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RESEARCH ARTICLE

Pharmacist involvement to improve patient outcomes in lower gastrointestinal surgery: a prospective before and after study

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Abstract

Background Enhanced recovery pathways were first introduced in the UK in 2002 (Enhanced Recovery Partnership Programme in Delivering enhanced recovery—helping patients to get better sooner after surgery. Department of Health, London, 2010). The aims of such pathways are to reduce patient length of stay whilst still providing high quality of care. *Objectives* To evaluate the impact of pharmacist involvement in enhanced recovery pathways. *Setting* A large 1200 bed tertiary hospital in the North of England. *Methods* The pre-post study included all patients admitted for major colorectal surgery during the period 2013–2016. Baseline data were collected on all patients seen pre-operatively in a nurse-led pre-admission clinic. The intervention was introduced where a dedicated surgical pharmacist pre-operatively reviewed patients from the time they were listed for surgery until discharge with a focus on medicines optimisation. *Main outcome measure* The primary outcome measures were length of stay along with the type and number of post-operative complications. *Results* 100 patients were included in this study, with 50 patients in the baseline group and 50 patients in the intervention group. There was a significant reduction in the median length of stay (baseline group—10.5 days; intervention group—7.5 days; $P<0.001$). The total number of complications was also less in the intervention group (baseline group—125; intervention group—75; $P>0.05$) as was the number of patients whom had no complications ($P>0.05$). *Conclusions* Active pharmacist involvement in enhanced recovery protocols is associated with a significantly reduced median length of stay as well as an overall reduction in the total number of post-operative complications.

Keywords Colorectal surgery · Enhanced recovery · Fast track surgery · Medicines optimisation · Pharmacist

Impacts on practice

- Optimising patients' pre-existing medical conditions and medication pre-operatively is imperative for a smooth and safe surgical journey
- Dedicated surgical pharmacists' input throughout the patient journey reduces both the number of complications and length of stay
- Pharmacist input into enhanced recovery pathways improves efficiency and patient throughput through the healthcare system.

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Introduction

Over 300 million patients globally undergo non-cardiac surgery each year [1], of which 4.2 million operations are carried out in England [2]. High-risk patients undergoing major surgery are at increased risk of post-operative complications, with the number of people falling into this cohort substantially increasing in recent years [3]. A precise estimate is difficult to obtain, but it is thought these events occur in between 3 and 17% of patients [4]. This is attributable to a combination of an ageing population, increasing numbers of patients with multiple comorbidities as well as the now available surgical options for previously untreatable conditions [5]. There is growing concern that this cohort of patients receives general sub-optimal care [6].

The concept of an enhanced recovery programme, otherwise known as fast-track surgery was described in 2002 by Professor Kehlet in Denmark [7, 8]. The aim of enhanced recovery is to optimise multiple aspects of patient care, improve recovery and facilitate earlier discharge without reducing patient satisfaction or the quality of care [9]. Enhanced recovery was introduced at the study site, in 2008. Although the pathways introduced heavily relied on medication related interventions both before and after surgery e.g. post-operative nausea and vomiting management and optimising analgesia control, there was no active or dedicated pharmacist involvement peri-operatively.

Traditionally, all elective patients attend a nurse-led pre-admission clinic prior to surgery. A detailed history is taken including any relevant past medical and surgical history, drug history along with a social history. Advice is given on which medications if any should be stopped prior to surgery, with nurses relying heavily on hospital guidelines and protocols compiled by a multi-disciplinary team of healthcare professionals. Patients are not reviewed by a pharmacist until the day of admission for surgery. By this time, it is often too late to make any significant changes to peri-operative drug management and on occasions patients may not be seen on the morning of planned surgery.

Evidence suggests that physiological preparation and optimising a patient's pre-existing medical conditions such as diabetes, hypertension and anaemia reduces the chances that surgery will be cancelled at a late stage and gives additional time for these conditions to be improved reducing overall patient morbidity and mortality [9]. Maessan et al. [10] and Fearon et al. [11] discuss the importance of a multidisciplinary approach in the success of enhanced recovery programmes to reduce the incidence of post-operative complications.

Aims

The aim of this study is to evaluate the impact pharmacist involvement can have on enhanced recovery pathways with a focus on medicines optimisation specifically to reduce the length of stay and incidence of post-operative complications.

Ethics approval

As this was a service improvement initiative, ethical approval was not required as confirmed by the Manchester University Hospitals NHS Trust Research and Ethics Committee.

