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DOI:
[10.1111/jcpt.13014](https://doi.org/10.1111/jcpt.13014)

Document Version

Accepted author manuscript

[Link to publication record in Manchester Research Explorer](#)

Citation for published version (APA):

Bansal, N., Tai, W-T., & Chen, L-C. (2019). Implementation of an innovative surgical pharmacy service to improve patient outcomes—Twelvemonth outcomes of the Enhanced Surgical Medicines Optimization Service. *Journal of clinical pharmacy and therapeutics*. <https://doi.org/10.1111/jcpt.13014>

Published in:

Journal of clinical pharmacy and therapeutics

Citing this paper

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Implementation of an innovative surgical pharmacy service to improve patient outcomes – twelve-month outcomes of the Enhanced Surgical Medicines Optimisation Service

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Word count (excluding title page, abstract, references, figures and tables): 2758 words

Abstract

What is known and objective

Pharmacists play vital roles in medicines optimisation in different care settings. Studies have shown that optimising patient's pre-existing co-morbidities prior to surgery leads to better post-operative outcomes. The Enhanced Surgical medicines optimisation service (ESMOS) is an innovative surgical pharmacy service introduced at a large teaching hospital in the UK in September 2017 which aimed to reduce the length of stay and postoperative complications in general surgical patients. This purpose of this study is to evaluate the implementation and outcomes of this service at 12 months after it was rolled out.

Methods

This cohort study was undertaken between September 2017 and September 2018. Adult patients undergoing elective major general surgical procedures were included and stratified into four sub-specialties, including hepato-pancreato-biliary (HPB), upper gastrointestinal (GI), lower GI and vascular surgery. Patient undergoing emergency and day case procedures or with missing outcome data were excluded from this study. Patients' demographics, baseline co-morbidities, high-risk medications, American Society of Anaesthesiologists (ASA) physical status classification, surgical procedure, post-operative complications, length of stay and nature of pharmacist interventions were collected and reported by descriptive statistics.

Results and discussion

A total of 246 patients were included in the four general sub-specialties: HPB (n=82), upper GI (n=17), lower GI (n=87) and vascular (n=60). There was a significant reduction in the median length of stay in three surgical specialties: lower GI (median reduction: -2; IQR: -4, 1.8; P=0.038), HPB (median reduction: -4.5; IQR: -7, -1; P=0.001) and vascular (median reduction: -2; IQR: -4, 0; P=0.043).

29 **What is new and conclusion**

30 The ESMOS model is a novel care pathway that allows both early identification of medicines
31 optimisation and peri-operative drug management issues in surgical patients hence
32 promoting quicker recovery after surgery and reducing the overall length of stay.

33

34 **Keywords:** Pharmacist-led; length of stay; postoperative complications; elective surgery;
35 medicines optimisation.

Introduction

Post-operative complications after major surgery are well documented in the literature with complication rates as high as 30% having been reported.¹⁻⁶ Complications may vary in severity from wound infections to more severe events, such as anastomotic leaks, wound dehiscence or even post-operative mortality.⁷ Factors associated with increased risk of post-operative complications include advanced age, co-morbidities such as diabetes and those related to cardiovascular disease along with undergoing major emergency surgery.^{3-4,8,9} In line with the emphasis on both quality and cost-effectiveness in the NHS, there is a need to re-organise the healthcare workforce to provide a multi-disciplinary model of care with the focus on optimising these pre-existing co-morbidities prior to surgery.¹⁰

To improve patient outcomes and reduce length of stay for surgical patients, the National Enhanced Recovery Programme was introduced in 2009 by collaboration by the Department of Health in partnership with NHS improvement, the National Cancer Action Team and the NHS Institute for Innovation and Improvement.¹¹ In line with this initiative, a pharmacist led Enhanced Surgical Medicines Optimisation Service (ESMOS) was implemented in a large 1200-bedded tertiary hospital in Central Manchester in September 2017 to mitigate the risks of post-operative complications and optimise post-operative care. The goals of the ESMOS service are to identify high-risk surgical patients once they are listed for surgery and get them in the best possible state for operation by focusing on optimising their pre-existing co-morbidities.

