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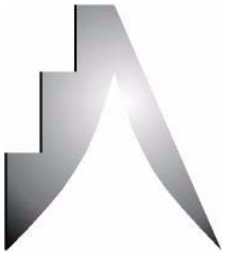

Australian Safety
and Efficacy
Register of New
Interventional
Procedures - Surgical

Brief review: Fast-track surgery and enhanced recovery after surgery (ERAS) programs

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Fast-track surgery and enhanced recovery after surgery (ERAS) programs

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Please note that this brief report, while broad in some aspects of systematic review methodology, should not be considered to be a comprehensive systematic review. This report also contains non-systematic elements, such as qualitative information gathered from local surgeons.

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Executive Summary

Objective

To assess the safety and efficacy of fast-track surgery programs on patient outcomes through a systematic review of the literature.

To qualitatively explore the status of fast-track surgery in Australia through interviews with surgeons who have experience with fast-track surgery.

Methods

Literature Review

Search strategy – Studies were identified by searching MEDLINE from 1980 to 2006, Entrez PubMed from January 2008 to February 2009, and the Cochrane Library from inception to January 2009. The Australian New Zealand Clinical Trials Registry, Clinical Trials Database (US), NHS CRD (UK), NHS HTA (UK), National Research Register (UK) and Current Controlled Trials were searched in February 2009. The TRIP database was searched in January 2009 for available guidelines.

Study selection – Systematic reviews and randomised controlled trials (RCTs) that reported the use of a fast-track surgery program in comparison to conventional surgical care, and that reported safety and/or efficacy outcomes were included for review.

Data collection and analysis – Data from the included RCTs were extracted by one researcher. Where possible, statistical pooling was conducted. Where not possible, data were grouped together as closely as possible into tables or described narratively.

Survey of surgeons

Surgeons from Australia and New Zealand who conduct fast-track surgery were identified via literature searches or through personal referrals. An informal semi-structured interview was conducted either in person or via the telephone. Responses were deidentified, grouped together into themes and reported narratively.

Results

A total of 13 documents were included for review: one systematic review, 11 RCTs and one guideline document.

Literature review

The current review looked at fast-track surgery in comparison with conventional surgery, and as such included studies examining various indications and surgical procedures. Results indicated:

- Optimising conditions before, during and after surgery reduced the length of hospital stay for patients with no increase in readmission rates.
- Using the mobilisation protocols, patients mobilised faster and spent more time

out of bed shortly after surgery. Optimised patients generally had a faster return of gastrointestinal function than conventional patients.

- There appeared to be little difference in patient-reported pain, although patients in the optimised groups may have had less pain shortly after surgery.
- There were no equivocal differences in quality of life outcomes between optimised and conventional patients, but only two studies reported this outcome. One reported a significantly improved outcome for optimised patients at three months, which was a longer follow-up than the second study.
- In relation to safety, two studies reported that optimised patients had significantly lower mortality and morbidity than conventionally treated patients, with the remainder of studies either reporting no difference between the groups or not reporting any statistical analyses.
- A search of ongoing and unpublished trials demonstrated that more studies are currently underway and that this an area of increasing interest. It may be that some trials currently underway are not recorded in a manner that notes fast-track surgery to be part of the research, and may instead incorporate it into a study in a different area.
- One guideline document regarding optimising conditions for surgery was identified. One training course regarding fast-track surgery was identified (to be held on 27 April 2009 in Auckland, New Zealand).

Survey of surgeons

Four surgeons were interviewed who presented a range of views and experience with fast-track surgery. Results indicated that:

- There is currently no uniform policy in relation to fast-track surgery in Australia or New Zealand, although it was acknowledged that many surgical units are investigating some aspects of optimised surgery.
- The surgeons generally had similar approaches to fast-track principles, although some followed protocols much more strictly than others. The area of most variation in technique was analgesia and the use of epidurals: hospitals with strict protocols generally used epidurals, while the hospitals with less formal processes used other forms of analgesia.
- There was consensus that it was important that all staff involved in fast-track programs be educated in the fast-track principles and procedures.
- It appeared that surgical units with a small number of surgeons and staff found implementation of fast-track principles and compliance with procedures easier than those who had a greater number of staff.
- There was a general view that fast-track surgery would save money in terms of reducing hospital stay, but only one surgeon had collected cost-effectiveness data.

Clinical and Research Recommendations

This report found that fast-track surgery programs can result in beneficial outcomes for patients. In particular, optimising conditions before, during and after surgery can reduce the length of hospital stay for patients with no increase in readmission rates. Further work is required to define the key aspects of optimised surgery, together with the indications and possible patient groups who are most likely to benefit. It may be that specialist societies, hospitals, health care trusts, local or federal departments of health, could play a role in facilitating this work, to assist in standardisation and implementation of any protocols, and to reduce unnecessary duplication of effort. Additional research involving larger patient numbers would provide data to show how optimised approach would differ from the conventional method.

Important note

The information contained in this report is a distillation of the best available evidence located at the time the searches were completed.

1. Introduction

Recent efforts to improve patient outcomes and to reduce hospital stay focus on enhancing postoperative recovery with a multimodal approach. The concept of fast-track surgery, also called enhanced recovery after surgery (ERAS) or multimodal surgery involves using various strategies to facilitate better conditions for surgery and recovery in an effort to achieve faster discharge from hospital and more rapid resumption of normal activities after both major and minor surgical procedures, without an increase in complications or readmissions. Patient education, optimising organ function before surgery, improved anaesthetic and postoperative analgesic techniques and better understanding of perioperative care principles with early oral feeding and ambulation have resulted in enhanced postoperative recovery (Kumar et al 2006; Kehlet & Dahl 2003). The main purpose of this integrated approach is to reduce psychological and physiological stresses associated with surgical illness, in order to reduce tissue catabolism (Kumar et al 2006; Kehlet & Dahl 2003).

Fast-track surgery has evolved as a result of recent evidence-based advances in the care of surgical patients (Kumar & Hewett 2007). Studies investigating the effects of standard/conventional care have been performed, and show that many of the traditional approaches to surgical care, such as preoperative bowel clearance, the use of nasogastric tubes, drains placed in cavities, enforced bed rest, and the use of graduated diets are unnecessary or even harmful (Kehlet & Wilmore 2002; Kehlet & Dahl 2003).

Figure 1 illustrates the main components of the fast-track surgery approach. Fast-track programs originated in Denmark by Henrik Kehlet, and are now being taken up worldwide (Kehlet & Wilmore 2008). Although various specialties have embraced fast-track programs, they are currently most used in relation to colonic and rectal surgery. The actual elements used in fast-track programs may differ widely between surgical units, but share many common features such as patient education, preoperative oral carbohydrates, improved anaesthetic and postoperative analgesic techniques, early oral feeding and ambulation.