Methods

This pre- and post- intervention study was performed at a large tertiary hospital in the North of England. Patients undergoing elective colorectal surgery with an expected length of stay of at least one night were included in the study.

Baseline data were collected on the service as it was originally delivered with a nurse-led pre-admission clinic over an 8-month period: 6-month continuous period between the 1st December 2013 and 1st June 2014 and a further 2 months between the 1st July 2015 and 1st September 2015. At the pre-admission clinic nurses complete a pre-populated proforma which collects the medical history and other mandatory fields including a section for documenting the patient's drug history with prompts for the drug name, strength, dose, route and frequency of administration. The baseline study captured data on the quality of medicines reconciliation along with the advice given to patients on any medications that needed to be withheld or doses altered prior to surgery. The quality of medicines reconciliation was determined against the Institute for Healthcare Improvement (IHI) definition as the process of identifying the most accurate list of a patient's current medicines to include the name, dosage, frequency, and route [12]. In the intervention phase, data were collected over two four-month periods between 1st August 2014 and 1st December 2014 and again from 1st October 2015 to 1st February 2016. To reduce bias due to staff changes, data collection was repeated in both the before and after study to ensure there had been no change in practice that could have been affected the study outcomes.

The intervention phase comprised patients identified by a medicines management pharmacy technician from a database of those due to have surgery in the near future. Once identified, the patient's medication history was obtained from their general practitioner (GP). These patients were then subsequently referred to a pharmacist in hospital who ascertained the patient's American Society of Anaesthesiologists (ASA) grade (see Table 1) based on pre-existing co-morbidities and their medication history. This is a widely used scale used by anaesthetists in the UK to assess patient's fitness to undergo an anaesthetic. It ranges from 1 to 5, with 1 being a normal healthy patient and 5 being a moribund patient. A proforma with clearly defined criteria was used to grade screen the ASA grade, with patients scoring an ASA grade of II or more being contacted and asked to attend a pre-operative clinic.

Pre-operatively, in addition to providing appropriate peri-operative advice, the pharmacist also looked for opportunities for medicines optimisation e.g. optimising blood pressure control, diabetes, respiratory and cardiovascular medication as well as identifying any pre-operative anaemia. A multi-disciplinary approach was used, with any clinical issues being discussed with the patient's GP, consultant surgeon in charge and/or anaesthetist as appropriate, with referrals sent to specialist consultants as required.

A week prior to surgery, all patients were reminded by a secure text messaging service or telephone call to stop any medication as intended and discussed with the pharmacists in the pre-operative clinic. The drug chart was

Table 1 ASA (American Society of Anaesthesiologists) grading system [13]

The ASA (American Society of Anaesthesiologists) Physical Status Classification System is a simple scale describing fitness to undergo an anaesthetic ranging from 1 to 5
ASA 1: A normal healthy patient
Examples: Healthy, non-smoking, no or minimal alcohol use
ASA 2: A patient with mild systemic disease
Examples: current smoker, social alcohol drinker, pregnancy, obesity (BMI > 30 but < 40), well-controlled diabetes/hypertension, mild lung disease
ASA 3: A patient with severe systemic disease
Examples: poorly controlled diabetes or hypertension, chronic obstructive pulmonary disease (COPD), morbid obesity (BMI ≥ 40), active hepatitis, alcohol dependence or abuse, implanted pacemaker, moderate reduction of ejection fraction, renal failure undergoing regularly scheduled dialysis, premature infant PCA < 60 weeks, history (> 3 months) of coronary events
ASA 4: A patient with severe systemic disease that is a constant threat to life
Examples: Patient with functional limitation from severe, life-threatening disease (e.g., unstable angina, poorly controlled COPD, symptomatic congestive heart failure, recent (less than three months ago) myocardial infarction or stroke
ASA 5: A moribund patient who is not expected to survive without the operation
Examples: ruptured abdominal/thoracic aneurysm, massive trauma, intracranial bleed with mass effect, ischemic bowel in the face of significant cardiac pathology or multiple organ/system dysfunction

written up prior to admission by a pharmacist prescriber to reduce errors that may occur due to inaccurate drug histories or patient's medication not being prescribed. On admission, this drug chart was double checked by a surgical admissions pharmacist to ensure that there had been no changes to the patient's medication by the GP and also to ensure that the drug chart had been written up correctly. On discharge, medicines reconciliation was undertaken to ensure that all changes to medication were clearly documented for the patient and their GP. Medical and nursing staffs were both aware of the interventions being made by the pharmacist prior to the patient's admission in the intervention group.