During the pre-operative phase, patients are reviewed in a virtual pharmacist clinic whereby patients' pre-existing medical co-morbidities are recorded by pharmacists along with any high-risk medication the patient is taking.¹² In the post-operative phase, all patients are closely monitored on the ward with the focus being on medicines optimisation to minimise the incidence of any post-operative complications occurring. This involves working collaboratively with the wider multi-disciplinary team including anaesthetists, surgeons,

specialist nurses, dieticians, physiotherapists along with both pharmacists and general practitioners in the community.

Prior to the implementation of ESMOS, a pilot study was undertaken between 2013 and 2016 on 100 patients admitted for major colorectal surgery before (n=50) and after (n=50) the introduction of ESMOS. This involved dedicated pharmacist involvement throughout the patient journey from the pre-operative stage to discharge post-surgery with a focus on medicines optimisation. Baseline data were collected on all patients seen pre-operatively in a nurse led pre-admission clinic. The results showed a significant reduction in both length of stay and the incidence of postoperative complications.¹³ Based on these positive results, the trust recruited additional senior surgical pharmacists and a pharmacy technician to provide the ESMOS service.

The ESMOS was initially rolled out to four main general surgical sub-specialities: hepato-pancreato-biliary (HPB), upper gastrointestinal (GI), lower GI and vascular surgery. Each speciality was allocated one specialist surgical pharmacist with independent prescribing status along with a pharmacy technician to support the service. A list of 'always events'¹⁴ (Appendix 1) was used to guide the ESMOS delivery to ensure optimal patient experience, improve outcomes and serve as a unifying force for all that demonstrates an on-going commitment to person and family centred care.

Patients who were eligible to receive the service were identified by the pharmacist technician through various methods (liaising with consultant secretaries and gaining access to scheduled calendars and access to the surgeon's lists) and by direct referrals to the service. Eligible patients were subsequently grouped into either 'low risk' or 'high risk' by a risk screening tool (Appendix 2) which was developed by expert pharmacist consensus considering patients' co-morbidities, type of surgery and medications. For 'high-risk' patients, a telephone consultation was arranged by the pharmacist to identify any medicines

92 optimisation issues. In addition, an anaemia assessment was undertaken for both low and
93 high-risk patients and those who are subsequently identified as being anaemic from their
94 biochemistry results were referred to haematology for iron replacement therapy.

95

96 To inform the further service expansion and improvement strategies, an iterative service
97 evaluation is needed to guide the continuous service improvement process. This project
98 aimed to assess the implementation of the ESMOS service and evaluate its impacts on
99 postoperative care outcomes.

Methods

Study design and data source

A retrospective cohort study was conducted using a registry collected by the ESMOS pharmacists prospectively during the individual patient admission from September 2017 (launch of service) to September 2018. The registry is an electronic database containing relevant information of all patients included in the service, including patient demographics (e.g. age, gender), the American Society of Anaesthesiologists (ASA) score for physiological status,¹⁵ co-morbidities, details of high-risk medication, nature of pharmacist interventions, post-operative complications, length of stay and details of any re-admissions. Data confidentiality was maintained with access restricted by password protection only to the ESMOS team. Anonymous data was extracted for data analysis purposes. Ethics approval was not required for this service evaluation.

Study cohort

All adult patients who underwent major elective general surgical procedures with an ASA grade of more than or equal to 2 (i.e. a patient with a mild systemic disease)¹⁵ during the study period were included. Patients who underwent planned day case or emergency surgery, and those with missing data of primary outcome were excluded. Included patients were further categorised into the four main general surgical sub-specialties that the ESMOS service covered in the hospital: HPB, upper GI, lower GI and vascular surgery.

Outcome measure

Information recorded included: baseline patient characteristics, including demographics (gender, age), ASA grade (scored between 1 to 5), co-morbidities and any high-risk medicines taken before the surgery. Types of pharmacist interventions as well as all complications reviewed by the relevant surgical teams were also extracted.