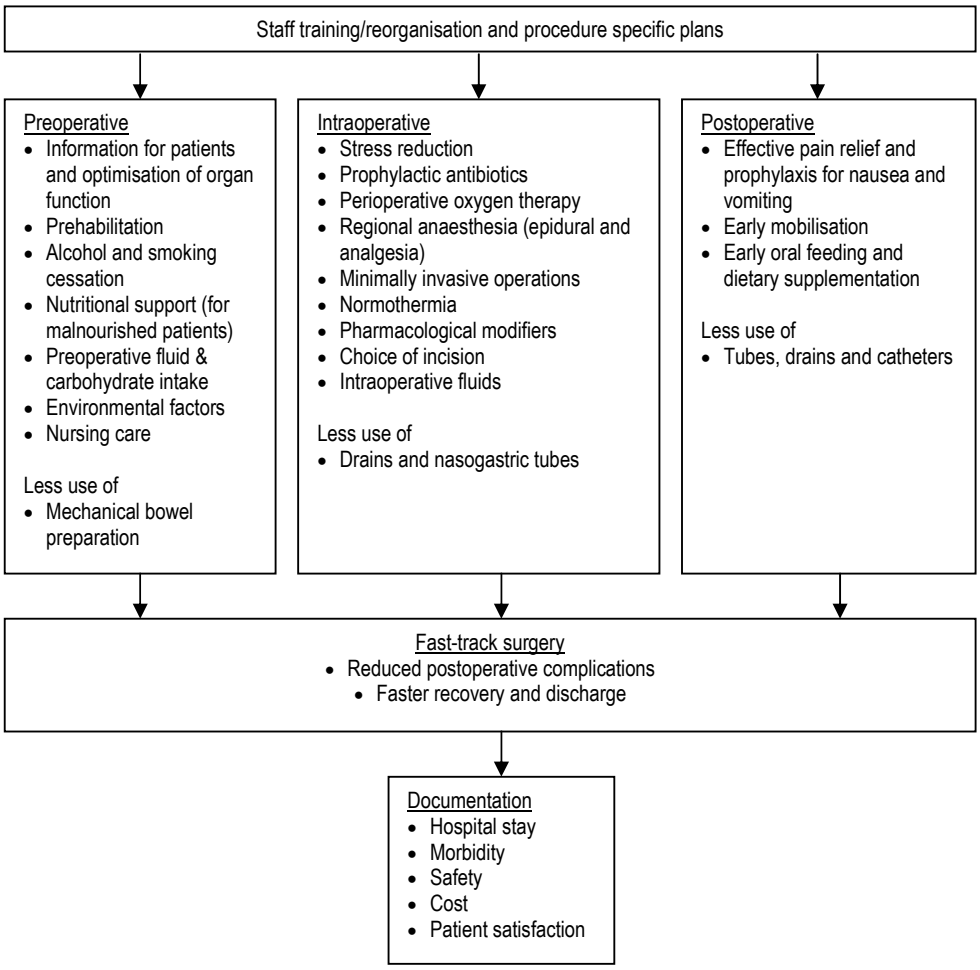
Research questions

There is currently very little information available regarding the uptake of fast-track surgery programs in Australia. Therefore, aim of this report is to address the following questions:

1. What are the primary safety, effectiveness and cost effectiveness issues reported in the medical literature surrounding these common approaches, and what patient selection criteria, if any, are employed?
2. What are the main approaches to fast-track surgery nationally and internationally (patient preparation; perioperative; patient recovery) according to the peer-reviewed literature and expert surgical opinion?

3. What are the most relevant approaches to fast-track surgery in Australia according to expert surgical opinion?
4. What issues are there with this surgical regimen according to Australian surgeons who have experience of fast-track surgery?

Figure 1. Common components of a surgical optimisation/fast-track surgery program*



*Different components for different types of surgery. Adapted from: Wilmore & Kehlet (2001) and Zargar-Shoshtari & Hill (2008)

2. Methodology

Literature review

Types of studies
Systematic reviews and RCTs were included for review.

Participants and intervention
Humans undergoing any type of surgery incorporating a fast-track (optimisation) program.

Comparator intervention
Patients undergoing surgery without an optimisation program.

Single intervention studies were excluded. Fast-track anaesthesia studies were also excluded.

Outcomes
Studies that reported at least one of the following outcomes were included:

Efficacy

- Length of hospital stay
- Mobilisation
- Quality of life
- Patient satisfaction

Safety

- Mortality and morbidity
- Readmission rates

Language restriction
Searches were restricted to studies reported in the English language.

Other documents included in review
Guideline documents or consensus recommendations concerning fast-track surgery or enhanced recovery programs were also retrieved.

Databases searched and search terms used

The databases searched are shown in Table 1.

Table 1. Databases searched

Database	Edition and date searched
Cochrane Library	Issue 2, 2006
Ovid MEDLINE	1980 to 2008
Entrez PubMed	January 2008 to 5 February 2009
Australian New Zealand Clinical Trials Registry	Searched 20 February 2009
Clinical Trials Database (US)	Searched 20 February 2009
NHS CRD (UK) NHS HTA (UK)	Searched 20 February 2009
National Research Register (UK)	Issue 2, 2006
Current Controlled Trials (mRCT)	Searched 20 February 2009
TRIP database	Searched 20 February 2009

Search terms

In *The Cochrane Library* the search terms used were:

fast track surgery and enhanced recovery after surgery

For MEDLINE, and Entrez-PubMed the following search terms were used:

1. fast track surgery OR
2. enhanced recovery after surgery OR ERAS OR
3. multimodal surgery OR
4. optimization of care
5. 1 OR 2 OR 3 OR 4

The NHS CRD databases were searched using the above terms. The National Research Register, Clinicaltrials.gov, Meta-Register and the Australian New Zealand Clinical Trials Registry were also searched using the above search terms for RCTs in progress. The TRIP database was searched for available guidelines.

Data analysis

Data were assessed to determine whether they were suitable for statistical pooling and meta-analyses. If possible, data were stratified into clinically relevant groups. Otherwise, data for the main outcomes have been reported narratively.

Survey of Australian surgeons

Participants

Surgeons from Australia who conduct fast-track surgery were identified via literature searches or through personal referrals.

Data collection

An informal semi-structured interview was conducted either in person or via the telephone. Interviews took approximately 15 – 20 minutes. All interviews were later

transcribed.

Interview questions

The following questions were used to guide the discussion:

1. What is your involvement with fast-track surgery?
2. What patients are selected for fast-track surgery?
3. What are the main components of your fast-track surgery program?
4. Do you have any cost-effectiveness data?
5. Are there any issues with the implementation of a fast-track program? If so, what are they?
6. Are there any other issues?
7. Who does fast-track surgery in Australia and New Zealand?

Data analysis

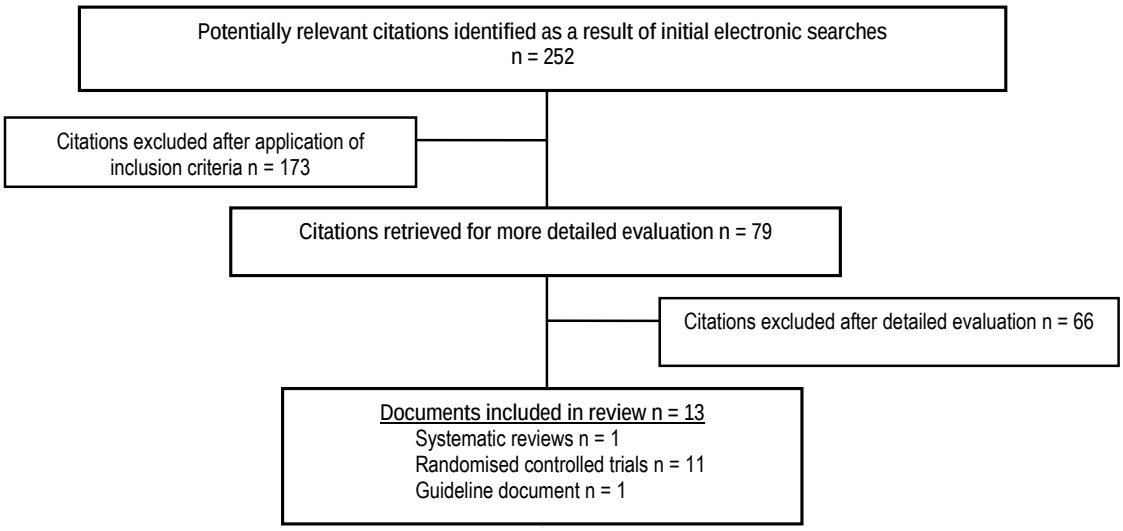
Responses were deidentified, grouped together into themes and reported narratively.

3. Studies included in the review

Literature search results

Details of the searching and retrieval process are shown in Figure 2.

Figure 2. Process for selection of studies retrieved from the literature databases



Description of studies

Systematic reviews

One systematic review was retrieved (Wind et al 2006). This systematic review included all RCTs and controlled clinical trials on fast-track colonic surgery. Six studies were included: three RCTs (Anderson et al 2003; Delaney et al 2003; Gatt et al 2005) and three non-randomised controlled clinical trials (Basse et al 2004; Raue et al 2004; Bradshaw et al 1998).

Databases were searched up to December 2005. Studies were included if they had a prospective intervention group comparing a multimodal fast-track perioperative care program with control patients undergoing elective colonic resection for malignant and benign disease, and reported age, sex, American Society of Anaesthesiologists (ASA) score, Physiologic and Operative Severity Score for the enUmeration of Mortality and Morbidity (POSSUM) score, type of resection, primary or overall hospital stay, readmission rate, morbidity, mortality, and at least four fast-track elements in the protocol.

Fast-track elements were based on those published by Kehlet and the ERAS study group (Kehlet & Dahl 2003; Kehlet & Wilmore 2002; Fearon et al 2005; Basse et al 2000, 2002, 2004; Hjort Jakobsen et al 2004). The main endpoints were number of applied fast-track elements, hospital stay, readmission rate, morbidity and mortality.