The following variables were extracted from the medical notes for each patient in the study during their stay: demographic information, ASA Grade (see Table 1), if appropriate, the medication stopped prior to surgery, details of any bridging therapy, details of any peri-operative advice provided, any relevant past medical history, length of inpatient stay and details of any post-operative complications.

Statistical analysis

Data were entered into a statistical software for analysis. Demographic data were summarised as frequency, mean (SD) and median (ranges) as appropriate. Length of stay was analysed quantitatively using the Wilcoxon Signed Rank test for nonparametric data. Post-operative complications were analysed using descriptive statistics such as counts and frequency proportions. Once all the data was themed into groups, categorical data was analysed using the two-tailed Chi squared test.

Results

Patient demographics are shown in Table 2. Both groups had a similar number of patients with similar mean ages ($P > 0.05$). There was a significant reduction ($P < 0.001$) in the median length of stay between both groups (baseline group—10.5 days; intervention group—7.5 days, Fig. 1). The number of readmissions within a 30-day period was similar between both groups, with one patient in the baseline group being admitted five times mainly due to nausea/vomiting and high stoma output ($P > 0.05$).

Table 3 depicts the number of complications seen in each group. The total number of complications was less in intervention group (baseline group—125; intervention group—75) as was the number of patients that had no complications ($P > 0.05$). More patients in the intervention group had open procedures versus laparoscopic procedures (baseline group—7 open procedures; intervention group—11 open procedures; Table 2). In terms of co-morbidities, cardiovascular disease was the most prevalent within both groups (Table 2).

In the baseline group, there was no documentation of the peri-operative drug advice in nearly two-thirds (67%) of patients (Table 4). Although there was no documentation of the advice provided, these patients may have been provided with verbal advice by the nurses. One patient in the baseline group was provided with incorrect advice. This patient was admitted for surgery however had a background of recurrent DVT's for which he was taking life-long warfarin. This patient should have been on treatment dose low molecular weight heparin once the warfarin was stopped pre-operatively but instead was given a low dose prophylactic dose as bridging therapy placing them at increased risk of thrombosis in the peri-operative period. In the baseline

Table 2 Patient demographics

	Baseline group	Intervention group	*P* value
Number of patients	50 (Male—35, Female—15)	50 (Male—37, Female—13)	0.838
Average age (years) (SD)	60.9 (SD ± 3.53)	60.8 (SD ± 3.51)	0.887
Median ASA grade	2 (Range 1–4)	2 (Range 1–4)	0.147
Number of laparoscopic procedures	40	32	0.119
Number of open procedures	6	11	0.287
Other procedures (reversal of ileostomy/hartmanns)	4	7	0.523
Type of co-morbidity n (%)			
Respiratory disease	7 (10.6%)	10 (14.3%)	0.722
Cardiovascular disease	26 (40.9%)	30 (42.9%)	0.871
Musculoskeletal disease	4 (6.1%)	5 (7.1%)	1.000
Urological, renal and liver disease	5 (7.6%)	4 (5.7%)	0.738
Gastro-intestinal disease	5 (7.6%)	4 (5.7%)	0.738
Central Nervous system	8 (12.1%)	6 (8.6%)	0.668
Endocrine disease	5 (7.6%)	6 (8.6%)	1.000
Immune system & malignant disease	3 (4.5%)	2 (2.8%)	0.933
Eye, ENT and skin	2 (3%)	3 (4.3%)	1.000
Number of re-admissions within 30 days	9	7	0.819