The interventions made by pharmacists were themed into two different categories, i.e. those related to peri-operative drug management or those pertaining to medicines optimisation.

Peri-operative drug management covered all issues that arose because of the surgery, such as peri-operative drug management advice, post-operative nausea and vomiting, optimising analgesic control, electrolyte correction and infection monitoring. Medicines optimisation interventions included actions that led to better management of patients pre-existing medical conditions. These included better blood pressure control, optimising diabetes management, compliance with inhalers and optimisation of heart failure medication.

The primary outcome was the actual length of stay (ALOS), which was calculated as the continuous time-period (days) of each inpatient spell. The nationally expected length of stay (ELOS) for corresponding major elective surgical procedures¹² was also retrieved and compared with each patient's ALOS.

Data analysis

Descriptive data was used to report the results, including mean and standard deviation (SD) or median and interquartile range (IQR) for the length of stay, and proportion for the categorical variables, such as gender, age rank and ASA grade. For each patient, the reduction in length of stay was calculated using the Wilcoxon signed rank test. All data analysis was conducted by using an online software package - Stats Pages (statpages.org).

Results

Study cohort

During the 12-month period, 544 patients were identified as potentially eligible for the ESMOS service, with 271 patients classified as 'high risk' and enrolled into the service. Twenty-one patients were excluded due to cancellation of surgery or whereby the surgeon considered that surgery was not appropriate due to disease progression. Of the 250 patients who received the ESMOS service, 4 patients were excluded due to missing data. In total, 246 patients were included in this study and classified into HPB (n=82), upper GI (n=17), lower GI (n=87) and vascular (n=60) group (Figure 1).

Characteristics of patients and pharmacist interventions

Of the 246 patients included in this study (Table 1), there were significantly more males than females (69.1% vs. 30.9%; $P<0.05$). The majority of patients fell in the 60-69 (35.7%) and 70-79 (36.9%) year age groups and most patients ASA grade being greater than or equal to 2 (58.9%). Cardiovascular disease was the most prevalent co-morbidity (36.3%).

Anti-platelets ($n=122$), anticoagulants ($n=49$) and angiotensin-converting enzyme inhibitors ($n=113$) were the most frequently identified high-risk drugs. In total, there were 420 interventions undertaken by pharmacists, including 186 (44.3%) interventions related to medicines optimisation and 234 (55.7%) interventions related to peri-operative drug management (Table 2).

Length of stay

The median length of stay for the four surgical sub-specialities were: 20 (IQR: 11.5, 32.3), 8 (IQR: 6, 11), 11.5 (IQR: 8.5, 15.8), and 6 (IQR: 4, 9.3) days for upper GI, lower GI, HPB and vascular surgery groups respectively, comparing again the corresponding expected length of stay (ELOS): 14 (IQR: 14, 14), 10, (IQR:10, 10), 14 (IQR: 11, 14), and 10 (IQR: 7, 10) days (Figure 2).

Furthermore, there was a significant reduction in the median length of stay in the lower GI (median reduction: -2; IQR: -4, 1.8; $P=0.038$), HPB (median reduction: -4.5; IQR: -7, -1; $P=0.001$) and vascular (median reduction: -2; IQR: -4, 0; $P=0.043$) surgical sub-specialities. The median ALOS was longer than median ELOS in the upper GI speciality (median reduction: 5; IQR: -3, 17; $P=0.055$), although it was not significant. Overall, the total length of stay reduction in patients whose ALOS fell in the 25th to 75th percentile range was -96 days in lower GI, -81 days in HPB and -104 days in vascular sub-specialities, which summed up to -281 days.

Post-operative complications

Overall, 118 (48.0%) patients experienced postoperative complications, and the proportion of patients who experienced postoperative complications was higher in the upper GI surgery group (n=13; 76.5%), followed by the lower GI (n=44; 50.6%), vascular (n=27; 45.0%) and HPB surgery (n=34; 41.5%). Of all the 275 episodes of complications (Table 3), postoperative nausea and vomiting (n=61; 22.2%) was the most frequently identified surgery related complication, followed by infections (n=50; 18.2%) and cardiac issues (n=25; 9.1%).