Randomised controlled trials

Eleven RCTs were retrieved which reported a total of 573 patients (Table 2). These studies were published between 2003 and 2008. All studies were conducted in single centres.

Table 2. Summary of included RCTs

Study	Indication	N		Follow-up (d)
		Optimised	Control	
Anderson et al 2003 (UK)	Elective hemicolectomy	14	11	30
Delaney et al 2003 (USA)	Interstitial or rectal resection by laparotomy	31	33	30
Gatt et al 2005 (UK)	Elective open colorectal resection	19	20	30
Khoo et al 2007 (UK)	Elective open colorectal resection for cancer	35	35	14
Gralla et al 2007 (Germany)	Laparoscopic radical prostatectomy	25	25	NR
Kuzma 2008 (Papua New Guinea)	Open appendectomy	32	25	30
Muehling et al 2008 (Germany)	Lung surgery (thoracotomy)	30	28	NR
Muehling et al 2008a (Germany)	Open infrarenal aortic aneurysm repair	37	42	To discharge
Recart et al 2005 (USA)	Laparoscopic radical nephrectomy	13	12	3
Larsen et al 2008 (Denmark)	Hip and knee replacement	45	42	90
Petersen et al 2006 (Denmark)	Total hip replacement	27	30	30

The main features of optimised treatment within each RCT is provided in Appendix 1 and Appendix 2.2 (only the differences between the optimised and conventional groups have been tabulated). These elements differ widely between the studies. Patient selection criteria of the included RCTs are reported in Table 3. In general, relatively broad patient populations were considered for inclusion. Table 4 details the components of study design within each study. Quality of the included studies is discussed in more detail in the Discussion section of the report.

Consensus reviews and guidelines

One consensus guideline was retrieved (Fearon et al 2005). In 2001 an ERAS group was established as a collaborative of five university or specialised Departments of Surgery from five Northern European Countries (Scotland, Sweden, Denmark, Norway and The Netherlands). Using the Medline database, an electronic search on 'fast-track' or 'multimodal' recovery was undertaken. Relevant papers from the reference lists of these articles and from group members' personal collections were also reviewed. The committee met on several occasions to reach a consensus on a protocol. The consensus statements published in the review were written specifically in relation to colonic resection.

Table 3. Patient selection criteria of included RCTs

Study	Indication	Patient selection criteria	
		Inclusion	Exclusion
Anderson et al 2003 Optimised n = 14 Control n = 11	Elective hemicolectomy	Patients who lived independently at home and required left or right hemicolectomy	NR
Gatt et al 2005 Optimised n = 19 Control n = 20	Elective colorectal resection	Patients who lived independently at home and required colorectal resection	Younger than 18 years, pregnancy, intolerance to pro- and/or pre- biotics, contraindications to one or more optimisation strategy, contraindications to early postoperative discharge, prescribed medications that may independently prolong hospital stay (eg anticoagulants), advanced malignancy on preoperative assessment, palliative surgery, emergency surgery, failure to perform colonic or rectal resection
Gralla et al 2007 Optimised n = 25 Control n = 25	Laparoscopic radical prostatectomy	Patients up to ASA III	Severe reduced renal function due to analgetic treatment with COX-II inhibitors
Khoo et al 2007 Optimised n = 35 Control n = 35	Elective colorectal resection for cancer	Elective patients presenting with colorectal cancer. No upper age limit set. Colonic and rectal surgery included	Inability to mobilise independently over 100m at preoperative assessment, contraindications to thoracic epidurals, pre-existing clinical depression. Excluded if having palliation only or undergoing a joint operation involving another surgical specialty
Kuzma 2008 Optimised n = 32 Control n = 25	Open appendectomy	Patients older than 10 years diagnosed clinically and on intraoperative macroscopic assessment as acute appendicitis	Younger than 10 years
Larsen et al 2008 Optimised n = 45 Control n = 42	Hip and knee replacement	All patients planned to undergo elective primary THR, TKA or UKA eligible	Mental disability, severe neurological disease
Muehling et al 2008 Optimised n = 30 Control n = 28	Lung surgery	All patients admitted with suspected lung neoplasm and who had the indication of lung resection (wedge of anatomic resection)	Clinical signs of infection (fever, leukocytosis) on admission, pre-existing pneumonia, contraindications for thoracic epidural anaesthesia (eg coagulopathy), a neuromuscular disorder that would prevent proper postoperative physiotherapy
Muehling et al 2008a Optimised n = 37 Control n = 42	Open infrarenal aortic aneurysm repair	All patients admitted with infrarenal aortic aneurysm and who had indication for elective repair	Clinical signs of infection (fever, leukocytosis) on admission, contraindications for epidural anaesthesia (eg coagulopathy), a neuromuscular disorder that would prevent proper postoperative physiotherapy, or intraoperative suprarenal clamping
Petersen et al 2006 Optimised n = 27 Control n = 30	Total hip replacement	Elective primary unilateral THR and perioperative epidural anaesthesia eligible	Chronic opioid use, chronic pain syndrome, rheumatoid arthritis, and mental disorders
Recart et al 2005 Optimised n = 13 Control n = 12	Laparoscopic radical nephrectomy	Patients undergoing unilateral laparoscopic nephrectomy, ASA I and II, aged 21 – 76 years	Clinically significant cardiac, pulmonary, hepatic or renal disease, abnormal renal function, extensive previous abdominal surgery, or known allergy to any study drugs or required conversion to an open procedure
Delaney et al 2003 Optimised n = 31 Control n = 33	Interstitial or rectal resection by laparotomy	Any patients scheduled for elective segmental intestinal or rectal resection by laparotomoy, including patients undergoing re-operation or pelvic surgery and those with co-morbidities	Loop ileostomy closure and ventral hernia repair with scheduled intestinal resection

ASA, American Society of Anaesthesiologists; THR, total hip replacement; TKA, total knee replacement; UKA, unicompartmental knee arthroplasty.

Table 4. Summary of study design elements reported in the included RCTs

Study	Method of randomisation	Method of allocation concealment	Order of allocation (consecutive/ non-consecutive)	Type of enrolment (prospective or retrospective)	Power calculation	Intention-to-treat analysis	Inclusion criteria	Exclusion criteria	Patient demographics	Analysis of baseline differences	Losses to follow up
Muehling et al 2008	•	NR	NR	prospective	NR	•	•	•	•	•	•
Khoo et al 2007	•	•	NR	prospective	•	?	•	•	•	•	•
Larsen et al 2008	•	•	•	prospective	•	?	•	•	•	•	•
Gatt et al 2005	•	•	•	prospective	•	NR (not ITT)	•	•	•	•	•
Kuzma 2008	•	•	•	prospective	•	NR (not ITT)	•	NR	•	•	•
Anderson et al 2003	NR	NR	•	prospective	•	NR	•	•	•	•	NR (0)
Gralla et al 2007	NR	NR	NR	prospective	NR	NR	•	•	•	•	NR (0)
Muehling et al 2008a	•	NR	NR	prospective	NR	○	•	•	•	•	•
Petersen et al 2006	•	•	NR	prospective	•	•	•	•	•	•	•
Recart et al 2005	•	NR	NR	prospective	•	NR (not ITT)	•	•	•	•	•
Delaney et al 2003	•	•	NR	prospective	•	•	•	•	•	•	•

• Reported

NR Not reported

○ Reported but not undertaken (eg it was reported that the did not use intention-to-treat analysis)

? Reported to be done, but not done (eg intention-to-treat analysis was reported to be used, but analysis of results revealed it was not)

4. Literature review results

The features of the fast-track program utilised in each study is summarised in Appendix 1 and Appendix 2.2. The results are categorised into safety and efficacy outcomes. The various outcomes of the included studies have been grouped together as closely as possible. It should be noted that the tools and methods used within the studies to measure efficacy and safety outcomes in many cases were not uniform.

Only the most commonly reported outcomes have been presented. Outcomes from three studies included in the systematic review (Wind et al 2006) are included (Anderson et al 2003; Delaney et al 2003; Gatt et al 2005).

Efficacy

Length of hospital stay

Systematic reviews

Wind et al (2006) reported that after pooling available data (from three RCTs and two non-randomised comparative studies), that primary hospital stay in the optimised group was significantly lower than in the control group (weighted mean difference -1.56 days, 95 per cent confidence interval (CI) -2.61 to -0.50 days).

Randomised controlled trails

Length of hospital stay was reported by 11 studies. In many cases, fast-track (optimised) patients had a shorter stay in hospital than control patients (Table 5).