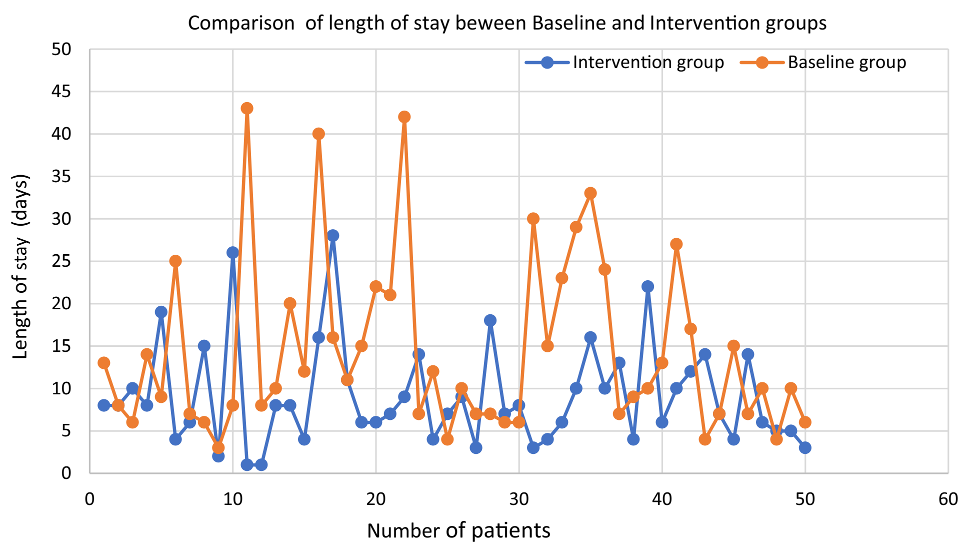

Fig. 1 Comparison of length of stay between baseline and intervention groups. Wilcoxon signed rank test, $P < 0.001$

cohort, a senior surgical pharmacist independently assessed patient medical records and found 12% of patients could have benefited from medicines optimisation pre-operatively.

Discussion

To the best of the authors knowledge, this is the first study of its type evaluating the role of pharmacists specifically within surgical enhanced recovery pathways, results which can be applied to other surgical specialities and institutions. Our results show impact in the median length of inpatient stay which is significantly less with pro-active pharmacist involvement. This could be secondary to a combination of better optimisation of patients prior to surgery as a well as a reduction in the overall number of post-operative complications. This reduction in length of stay was seen despite their being more open procedures undertaken in the intervention group. Open procedures are generally associated with an increased length of stay compared to laparoscopic procedures [14]. The co-morbidities were similar in both groups with cardiovascular disease being the most prevalent.

The role of pharmacists in medicines reconciliation has been well documented in the literature [15, 16]. Guidance from the National Institute for Health and Care Excellence (NICE) in the UK suggests that medicines reconciliation

Table 3 Number of post-operative complications in each group

Post-operative complications	Baseline (%)	Intervention (%)	*P* value
Poor post-operative nausea and vomiting (PONV) management/incorrect/insufficient prophylaxis	19 (15.2%)	10 (13.3%)	0.717
Post-operative ileus/obstruction	15 (12%)	9 (12%)	1.000
Surgical site infections including wound site infections and those around the stoma (if applicable)	6 (4.8%)	6 (8%)	0.356
Anastomotic leaks/abdominal collections/intra-abdominal abscess	5 (4%)	4 (5.3%)	0.660
Poor post-operative pain management/extended opioid use/suboptimal dose/dose too high	17 (13.6%)	7 (9.3%)	0.369
Sepsis (Urosepsis/Hospital acquired pneumonia/sepsis of unknown origin)	20 (16%)	14 (18.7%)	0.627
Cardiovascular issues ((Atrial fibrillation, poor blood pressure control, omission of essential cardiac medication, heart failure medication not optimised)	5 (4%)	5 (6.7%)	0.402
Dehydration ± Acute kidney injury	12 (9.6%)	8 (10.7%)	0.808
High stoma output	13 (10.4%)	6 (8%)	0.575
Post-operative anaemia requiring blood transfusion	3 (2.4%)	2 (2.7%)	0.907
Pulmonary embolism	2 (1.6%)	0 (0%)	0.271
Poor electrolyte management post operatively (in particular Mg^{2+} and K)	8 (6.4%)	4 (5.3%)	0.758
No of patients with no complications	11	19	0.127

Table 4 Peri-operative drug advice provided to patients

	Baseline cohort (number of patients)	Intervention cohort (number of patients)
Correct advice provided	13 (25%)	47 (90%)
Incorrect advice provided	1 (2%)	0
Nil documentation of advice provided	35 (67%)	0
Not applicable (not on regular medication)	2 (4%)	3 (10%)
Medicines optimisation could have led to improved patient outcomes (determined by independent assessment by a senior surgical pharmacist)	6 (12%)	Not applicable. All patients were reviewed by a pharmacist and medicines optimisation considered for each patient

should be undertaken within 24 h of admission to hospital [17]. However, in the elective surgical patient group, it may be more prudent if medicines reconciliation is undertaken prior to admission so as to reduce this variance and manage any peri-operative drug issues more effectively. A study conducted by Hale et al. [18] demonstrated that medication charts written pre-operatively by pharmacists contained fewer clinically significant omissions and prescribing errors when compared with charts written by doctors.