Discussion

To our knowledge, this research is the first to assess the short-term outcomes of an innovative surgical pharmacy-led service model to enhance surgical care. The results demonstrated a significant reduction in length of stay for service receivers in the lower GI, HPB and vascular surgical sub-specialities in comparison with the corresponding expected length of stay by the national standard. The results of this study support the feasibility to further evaluate the impact of ESMOS in a prospective study.

Pharmacists' impact on the outcome of chronic disease management and medicine optimisation have been well documented in the literature, in particular in managing the use of high-risk medicines. As documented in the literature, anti-platelets, anticoagulants and angiotensin-converting enzyme inhibitors were the most frequently identified high-risk drugs, and cardiovascular disease was the most prevalent co-morbidity in patients scheduled for surgery.¹⁶ In a meta-analysis reported by Machado *et al* (2007) which included 2246 patients from 13 controlled (randomised, single arm and non-randomised) trials, and found that systolic blood pressure was significantly reduced following pharmacist's intervention, while it remained unchanged in the standard care group.¹⁷

The ESMOS users had a significant reduction in length of stay compared with the expected length of stay in those within lower GI, HPB and vascular sub-specialities but not within the upper GI sub-speciality. This could be due to the small patient numbers in this group. Additionally, patients who underwent upper GI surgery tended to have longer hospital stays due to ongoing anastomotic leaks and infections hence need for extended courses of intravenous antibiotics.

A reduction in length of stay (median reduction: - 2 days) was observed within those who received vascular surgery. The trust is a recognised tertiary referral centre for vascular cases, and the service is strongly supported by a vascular specialist nurse who also referred patients to the ESMOS pharmacist pre-operatively. This streamlining of prioritisation of resources may also contribute to this reduction in length of stay effect observed.

Similarly, the trust is also a tertiary referral centre for HPB surgery within the region, hence it tends to receive patients with very complex cases. There was a substantial reduction in length of stay (median reduction: -4.5 days) within those patients who underwent HPB surgery. This could also be due to other interventions such as the implementation of a regional jaundice pathway to improve patients' outcomes, recruitment of a jaundice clinical nurse specialist and the introduction of a prehabilitation programme led by both a specialist dietitian and a physiotherapist with the aim of getting patients in the best possible state for surgery.

For patients who received lower GI surgery, a decrease in length of stay (median reduction: -2 days) was also observed. This reduction was observed despite there being some disruptions in the provision of lower GI services within the trust with two stoma nurses leaving posts within the study period. Consequently, patients with a stoma might wait longer for a review by a stoma nurse or may have inadequate stoma output prolonging their hospital stay.

239

240 In addition, post-operative complications are a significant source of morbidity and mortality
241 and have been shown to increase the length of stay.¹⁸ In our study, 48% of patients who
242 underwent a surgical procedure developed at least one postoperative complication. The
243 most frequently observed complications were postoperative nausea and vomiting, followed
244 by infections and cardiac issues.

245

246 This study demonstrates the importance of a multi-disciplinary team approach to patient care
247 and in particular the invaluable role of the pharmacy team which is often overlooked and
248 undervalued. Although it analysed a short-term outcome, the potential cost savings which
249 can be achieved through the reduced length of stay far outweigh the costs of setting up the
250 service. As a result of dedicated pharmacist input pre-operatively, patient's co-morbidities
251 are optimised before surgery taking the pressure off primary care and ensuring that
252 interventions are acted upon promptly. This may have an impact on patient's quality of life
253 and GP workload both pre- and post-operatively.