Table 5. Length of hospital stay

Study	Type	Indication	Length of stay	Conventional	Optimised	P-value
Anderson et al 2003	RCT	Hemicolectomy		N = 11	N = 14	
			Median d (range)	7 (4 – 10)	3 (2 – 7)	0.002
			Mean hours ± SD	167.8 ± 49.6	95.1 ± 42.5	0.002
Gatt et al 2005	RCT	Elective colorectal resection		N = 20	N = 19	
			Median d [IQR]*	7.5 [6 – 10]	5 [4 – 9]	0.027
			Median (range) [IQR] †	8 (4 - 13) [6 - 10]	5 (2 - 8) [3 - 6]	0.027
Khoo et al 2007	RCT	Elective colorectal resection		N = 35	N = 35	
			Median d (range)	7 (4 – 63)	5 (3 – 37)	< 0.001
			including readmissions‡	7 (4 – 63)	5 (3 – 37)	< 0.001
Delaney et al 2003	RCT	Interstitial or rectal resection by laparotomy		N = 33	N = 31	
			Mean d ± SD§	5.8 ± 3	5.2 ± 2.5	0.12
			Inc readmissions, mean d ± SD	7.1 ± 4.8	5.4 ± 2.5	0.022
Gralla et al 2007	RCT	Laparoscopic radical prostatectomy		N = 25	N = 25	
			Length of stay post surgery, mean d	6.7	3.6	< 0.001
			Total length of stay, mean d	8.7	5.6	< 0.001
Kuzma 2008	RCT	Open appendectomy		N = 25	N = 32	
			Days in hospital after surgery, mean ± SD	4.00 ± 1.26	2.19 ± 0.47	< 0.001
			Median [range]	4 [5]	2 [2]	
Larsen et al 2008	RCT	Hip and knee replacement		N = 42	N = 45	
			Time from admission to discharge,‖ mean d ± SD	7.8 ± 2.1	4.9 ± 2.4	< 0.001

Table continued over page

Table 5. Length of hospital stay *continued*

Study	Type	Indication	Length of stay	Conventional	Optimised	P-value
Petersen et al 2006	RCT	Total hip replacement	Per protocol), median d (range)	N = 30 8 (1 – 10)	N = 27 7.0 (1 – 9)	0.019
			Intention-to-treat analysis, median d (range)	N = 36 NR	N = 34 NR	0.20
Muehling et al 2008	RCT	Lung resection	Day of discharge, median (range)	N = 28 11 (7 - 34)	N = 30 11 (8 - 33)	NS
			Length on ICU, median d (range)	1 (1 - 12)	1 (1 - 33)	NS
Muehling et al 2008a	RCT	Elective open infrarenal aneurysm repair	Day of discharge, median (range)	N = 42 11 (8 - 24)	N = 37 10 (8 - 49)	NR
			Length on ICU, median h (range)	41 (12 – 192)	20 (14 - 336)	NR
Recart et al 2005	RCT	Radical laparoscopic nephrectomy	Time to discharge from PACU, mean mins ± SD	N = 12 103 ± 47	N = 13 74 ± 23	NR
			Time to discharge from Hospital, mean h ± SD	59 ± 11	41 ± 11	< 0.05

* Data from text. By day 5 after surgery, 11/19(58%) optimised patients vs 2/20 (10%) conventional patients had been discharged (no statistical analyses reported).

† Data from graph.

‡ It was unclear how the calculations for length of stay including readmissions was made by the study authors. It was stated that if the additional inpatient days from readmissions were factored into the analysis, the results were still statistically significant.

§ When surgeons experienced in the optimised protocol cared for patients in the optimised group, patients were discharged after 3.8 ± 0.8 days compared with 5 ± 1.3 days for control patients cared for by surgeons with experience in the optimised protocol (p = 0.001). Optimised and control patients cared for surgeons with experience in the optimised protocol were discharged significantly earlier than patients cared for by surgeons who had no experience with the optimised protocol (p = 0.03 – 0.003).

‖ 35/43 (81.4%) patients in optimised group compared with 3/42 (7.1%) in control group were discharged at or before the 5th day (p < 0.001). This led to a number needed to treat of 1 patient (95% CI: 1 – 2).

Mobilisation and time out of bed

Randomised controlled trails

Outcomes relating to mobilisation were reported by four studies. Petersen et al (2006) reported that during the first six days of admission, mobilisation in the optimised group was more efficient than in the control group, and that the optimised group fulfilled the mobilisation goals to a greater extent than did the control group ($p < 0.001$). These authors further reported that physical activity (daily walking distances in metres) was found to significantly correlate with the ambulation time ($p = 0.002$). The median day of independence in personal activities of daily living (PADL) index ranks was the third postoperative day (range 1 – 4), in the intervention, and the fourth postoperative day (range 1 – 5) in the control group ($p = 0.22$).

The other three studies reported the time from surgery to mobilisation to the toilet unaided. Anderson et al (2003) and Khoo et al (2007) reported that the optimised groups mobilised to the toilet significantly earlier than the conventional groups ($p = 0.043$ and $p < 0.001$ respectively), while Gatt et al (2005) reported no significant differences between the two groups (Table 6).

Table 6. Mobilisation

Study	Type	Indication	Time from surgery to unaided mobilisation to toilet		
			Conventional	Optimised	P-value
Anderson et al 2003	RCT	Hemicolectomy	N = 11 Median h [IQR] 69 [44 – 121]	N = 14 Median h [IQR] 46 [37 – 54]	0.043
Gatt et al 2005	RCT	Elective colorectal resection	N = 14 Median h [IQR] NR	N = 19 Median h [IQR] NR	0.791
Khoo et al 2007	RCT	Elective colorectal resection	N = 35 Median d (range) 2 (1 – 10)	N = 35 Median d (range) 4 (2 – 32)	< 0.001

IQR, interquartile range; NR, not reported

Two studies reported that patients in the optimised group spent significantly more time out of bed than patients in the conventional groups (Table 7).

Table 7. Time out of bed

Study	Type	Indication	Conventional	Optimised	P-value
Gatt et al 2005	RCT	Elective colorectal resection	Time out of bed day PO day 1, median min [IQR]		
			N = 20 8 [0 – 38]	N = 19 105 [34 – 225]	0.047
Petersen et al 2006	RCT	Total hip replacement	Total time out of bed, average h ± SD		
			N = 27 25.5 ±14.4	N = 30 37.4 ± 10.4	< 0.001

IQR, interquartile range; PO, postoperative; SD, standard deviation

Gut function

Systematic reviews

Wind et al (2006) reported that postoperative ileus, in terms of necessity for reinsertion of a nasogastric decompression tube, time until first defecation and number of days after surgery required to attain tolerance of solid food were reduced in the optimised group compared with the control group for some, but not all studies that reported these outcomes.

Randomised controlled trails

Outcomes relating to gut function following surgery were reported by five studies (Table 8). Four studies reported that optimised patients had significantly faster improvement in gut function than control patients. One study reported that bowel sounds were present earlier for optimised patients than controls ($p = 0.004$), but that there were no significant differences between the groups for the time taken to pass flatus, opening of bowels, and tolerating a solid diet.

Table 8. Gut function

Study	Type	Indication	N		Gut function
Anderson et al 2003	RCT	Hemicolectomy			Return of gastrointestinal function, median h [IQR]
			11	Conventional	76 [70 - 110]
			14	Optimised	48 [33 – 55]
				P-value	0.001
Gatt et al 2005	RCT	Elective colon resection			Fluid tolerance - duration of IV fluids from time of surgery, median h (range) [IQR]
			20	Conventional	68 (27 - 77) [57 - 72]
			19	Optimised	34 (20 – 66) [22 - 46]
				P-value	0.007
Gatt et al 2005	RCT	Elective colon resection			Return of gut function – time to full diet from time of surgery, median h (range) [IQR]
			20	Conventional	90 (22 - 170) [45 - 120]
			19	Optimised	45 (22 - 70) [40 - 70]
				P-value	0.042
Khoo et al 2007	RCT	Elective colon resection			Tolerating solid diet, median POD (range)
			35	Conventional	4 (2 – 9)
			35	Optimised	1 (0 – 6)
				P-value	< 0.001
					Passage of stool/stoma functioning, median POD (range)
			35	Conventional	5 (0 – 23)
			35	Optimised	3 (1 – 5)
				P-value	< 0.001
Kuzma et al 2007	RCT	Open appendectomy			Passed flatus, mean d ± SD
			25	Conventional	2.08 ± 0.70
			32	Optimised	1.78 ± 0.61
				P-value	0.09
					Bowels opened, mean d ± SD
			25	Conventional	2.53 ± 0.77
			32	Optimised	2.15 ± 0.68
				P-value	0.09
					Bowel sounds present, mean d ± SD
			25	Conventional	2.21 ± 0.66
			32	Optimised	1.69 ± 0.64
				P-value	0.004
					Tolerated solid diet, mean d ± SD
			25	Conventional	3.16 ± 0.69
			32	Optimised	2.44 ± 0.56
				P-value	0.17

