BMI at 2 & 3 years and infant length for children born on Wirral between 1990 and 2000
Are some social groups affected more than others?

Babies of affluent families are born heavier in Manchester still

Vanishing social trends in early infant weight gain in Manchester from 1986 to 2004

Decreasing inequalities in BMI at 3 years on Wirral

Rochdale 5yr old obesity by deprivation in 2005

...was there a spatial as well as a social diffusion pattern of obesity across the 1990s?...

No correlation with deprivation (IDAC 2004): $r = -0.04$ (-0.08 to 0.05)
BMI of 3 yr olds
1998 - 1999

BMI of 3 yr olds
2000 – 2001

BMI of 3 yr olds
2002 - 2003

...height and linear growth are socially sensitive, so how did they change with BMI across the 1990s?...

Increasing correlation between height and weight in Wirral 3-yr-olds 88 to 03

Source: Buchan et al. pre-publication

Secular trend to increasing BMI is much greater in taller children

Source: Buchan et al. pre-publication
Faster infant growth and slower early child growth

Adiposity fluctuates less in young children than it used to

...if fat is sticking more through childhood what is happening to physical fitness?...

Cardio-respiratory endurance levels of Liverpool 10 year olds fell in all BMI groups

BMI of Liverpool 10 year olds rose irrespective of cardio-respiratory endurance
Discoveries from service e-records
The obesity epidemic in children:
• Concurred with accelerating infant growth
• Showed a temporo-spatial spread pattern
• Ignored socio-economic groups
• Affected the physically fit and unfit alike

Evidence Based Practice
Needs
Practice Based Evidence

Informatics challenges in tackling obesity...

Intelligence to support decisions

Future decision support
• Personal
  – “what activities and diet do I need to combat the past 48h of metabolic stress my biosensors report?”
• Clinical
  – “what dose adjustment should I make to match my patient’s adiposity?”
• Population
  – “what is the obesity-related health gain for every pound we invest in green transport?”

Information culture shifting
• ↓ Report cycles → ↑ surveillance
• ↑ tactical service responses
• More personal health systems: ↑ co-ordination (individual & societal) of preventive healthcare
... Turning bio-health information into discoveries