254

255 However, as the ESMOS is a new service model, the results of this study were limited by a
256 lack of comparison. The ESMOS model warrants further validation using a rigorous
257 comparative analysis to routine care, ideally in the form of a prospective randomised clinical
258 trial. Nevertheless, the evaluation of service delivery and improvement is an iterative
259 process and using real-world data, such as comparing services in different hospital settings
260 or using the historical comparator group could be an alternative.¹⁹

261

262 At the time of manuscript submission, another hospital part of the same trust has also
263 funded the replication of ESMOS model within the urology sub-speciality. Evaluation of
264 ESMOS implementation at other sites will help further validate findings from this study. In
265 addition, to ensure the efficient implementation of the service, a process evaluation to
266 identify the key factors influencing the process of implementation are also important.²⁰

267

268 A patient and public involvement (PPI) group was also set up as part of the ESMOS service
269 which included around 12 patients who had received the service. Patient users from the
270 group felt the ESMOS service was invaluable to their surgical journey. Patients who received
271 the service felt the continuity of care and contact with a healthcare professional were critical
272 elements of the service.

273

274 **Conclusion**

275 The results of this study reaffirm the importance of a holistic and multi-disciplinary approach
276 to patient care, with a positive effect of dedicated pharmacist input through the patient
277 journey, starting pre-operatively until discharge post-surgery. Further study is needed to
278 validate our findings ideally in the form of a prospective randomised controlled trial.

279

280 **Contributors**

281 NB: concept of study, execution of study and write up. SW: Data management and
282 interpretation of results. LCC: interpretation of results and write up.

283

284 **Competing interests and funding**

285 None declared.

286

287 **Ethics approval**

288 Ethics approval was not required as this was an existing service evaluation.

289

290 **Acknowledgements and affiliations**

291 We would like to thank the surgical pharmacy team at the Manchester University Hospitals
292 NHS Trust for their help with the data collection for this study.

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Table 1. Characteristics of the study cohort

	Upper GI (N=17)	Lower GI (N=87)	HPB (N=82)	Vascular (N=60)	Total (N=246)
Gender					
Male	11 (64.7%)	47 (54.0%)	62 (75.6%)	50 (83.3%)	170 (69.1%)
Female	6 (35.3%)	40 (46.0%)	20 (24.4%)	10 (20.0%)	76 (30.9%)
Age rank (years)					
<50	0 (0.0%)	12 (13.8%)	1 (1.2%)	1 (1.7%)	14 (5.7%)
50-59	2 (11.8%)	12 (13.8%)	7 (8.5%)	5 (8.3%)	26 (10.6%)
60-69	6 (35.3%)	30 (34.5%)	36 (43.9%)	16 (26.7%)	88 (35.8%)
70-79	9 (52.9%)	24 (27.6%)	32 (39.0%)	26 (43.3%)	91 (37.0%)
>80	0 (0.0%)	9 (10.3%)	6 (7.3%)	12 (20.0%)	27 (11.0%)
ASA Grade					
1	0 (0.0%)	10 (11.5%)	2 (2.4%)	0 (0.0%)	12 (4.9%)
2	17 (100%)	63 (72.4%)	46 (56.1%)	19 (31.7%)	145 (58.9%)
3	0 (0.0%)	14 (16.1%)	34 (41.5%)	41 (68.3%)	89(36.2%)
4	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
5	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Co-morbidity					
Respiratory disease	3 (5.7%)	17 (5.8%)	11 (4%)	21 (8%)	42 (4.9%)
Cardiovascular disease	25 (47.2%)	89 (30.2%)	95 (34.2%)	103 (37.1%)	312 (36.3%)
Musculoskeletal disease	6 (11.3%)	21 (7.1%)	15 (5.5%)	16 (5.8%)	38 (4.4%)
Renal, liver and urological disease	0 (0.0%)	21 (7.1%)	16 (5.8%)	13 (4.7%)	50 (5.8%)
Vascular disease	3 (5.7%)	13 (4.4%)	12 (4.3%)	27 (9.7%)	55 (6.4%)
Gastro-intestinal disease	9 (17%)	49 (16.6%)	25 (9%)	20 (7.2%)	103 (12%)
Nervous system	1 (1.9%)	18 (6.1%)	13 (4.7%)	5 (1.8%)	37 (4.3%)
Endocrine disease	5 (9.4%)	23 (7.8%)	33 (11.9%)	14 (5%)	75 (8.7%)
Immune system and malignant disease	1 (1.9%)	19 (6.4%)	27 (9.7%)	7 (2.5%)	54 (6.3%)
ENT, oropharynx and skin disease	0 (0.0%)	8 (2.7%)	3 (1.1%)	5 (1.8%)	16 (1.9%)
Previous surgery	0 (0.0%)	17 (5.8%)	28 (10.1%)	32 (11.5%)	77 (9%)