IQR, interquartile range; IV, intravenous;POD, postoperative day; SD, standard deviation

Pain

Randomised controlled trails

Pain following surgery was reported by six studies. One study reported no differences in pain scores between the groups (Gatt et al 2005). Anderson et al (2003) reported that there was a significant increase in postoperative pain at rest, on movement and on coughing in the control group ($p = 0.026$, $p = 0.020$ and p 0.011 respectively) on postoperative day one. In contrast, postoperative pain did not significantly differ from preoperative levels in the optimised group for these three parameters ($p = 0.113$, $p = 0.153$ and $p = 0.091$ respectively). On the first postoperative day, median pain scores at rest, on movement and on coughing were all significantly higher in the control group than in the optimised group ($p = 0.027$, $p = 0.002$ and $p = 0.012$ respectively). By day seven, pain scores at rest and during mobilisation were similar in the two groups, but pain on coughing remained significantly increased in the control group ($p = 0.004$).

The results for pain for the other four studies are reported in Table 9. One study reported significant differences in pain scores in favour of the optimised groups during

post anaesthesia care unit (PACU) stay and at postoperative day one, but not at six hours after surgery, or postoperative days two and three (Recart et al 2005). The other three studies found no significant differences in pain scores between the optimised and control groups.

Table 9. Pain

Study	Type	Indication	N	Intervention	Pain				
Kuzma 2008	RCT	Open appendectomy			Facial pain score*, median [range]				
					POD 1			POD 2	
			25	Conventional	3.00 [3.00]			2.00 [2.00]	
			32	Optimised	3.00 [3.00]			1.00 [2.00]	
				P-value	0.09			0.21	
Petersen et al 2006	RCT	Total hip replacement			Pain score†, median [range]				
					48 h after surgery			During the following 4 days	
			30	Conventional	1.2 (0–4.1)			1.0 (0–5.5)	
			27	Optimised	1.8 (0–5.5)			1.0 (0–5)	
				P-value	0.949			0.700	
Recart et al 2005	RCT	Radical laparoscopic nephrectomy			Max pain score‡, mean ± SD				
					PACU	At 6 h	POD 1	POD 2	POD 3
			12	Conventional	5 ± 3	6 ± 2	7 ± 2	4 ± 2	3 ± 3
			13	Optimised	3 ± 2	5 ± 1	4 ± 2	3 ± 2	2 ± 3
				P-value	< 0.05	NS	< 0.05	NS	NS
Delaney et al 2003	RCT	Interstitial or rectal resection by laparotomy			Pain score, mean + SD§				
					Day 2		Discharge/day 10	Day 30	
			33	Conventional	3.4 ± 1.5		3.1 ± 2.4	1.5 ± 2.1	
			31	Optimised	3.3 ± 1.9		3.1 ± 2	1.2 ± 1.6	
				P-value	0.59		0.79	0.97	

PACU, post anaesthesia care unit; POD, postoperative day; SD, standard deviation
* Facial pain score measured by VAS of six faces, sore 0 – 5.
† Measured on a visual analogue scale (magnitude not specified).
‡ Pain measured on an 11 point verbal rating scale from 1, none to 10, maximum.
§ Measured on a visual analogue scale (magnitude not supplied). There was also no significant difference in pain scores when the McGill Pain Questionnaire was used (except for at discharge p = 0.022 which the authors attributed to the shorter length of stay of the optimised group).

Analgesia/pain medication

Randomised controlled trails

Three studies reported outcomes for requirements of analgesics and pain medication. Gatt et al (2005) reported that there were no differences in analgesic requirements between the groups. Recart et al (2005) reported that the time to the first rescue analgesic was prolonged in the optimised group compared with the control (42 ± 25 vs 24 ± 25 mins) but that this was not statistically significant. The authors further reported that the optimised group required significantly less PCA morphine on postoperative day 1 and postoperative day 2 compared with controls (12 ± 16 vs 32 ± 29 mg ($p < 0.05$) and 2 ± 0 vs 8 ± 8 mg ($p < 0.05$) respectively). Delaney et al (2003) reported that although optimised patients used 30% less intravenous opiate than control patients, there was no significant difference in the amount of opiates used (137 ± 109 vs 187 ± 152 mg, $p = 0.08$).

Readmissions to hospital

Systematic reviews

Wind et al (2006) reported that after pooling available data from three RCts and three non-randomised comparative studies) that readmission rates were not significantly

different between the optimised and control groups (relative risk 1.17, 95% CI 0.73 to 1.86).

Randomised controlled trials

Eight studies reported readmissions after the initial operation. Anderson et al (2003) reported that no patient was readmitted within 30 days of surgery and Recart et al (2005) reported that none of the patients required readmission to the hospital after discharge home. Readmission rates in the other six studies varied from 0 to 10% in the optimised group and 0 to 20% in the conventional group (Table 10). Only one study reported a significant difference (which was in favour of optimisation) in readmission rates between the conventional and optimised groups (Delaney et al 2003).

Table 10. Readmission rates

Study	Type	Indication	N	Intervention	Readmissions, n (%)	Reasons for readmissions (n)	Follow-up (d)
Delaney et al 2003	RCT	Interstitial or rectal resection by laparotomy	33	Conventional	6 (18.2)	Obstruction or ileus (3); Dehydration (2); Dehydration with renal failure (1)	30
			31	Optimised	3 (9.7)	Pelvic abscess (1); Wound infection (1); Small bowel obstruction (1)	30
				P-value	0.022		
Gatt et al 2007	RCT	Laparoscopic radical prostatectomy	20	Conventional	4 (20)	NR	30
			19	Optimised	1 (5)	NR	30
				P-value	0.169		
Khoo et al 2007	RCT	Elective colorectal resection	35	Conventional	1 (2.9)	Pressure sore (1)	14
			35	Optimised	3 (8.6)	Abscess in perineal wound (1); Upper GI bleeding from peptic ulcer (1); Wound infection (1)	14
				P-value	NR		
Kuzma 2008	RCT	Open appendectomy	30	Conventional	1 (3.3)	Surgical site infection (1)	30
			32	Optimised	1 (3.3)	Surgical site infection (1)	30
				P-value	NR		
Larsen et al 2008	RCT	Hip and knee replacement	42	Conventional	1 (2.4)	Wound infection (1)	90
			45	Optimised	2 (4.4)	Swelling and pain in knee (1); Dislocation of hip (1)	90
				P-value	NR	NR	
Gralla et al 2007	RCT	Laparoscopic radical prostatectomy	25	Conventional	1 (4)	NR	NR
			25	Optimised	2 (8)	Abdominal discomfort (2)	NR
				P-value	0.55		

NR, not reported

Quality of life

Randomised controlled trails

Outcomes relating to quality of life were reported by two studies (Table 11). One study reported no significant differences between the two groups at discharge/day 10 and at day 30 (Delaney et al 2003), while the other study reported a significant gain in quality of life from baseline to three months follow-up for both groups; this was significantly greater in the optimised group ($p = 0.003$) (Larsen et al 2008).

Table 11. Quality of life

Study	Type	Indication	N	Intervention	QoL outcome	
Larsen et al 2008	RCT	Hip and knee replacement			Gain in QoL* from baseline to 3 month follow up, mean ± SD	
			42	Conventional	0.26 ± 0.31	
			45	Optimised	0.42 ± 0.31	
				P-value	NR†	
Delaney et al 2003	RCT	Interstitial or rectal resection by laparotomy			Overall CGQL‡, mean ± SD	
					Discharge/ day 10	Day 30
			33	Conventional	7.5 ± 1.7	7.6 ± 1.4
			31	Optimised	5.6 ± 1.8	6.3 ± 2.1
				P-value	0.4	0.87

CGQL, Cleveland Clinic Global Quality of Life Score; QoL, quality of life; SD, standard deviation

* As measured using EQ-50.More than half (28/45, 62.2%) patients were classified as being well (at or above the observed age-adjusted QoL for the Danish population) in the optimised group, and 15/42 (35.7%) patients were classified as being well in the control group at the 3 month follow-up. This led to a number needed to treat of 3 (95% CI: 2 – 11) for the optimised intervention.