At the start of the study, it was felt that complications the pharmacist was most likely able to reduce would include the incidence of post-operative nausea and vomiting, better pain management, reduced incidence of venous thromboembolic events, reduced surgical site infections, reduced need for blood transfusions after surgery and reduction in the number of cardiovascular and respiratory complications. The number of complications in the intervention group was less than the baseline group as was the total number of patients with no complications after surgery (both had a $P > 0.05$). Patients in the intervention group demonstrated improved post-operative nausea and vomiting management as well as improved post-operative pain control, the latter of which potentially reduced the incidence of bowel ileus in this cohort. The association of better pain control to reduce the incidence of post-operative ileus is well recognised [19]. Ahmed et al. [19] report that the most prominent factors associated with an increased length of stay is ileus. Other independently associated factors included blood transfusion, anastomotic leak, sepsis, pulmonary embolism, and surgeon [20]. Better pharmacological management of high output stomas was seen in the intervention group and this potentially led to a reduction in the incidence of dehydration and concomitant acute kidney injury. Goodey and Coleman [21] found that an improved monitoring of patients with high output stomas can reduce the need for readmission and improve patient safety and outcomes. There were also fewer cases of sepsis in the intervention group. This could have potentially been attributed to a reduction in length of stay in this patient group [22].

There are a few limitations to this study. Firstly, the study was performed at a single hospital site hence we cannot assume generalisability of the results. In the pre-operative stage, a medicines management technician was not always able to help with the medicines reconciliation due to the lack of funding. Another limitation in the pre-operative stage was that despite setting up the text message service, this was unable to be implemented in time for the project. Furthermore, due to time constraints, it was not always possible to write up the patient's drug chart prior to surgery. During the patient surgical journey, there was often more than one pharmacist following the patient and thus there may have been variations in the interventions made. All enhanced recovery patients were followed up during the working week by a dedicated surgical pharmacist. However, on the weekends, staff numbers were curtailed to on-call staff, therefore it was not always possible to review these patients as closely as wanted.

Potential ways to overcome the limitations for this study include undertaking the study at different hospitals to obtain more robust data as well as undertake training sessions to the pharmacy team in an attempt to standardise the data collection process. As pharmacists will be collecting the data in addition to their routine pharmacy duties, there may be the chance of incomplete data. To overcome this, the principal investigator should review the data on a regular basis to ensure complete data capture.

The strengths of this study are that it firstly demonstrates the importance of a multi-disciplinary team approach to patient care, and in particular the invaluable role of the pharmacy team which is often overlooked and undervalued. Secondly, we believe that the results are generalisable in different centres. As a result of dedicated pharmacist input pre-operatively, patient's co-morbidities are optimised prior to surgery taking the pressure off primary care and ensuring that interventions are acted upon and not merely left as suggestions on clinic letters.

To ensure equity of care, the results of this study have been rolled out to other major surgical specialities with the successful approval of funding for the recruitment of specialist surgical pharmacists and a dedicated pharmacy technician leading to the introduction of the Enhanced Surgical Medicines Optimisation Service (ESMOS). ESMOS is an initiative service aimed at medicines optimisation in surgical patients. Initially introduced in colorectal patients only, the service has been rolled out to include upper gastrointestinal, hepato-pancreatobiliary and vascular surgical subspecialities. A meta-analysis conducted by Cheng et al. [23] confirmed that patients on enhanced recovery programmes demonstrated better outcomes than those receiving traditional care.

One unique feature of the ESMOS service is the set-up of a medicines optimisation clinic pre-operatively. This is a virtual clinic set up to optimise patient's pre-existing medical conditions to get them in the best possible state for surgery. The pharmacist undertakes an in-depth review of the patient including review of blood tests, clinical letters along with reports generated in a cardiopulmonary exercise tolerance test (CPET) clinic. The pharmacist ensures all relevant blood tests are ordered as suggested by NICE guidelines [24]. The pharmacists also have the chance to speak to patients at surgery school, an initiative set up by the critical care anaesthetists at the hospital. At surgery School, patients are educated on what to expect during surgery and have the opportunity to ask any questions. The success of this service will be measured in the number of bed days saved. This may consequently have an effect on reducing theatre waiting lists, currently capped to 18 weeks as a maximum recommended waiting time in England, a timeline most NHS trusts struggle to meet at present [25, 26].

Conclusion

Active pharmacist involvement in enhanced recovery protocols for elective colorectal surgery is associated with a significantly reduced median length of stay as well as an overall reduction in the total number of post-operative complications.

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Conflicts of interest The authors declare that they have no conflicts of interest.

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