(Note) GI: gastrointestinal; HPB: Hepato-pancreato-biliary ASA: American Society of Anaesthesiologists; ENT: ear, nose and throat

Table 1. Number of high-risk medicines taken by patients and the major pharmacist interventions

	Upper GI (N=17)	Lower GI (N=87)	HPB (N=82)	Vascular (N=60)	Total (N=246)
Total number of patients					
0-3 drugs	9 (52.9%)	34 (39.1%)	27 (32.9%)	8 (13.3%)	78 (31.7%)
4-6 drugs	5 (29.4%)	26 (29.9%)	33 (40.2%)	27 (45.0%)	91 (37.0%)
7-9 drugs	1 (5.9%)	20 (23.0%)	15 (18.3%)	19 (31.7%)	55 (22.4%)
10-12 drugs	0 (0.0%)	5 (5.7%)	7 (8.5%)	6 (10.0%)	18 (7.3%)
>12 drugs	2 (11.8%)	2 (2.3%)	0 (0.0%)	0 (0.0%)	4 (1.6%)
Number of interventions	N=55	N=191	N=112	N=62	N=420
Medicines optimization	30 (54.5%)	85 (44.5%)	43 (38.4%)	28 (45.2%)	186 (44.3%)
Peri-operative drug management	25 (45.5%)	106 (55.5%)	69 (61.6%)	34 (54.8%)	234 (55.7%)

(Note) GI: gastrointestinal; HPB: Hepato-pancreato-biliary

Table 1. Postoperative complications identified before patients discharged from hospital

	Upper GI (N=17)	Lower GI (N=87)	HPB (N=82)	Vascular (N=60)	Total (N=246)
Number of patients with complications	13 (76.5%)	44 (50.6%)	34 (41.5%)	27 (45.0%)	118 (48.0%)
Total number of complications	n=38	n=82	n=122	n=33	n=275
Post-operative nausea and vomiting	3 (7.9%)	28 (34.1%)	17 (13.9%)	13 (39.4%)	61 (22.2%)
Ileus/obstruction	0 (0.0%)	14 (17.1%)	0 (0.0%)	0 (0.0%)	14 (5.1%)
Infections (chest, UTIs, wound, abscess, collections)	3 (7.9%)	19 (23.2%)	23 (18.9%)	5 (15.2%)	50 (18.2%)
Poorly controlled pain	5 (13.2%)	5 (6.1%)	5 (4.1%)	2 (6.1%)	17 (6.2%)
Delirium/confusion	1 (2.6%)	3 (3.7%)	13 (10.7%)	1 (3.0%)	18 (6.5%)
De-arranged U&Es	7 (18.4%)	2 (2.4%)	7 (5.7%)	3 (9.1%)	19 (6.9%)
Acute Kidney Injury	1 (2.6%)	2 (2.4%)	6 (4.9%)	2 (6.1%)	11 (4.0%)
Cardiac issues (raised BP, tachycardia, atrial fibrillation)	11 (28.9%)	1 (1.2%)	11 (9.0%)	2 (6.1%)	25 (9.1%)
Anastomotic/bile/pancreatic leak	3 (7.9%)	3 (3.7%)	12 (9.8%)	0 (0.0%)	18 (6.5%)
Bleeding	0 (0.0%)	3 (3.7%)	5 (4.1%)	2 (6.1%)	10 (3.6%)
Pulmonary embolisms / thrombus	1 (2.6%)	0 (0.0%)	2 (1.6%)	0 (0.0%)	3 (1.1%)
Erratic blood glucose levels	0 (0.0%)	0 (0.0%)	5 (4.1%)	0 (0.0%)	5 (1.8%)
Bowels not opened	2 (5.3%)	0 (0.0%)	15 (12.3%)	1 (3.0%)	18 (6.5%)
Drop in haemoglobin requiring blood transfusion	1 (2.6%)	0 (0.0%)	0 (0.0%)	1 (3.0%)	2 (0.7%)
Death	0 (0.0%)	2 (2.4%)	1 (0.8%)	1 (3.0%)	4 (1.5%)