† Both groups reported a significant gain in quality of life from baseline to three months follow up (optimised 0.42 ± 0.31; control 0.26 ± 0.31). There was a significant unadjusted crude difference in gain in QoL of 0.16 (95% CI: 0.02 – 0.29, p = 0.02) favouring the intervention group. The adjusted mean difference also yielded a significant difference in gain in QoL of 0.08 (95% CI: 0.004 – 0.16, p = 0.003) in favour of the intervention group.

‡ The component scores of the CGQL assess quality of life, quality of health and level of energy. There were no differences between the groups for these parameters. SF-36 evaluation revealed no difference between the group at baseline, POD 10, or POD 30. At the time of discharge there was a significant reduction in the overall mental component summary score for the control group (7.69 ± 8.2 vs 3.85 ± 3.44, p = 0.02). Authors report that this reduction may be explained by earlier charge of optimised patients.

Patient satisfaction

Randomised controlled trails

Outcomes relating to various patient satisfaction outcomes were reported by two studies (Table 12). One study reported significant increases in patient satisfaction with pain management for the optimised patients but no significant differences in satisfaction with quality of recovery (Recart et al 2005). The other study did not report a difference between the two groups for satisfaction in hospital stay or happiness to be discharged from hospital (Delaney et al 2003).

Table 12. Patient satisfaction

Study	Type	Indication	N	Intervention	Satisfaction measure		
Recart et al 2005	RCT	Radical laparoscopic nephrectomy			Patient satisfaction* with pain management, mean ± SD		
					POD 1	POD 2	POD 3
			12	Conventional	85 ± 12	91 ± 10	94 ± 6
			13	Optimised	98 ± 3	100	100
				P-value	< 0.05	< 0.05	< 0.05
					Patient satisfaction† with quality of recovery, mean ± SD		
					POD 1	POD 2	POD 3
			12	Conventional	13 ± 2	15 ± 1	16 ± 2
			13	Optimised	15 ± 1	16 ± 1	17 ± 1
				P-value	NS	NS	NS
Delaney et al 2003	RCT	Interstitial or rectal resection by laparotomy			Satisfaction with hospital stay‡, mean ± SD		
					Day 10	Day 30	
			33	Conventional	8.2 ± 1.9	8.4 ± 1.6	
			31	Optimised	8.1 ± 2.2	8.2 ± 2.2	
				P-value	0.81	0.97	
					Happiness to be discharged from hospital‡, mean ± SD		
					Day 10	Day 30	
			33	Conventional	8 ± 1.9	8.2 ± 2.4	
			31	Optimised	8 ± 1.9	8.5 ± 2.2	
				P-value	0.95	0.79	

SD, standard deviation

* Measured on a verbal rating scale of 0, poor to 100, excellent. Assessed by blinded investigator.

† Measured on a scale of 0, poor to 18, excellent. Assessed by blinded investigator.

‡ Method of calculation of variable not reported.

Safety

Morbidity and mortality

Systematic reviews

Wind et al (2006) reported that pooled data from the six studies (three RCTs and three non-randomised comparative studies) showed that morbidity was significantly lower for fast-track programs (relative risk 0.54, 95% CI 0.42 to 0.69). The absolute risk reduction of the pooled data was -0.15 (95% CI -0.28 to -0.02).

No difference in mortality was found between the patient groups.

Randomised controlled trials

Outcomes related to complications following surgery were reported by all studies. Kuzma et al (2008) reported no statistically significant differences between groups in relation to morbidity rate and the frequency of abdominal cramps and vomiting. Petersen et al (2006) reported that there was no difference in complications between groups. The relative risk in the intention-to-treat analysis was 1.6 (0.6 – 4.0) ($p = 0.39$) and in the per-protocol analysis 1.7 (0.5 – 5.3) ($p = 0.49$) and no patients were re-admitted. Data relating to complications reported in the other nine studies are reported in Table 13. Two studies reported significantly fewer complications in the optimised groups compared with controls (Gralla et al 2007; Muehling et al 2008a), three studies reported no significant differences between the two groups (Gatt et al 2005; Muehling et al 2008; Delaney et al 2003), and four studies did not report statistical analyses between the groups (Anderson et al 2003; Khoo et al 2007; Larsen et al 2008; Recart et al 2005).

Table 13. Morbidity and mortality

Study	Type	Indication	N	Intervention	Postoperative complications, n	Details, (n)
Anderson et al 2003	RCT	Hemicolectomy	11	Conventional	6 patients (7 events)	Death (1); Urinary retention (1); Atrial fibrillation (2); Respiratory depression related to PCA (2); Ileus (1)
			14	Optimised	4 patients (5 events)	Ineffective epidural (2); Ileus (1); Urinary tract infection (1); Wound infection (1)
				P-value	NR	
Gatt et al 2005	RCT	Elective colorectal resection	20	Conventional	15 patients (15 events)	Urinary tract infection (2); Wound infection or breakdown (4); Diarrhoea and vomiting (2); Ileus (3); Other (4)
			19	Optimised	10 patients (10 events)	Death (1); Diarrhoea and vomiting (1) Ileus (3); Chest infection (1); Deep vein thrombosis (2); Other (1)
				P-value	0.076	
Khoo et al 2007	RCT	Elective colorectal resection	35	Conventional	14 events	Death (2); Intestinal leaks (3); NGT Decompression (4); Cardiorespiratory compromise (4); Pressure sores (3); Urinary tract infection (2)
			35	Optimised	9 events	Intestinal leaks (1); NGT Decompression (3); Urinary tract infection (1); Transient urinary retention (4)
				P-value	NR	
Gralla et al 2007	RCT	Laparoscopic radical prostatectomy	25	Conventional	14 patients (16 events)	Penoscrotal (12); Cardial (1); Major complications (1); Urinary retention (1); Pneumonia (1)
			25	Optimised	6 patients (6 events)	Penoscrotal (5); Parasthesia (1)
				P-value	0.02	
Larsen et al 2008	RCT	Hip and knee replacement	42	Conventional	2 patients (2 events)	Death (1); Wound infection (1)
			46	Optimised	2 patients (2 events)	Swelling and pain in knee (1); Dislocation of hip (1)
				P-value	NR	
Muehling et al 2008	RCT	Lung resection		Conventional	14 patients (15 events)	Death (1); Atelactasis (2); Pneumonia (3); Prolonged air leak > 7 d (3); Pleural effusion (2); Arrhythmia (1); Myocardial infarction/ decompensation (1); Re-operation (1); Renal insufficiency (1)
				Optimised	8 patients (10 events)	Death (1); Prolonged air leak > 7 d (1); Pleural effusion (1); Arrhythmia (3); Myocardial infarction/ decompensation (1); Re-operation (1); Urinary tract infection (2)
				P-value	0.172*	
Muehling et al 2008a	RCT	Open infrarenal aortic aneurysm repair	42	Conventional	15 patients (16 events)	Myocardial ischemia (1); Dysrhythmia (3); Acute renal failure (3); Pneumonia (1); Functional bowel obstruction (5); Urinary tract infection (2); Intravenous line infection (1)
			37	Optimised	6 patients (7 events)	Myocardial ischemia (1); Dysrhythmia (1); Acute renal failure (2); Functional bowel obstruction (2); Urinary tract infection (1)
				P-value	0.045	
Delaney et al 2003	RCT	Interstitial or rectal resection by laparotomy	31	Conventional	10 patients (10 events)	Postoperative ileus or small bowel obstruction (4); Dehydration (2); Dehydration with renal failure (1); Re-operation for bleeding (3)
			33	Optimised	7 patients (7 events)	Postoperative ileus or small bowel obstruction (3); Wound infection (1); Infected Hickman catheter (1); Re-operation for bleeding (1); Pelvic abscess (1)
				P-value	0.25	
Recart et al 2005	RCT	Radical laparoscopic nephrectomy	12	Conventional	NR	
			13	Optimised	1 patient (1 event)	Mild ileus
				P-value	NR	

*Pulmonary complications (primary endpoint) occurred in 10/28 (36%) patients in control group vs 2/30 (7%) in optimised group (p = 0.009).

Consensus reviews and guidelines

Fearon et al (2005) was identified as part of the systematic literature search. No other guidelines regarding fast-track surgery for any indication were identified, either locally or internationally. The consensus statements developed by Fearon et al (2005) are listed in Table 14.

Table 14. Summary of core protocol elements as reported by Fearon et al (2005)

ERAS principle	Details
Patient information	Essential before admission for surgery
Preoperative bowel preparation	No routine oral preparation for colon resections.
Preanaesthetic medication	Not recommended.
Preoperative fasting and fluids	Patients should be allowed to drink clear fluids up to two hours prior to initiation of anaesthesia and should receive preoperative oral carbohydrate loading.
Standard anaesthetic protocol	Intraoperative mid-thoracic epidural analgesia (local anaesthetic plus low-dose opioid). Short-acting intravenous or inhalational anaesthetic agents, according to local traditions.
Prevention of intraoperative hypothermia	Warmed intravenous fluids and upper body air-warming device.
Thromboembolic prophylaxis	Low-dose low molecular weight heparin started about two hours after placement of epidural catheter and continued until full mobilisation.
Nasogastric decompression tubes	Not recommended.
Prophylactic antibiotics	Indicated with two drugs (anaerobic and aerobic prophylaxis) given before skin incision and single dose, may be repeated when surgery is less than three hours.
Incision	Short midline or transverse incisions recommended.
Drainage	Drains should not be used routinely in colonic surgery.
Urinary bladder catheterisation	Suprapubic or urethral catheterisation. Removal of catheter 24 – 48 hours after surgery recommended.
Fluid therapy	Avoid excessive intravenous fluids. Vasopressors recommended for treatment of epidural-related hypotension. Discontinuation of intravenous fluids on postoperative day one.
Ileus prophylaxis and promotion of GI motility	Continuous thoracic epidural analgesia for first two postoperative days (low-dose epidural local anaesthetic–opioid). Use of magnesium oxide twice daily recommended.
Postoperative analgesia	Continuous thoracic epidural analgesia for two days postoperatively (low-dose epidural local anaesthetic–opioid), paracetamol as routine oral analgesic and epidural top up as rescue. Commence non-steroidal anti-inflammatory drugs at end of epidural. Additional opioid only if other efforts fail.
Nutrition	Postoperative nutrition includes oral nutritional supplements from the day of operation in addition to normal food. Malnourished patients should continue oral nutritional supplements at home.
Early mobilisation	A care plan that facilitates patients being out of bed for two hours on the day of surgery and six hours thereafter is recommended.
Discharge criteria	Good pain control with oral analgesics, taking solid food and no intravenous fluids, independently mobile, willing to go home.
Follow-up and audit	Patients should be contacted one to two days after discharge, reviewed clinically at seven to 10 days postoperatively and reviewed finally at 30 days postoperatively. Audit of results/endpoints/adverse events and protocol compliance is essential.

Ongoing and unpublished trials

Searches of the Clinical Trials Database, NHS CRD, NHS HTA, Current Controlled Trials, Australian New Zealand Clinical Trials Registry and the National Research Register identified a number of unpublished studies. The details for each are provided in Table 15.

Table 15. Ongoing and unpublished studies

Study	Indication	Details	Outcomes
The Protocol of Enhanced Recovery after Surgery (ERAS) in Colorectal Surgery ClinicalTrials.gov Identifier: NCT00498290	Colorectal surgery	Design: treatment, randomised, open label, active control, parallel assignment, safety/efficacy study Estimated enrolment: n = 500 Start/end date: September 2006/ July 2008 Sponsors and collaborators: Fundan University Location: China	Safety: surgical stress, functional recovery and complication rates 30 days after surgery
A Randomised Controlled Trial of Optimised Surgical Recovery: the Potential Synergy between Enhanced Gastrointestinal Motility and Oral Nutritional/ Metabolic Support ClinicalTrials.gov Identifier: NCT00538954	Colorectal liver metastases	Health services research, randomised, open label, active control, factorial assignment, safety/efficacy study Estimated enrolment: n = 64 Start/end date: August 2006/ August 2008 Sponsors: University of Edinburgh Collaborators: NHS Lothian Location: Netherlands, United Kingdom	Efficacy: recovery of gastrointestinal function, length of hospital stay, patient activity level
Randomised Double Blind Trial to Investigate the Effects of Intraperitoneal Local Anaesthetic Following Colonic Surgery in an ERAS Program ClinicalTrials.gov Identifier: NCT00722709	Colon surgery	Design: treatment, randomised, double blind (subject, caregiver, investigator, outcomes assessor), placebo control, single group assignment, efficacy study Estimated enrolment: n = 60 Start/end date: September 2008/ December 2009 Sponsors and collaborators: University of Auckland Location: New Zealand	Safety: ropivacaine plasma levels, cytokines, cortisol, CRP, albumin, local anaesthetic toxicity Efficacy: postoperative pain, fatigue assessment, grip strength, serum glucose
Is Urinary Catheter Necessary After Fast-Track Colonic Surgery? ClinicalTrials.gov Identifier: NCT00817141	Colonic surgery	Design: cohort, prospective, observational Estimated enrolment: n = 50 Start/end date: March 2008/NR Sponsors and collaborators: Université Catholique de Louvain Location: Belgium	Safety: Incidence of urinary retention necessitating catheterisation, other urinary complications Efficacy: modification of the fast-track protocol
Fast track in Open Colonic Surgery - A Multicentric Randomised Controlled Trial (study terminated – interim analysis) ClinicalTrials.gov Identifier: NCT00556790	Elective colectomy and median laparotomy	Design: treatment, randomised, open label, active control, parallel assignment, efficacy study Estimated enrolment: n = 150 Start/end date: November 2007/ January 2007 Sponsors and collaborators: University of Lausanne Hospitals - University of Zurich, Kantonsspital Olten, Kantonsspital Winterthur, Spital Uster Location: Switzerland	Safety: complications, Efficacy: hospital stay, adherence to fast track protocol
Prospective Randomised Controlled Trial to Reduce Morbidity and Mortality after Lung Surgery in Patients With FEV1 < 70% of Expected Value or < 1.5L ClinicalTrials.gov Identifier: NCT00530491	Lung surgery	Design: treatment, randomised, open label, parallel assignment Estimated enrolment: n = 90 Start/end date: September 2007/ October 2008 Sponsors and collaborators: University of Ulm University of Heidelberg Location: Germany	Safety: pulmonary complications, lung function, overall mortality, duration of ICU treatment

Table 15. Ongoing and unpublished studies *continued*

Study	Indication	Details	Outcomes
Randomised Controlled Trial of Fast-Track Rehabilitation after Elective Colorectal and Small Bowel Resection ClinicalTrials.gov Identifier: NCT00606944	Colorectal cancer	Design: treatment, randomised, open label, placebo control, parallel assignment, safety/efficacy study Estimated enrolment: n = 320 Start date/end date: September 2007/ December 2009 Sponsors and collaborators: Seoul National University Hospital Location: Republic of Korea	Safety: postoperative complication, readmission rate Efficacy: Length of Hospital stay, pain, quality of life
Prospective Randomised Controlled Trial to Evaluate Fast Track Recovery in Elective Open Infrarenal Aortic Aneurysm Repair ClinicalTrials.gov Identifier: NCT00615888	Open infrarenal aortic aneurysm repair	Design: treatment, randomised, open label, active control, parallel assignment, safety/efficacy study Estimated enrolment: n = 100 Start date/end date: September 2005/ January 2008 Sponsors and collaborators: University of Ulm Location: Germany	Safety: morbidity and mortality, length of ICU treatment, need for postoperative mechanical ventilation, day of discharge
Preoperative Prevention and Early Rehabilitation for Patients Undergoing Elective Spine Surgery ClinicalTrials.gov Identifier: NCT00459966	Degenerative lumbar disease	Design: prevention, randomised, open label, placebo control, single group assignment, safety study Estimated enrolment: n = 60 Start date/end date: February 2005/November 2006 Sponsors and collaborators: Rigshospitalet Location: Denmark	Efficacy: hospital discharge
Influence of laparoscopy and/or fast-track multimodal management on gastrointestinal motility in comparison to open surgery and/or standard care ISRCTN26698501	Colorectal cancer	Design: randomised, double-blind, active controlled, parallel group trial Estimated enrolment: 80 Start date/end date: September 2005/ July 2007 Sponsors: Academic Medical Centre Location: The Netherlands	Efficacy: gastrointestinal transit, intra-abdominal inflammatory status
Perioperative strategy in colonic surgery; LAparoscopy and/or FAst track multimodal management versus standard care (LAFA study) ISRCTN79588422	Segmental colectomy for malignant disease	Design: Randomised controlled trial Estimated enrolment: n = 400 Start date/end date: July 2005/ December 2008 Sponsors: Academic Medical Centre Location: The Netherlands	Safety: morbidity, readmission rates Efficacy: total postoperative hospital stay, quality of life, medical and non medical costs, patient satisfaction

Training course

In addition to the above trials, a one-day multidisciplinary course concerning enhanced recovery protocols was identified. The Advanced Clinical Skills Centre in New Zealand is conducting this course, which will cover patient preparation, anaesthesia, surgical techniques, nutrition, ward care, and mobilisation. This course is scheduled to take place on 27 April 2009 in Auckland, New Zealand. Specific details can be found at: http://www.fmhs.auckland.ac.nz/som/acsc/surgical/courses.aspx

5. Australian and New Zealand surgeon survey results

Interviews were conducted with four surgeons. Initial discussions with Australian surgeons revealed that little formal fast-track surgery is being conducted in Australia, so surgeons from New Zealand were also contacted.