(Note) GI: Gastro-intestinal; HPB: Hepato-pancreato-biliary; UTI: Urinary tract infection ;BP: blood pressure ;U&E: Urea and Electrolytes

Figure 1. Selection of study cohort

Figure 2. Number of medicines identified

Figure 1. Comparison of expected and actual length of stay across four surgery specialities

(Note) GI: Gastrointestinal; HPB: Hepato-pancreato-biliary; ELOS: expected length of stay; ALOS: actual length of stay

Appendix 1. ESMOS always events

1. Ensure all patients are assessed by a pharmacist pre-operatively
2. Ensure patient is contacted before surgery and draw out an individually tailored plan on medicines to be stopped peri-operatively
3. Pre-operatively look for opportunities for medicines optimisation to ensure the patient is in the best possible state for surgery hence aim to reduce the incidence of postoperative complications
4. Always ensure the right regular medication is given on the day of surgery.
5. Always ensure VTE thromboprophylaxis is prescribed and administered appropriately.
6. Always ensure that postoperative nausea and vomiting is controlled.
7. A pharmacist will work with all ESMOS patients to achieve adequate pain control
8. Aim to have the take-home medication ready on the ward the day before discharge
9. All patients are asked if they have any concerns about their medicines throughout their surgical journey.

Appendix 2. Screening tool for identification of patients eligible for peri-operative ESMOS pharmacist optimised care ('high' risk patients)

A. Type of Surgery

Whipple	FEVAR or not high enough risk (but high AKI risk if misaligned)	Hemicolectomy
Total Pancreatectomy	Neuroendocrine tumour surgery	Colectomy
Liver Resection	Total gastrectomy	Pan-proctocolectomy
Open AAA repair	Cardio-oesophagectomy	Anterior resection
Aorto-bifemoral graft	Total oesophagectomy	Abdominoperineal resection

B. Co-morbidities

Severe COPD	Thrombophilia	Previous/current CPE colonisation
Severe Asthma	Haemophilia	Previous/current MRSA colonisation
PFTs < 60% of predicted	Epilepsy	Penicillin allergy
Coronary artery bypass graft (CABG)	Diabetes Type 1 or 2 with HBA1c > 59 mmol/ml	
Percutaneous Coronary Intervention (PCI)	Carcinoid syndrome	
Acute coronary syndrome (ACS) within one year	Thyrotoxicosis – not yet euthyroid	
Metallic Valve Replacements (mitral or aortic)	HIV positive	
Previous transplant (any organ or bone marrow transplant)	Parkinson's Disease	
Congestive Heart Failure EF <50%	Anaemia	
eGFR baseline < = 60mls/min	Cirrhosis with coagulopathy	

C. High-Risk Drugs

Warfarin/ Synthrome	Monoclonal Antibody	Sustained release opiate preps (oral or topical)
Direct Oral Anticoagulants (DOACS)	Erythropoietin/Darbepoetin	Aminophylline/theophylline
Treatment dose low molecular weight heparin (LMWH)	Sodium Bicarbonate	Beta-blockers
Aspirin/Clopidogrel/ Ticagrelor	Electrolyte supplements	Any medication that requires alteration pre-surgery

Ace inhibitor/angiotensin II antagonists	Tacrolimus/Cyclosporin	
Diuretics	Mycophenolate/ Azathioprine	
Metolazone	Antiretrovirals	
Long term oxygen therapy (LTOT)	Metformin	
Prednisolone/Hydrocortisone/ Dexamethasone	Glitazones	
Maximum dose steroid inhaler	Phenytoin	
Digoxin	Sodium valproate	
Methotrexate	Lithium	

Enhanced Surgical Medicines Optimisation Service