Two surgeons were from Australia, and two were from New Zealand. All four surgeons worked in urban hospitals. Two surgeons worked in hospitals with less than 350 beds, while the other two surgeons worked in hospitals with more than 350 beds. Three surgeons were colorectal surgeons, and one was a hepatopancreaticobiliary surgeon.

One interview was conducted in person, while the other three interviews were conducted over the telephone.

Surgeon opinions

Status of fast-track surgery in Australia and New Zealand

There was a consensus among the surgeons that there is currently no uniform policy in relation to fast-track surgery in Australia or New Zealand. There was a belief that many surgical departments (or parts thereof) are implementing fast-track programs but are doing so on an *ad hoc* basis.

Two surgeons (one from Australia and one from New Zealand) were part of formal fast-track programs within hospitals. One surgeon was investigating fast-track recovery in relation to a different study area. Another surgeon was incorporating fast-track elements into patient care, but not in a formal program.

Two surgeons were in the process of preparing, or had submitted data for peer-reviewed publication. In one case, the trial was recorded under a title that did not specifically refer to fast-track surgery, or any other iteration of an optimised technique.

Three of the surgeons indicated that they were aware of research being conducted pertaining to some element of fast-track surgery within either their own, or another hospital, or that they were aware of programs at the initial stages of implementation within a hospital.

Surgery type

Three surgeons reported using fast-track surgery for colonic surgery. Of these, one also used it for colorectal surgery. The other surgeon reported using fast-track principles for hepatopancreaticobiliary surgery (pancreaticoduodenectomy, pancreatic resections, liver resections). One surgeon suggested that fast-track surgery protocols were relatively generic, and could be applied to any indication with clinically-relevant adaptations.

Patient selection

Elective surgery patients were the main focus of the fast-track surgeries, but one surgeon used the principles on all patients. One surgeon cited the main reason for using it only on elective patients was the time required to prepare patients for their procedure using the fast-track protocol (patient education and preparation, appropriate staff involvement etc).

Main features of fast-track programs

All surgeons agreed that it was the incorporation of a number of features that made fast-track programs successful. The surgeons interviewed generally had similar approaches to fast-track principles, although some followed protocols much more strictly than others. Two surgeons felt that it was important to monitor compliance to ensure that all relevant fast-track procedures were followed.

In general, the surgeons employed the following broad principles:

- Patient education, including setting positive performance goals
- Allowing patients to drink up to two hours before surgery
- No bowel preparation
- Less use of drains and nasogastric tubes
- Early removal of catheters
- Maximising analgesic requirements without narcotics
- Early mobilisation and feeding

The area of most variation in opinion was analgesia and the use of epidurals. In the hospitals where strict protocols were followed, epidurals were used, while the hospitals with less formal processes used other forms of analgesia (intrathecal morphine or local anaesthetic infusion agents). The reasons cited for using pain relief other than epidurals were that efficacy of epidurals were practitioner dependent and could be difficult to maintain, and that the hospital could not run vasopressors on the ward to control hypotension induced by epidurals.

Issues with implementation

All of the surgeons interviewed felt that fast-track surgery challenged current practice and engrained dogma. Most felt that some changes were difficult to accept for some staff, including anaesthetists, acute pain units, nursing staff and surgeons. There was consensus that it was important that all staff involved in fast-track programs be educated in the fast-track principles and procedures. Nurses, if informed openly, were likely to look favourably upon the fast-track approach, as it was based on an unambiguous protocol. Two surgeons said that nursing staff were particularly important in a fast-track program as they were the ones implementing much of the detail of the protocol. These surgeons believed that it was important that nursing staff had some ownership of the program. In addition to this, one of these surgeons believed that acute pain units were

also important to recruit as they were prone to giving patients high does of postoperative narcotic analgesia, which prevent measurement of patient controlled pain relief.

In general, it appeared that surgical units with a small number of surgeons and staff found implementation of fast-track principles and compliance with procedures easier than those who had greater numbers of staff, although one surgeon from a larger hospital did not indicate that he had encountered any problems with implementation.

One surgeon reported encountering difficulties when surgeons not familiar with the fast-track protocol tried to become involved with the program. These surgeons did not completely follow the protocol and this resulted in longer hospital stays for patients. This surgeon felt that it was vital that a comprehensively defined protocol was in place and that it should be followed exactly.

One surgeon believed that fast-track programs were labour intensive and would, at this time, not become standard practice.

One surgeon reported that a limitation of fast-track programs for some patients is ensuring that patients have access to adequate care (eg in the home or a care facility) once they are discharged from hospital.

Cost-effectiveness

There was a general view that fast-track surgery programs would save money in terms of reducing hospital stay. The surgeons conducing fast-track surgery in hospitals without a specific program reported that no specific fast-track cost-effectiveness data had been collected. Two surgeons stated that cost-effectiveness data was being compiled for studies investigating other interventions which used fast-track principles to enhance recovery after surgery. Only one surgeon reported having cost-effectiveness data for a fast-track program. It was reported that substantial savings were being made using the fast-track program in terms of reduced hospital stay and decreased complication rates. These savings included the initial set up costs of the program and a research fellow's salary.

6. Discussion

Fast-track surgery combines various techniques used in the care of patients undergoing surgery to provide improved standards of care by reducing morbidity and mortality associated with major surgery while attempting to improve the overall quality of recovery (Zargar-Shoshtari & Hill 2008). Fast-track surgery involves preoperative education, and nutrition, epidural or regional anaesthesia, minimally invasive techniques, optimal pain control, postoperative oral nutrition and ambulation (King et al 2006; Wilmore & Kehlet 2001, see also Figure 1).

Limitations of the evidence

Literature review component:

The purpose of this part of the report was to conduct a systematic review of the literature to assess whether fast-track surgery was safe and effective in comparison to conventional surgery. As such, it included studies irrespective of the type of surgery and included laparoscopic as well as open procedures. Different indications and outcome measures meant that results could not always be easily grouped. The heterogeneity of indications and surgical procedures (eg open versus laparoscopic surgery), may have resulted in comparisons between studies not having high validity. The inclusion of a published systematic review that included three RCTs that were also included individually resulted in duplication of some outcomes.

The search strategy developed for this review may not have found all of the articles because some studies do not refer directly to 'fast-track surgery' or 'enhanced recovery programs'. In addition to this, this review may have excluded some important studies in the area of fast-track surgery because the researchers did not employ a randomisation strategy in their study design, and this may have been subject to reporting bias.

All of the studies included in this systematic review were single-centred studies, with generally low numbers of patients. This may have resulted in the studies being insufficiently powered to detect significant differences between groups, especially with regard to less common outcomes.

Discharge criteria were not comparable between studies. Not all studies applied well defined discharge criteria, which is of major importance with hospital stay as one of the outcome parameters, and may have resulted in invalid comparisons.

Many important features of a well-designed RCT were often not reported in the included studies (Table 4), such as the method of patient randomisation (Anderson et al 2003; Gralla et al 2007), allocation concealment (Anderson et al 2003; Gralla et al 2007; Meuhling et al 2008a; Recart et al 2005), power calculations (Meuhling et al 2008; Gralla et al 2007; Meuhling et al 2008a), and consecutive patient allocation (Meuhling et al 2008a; Khoo et al 2007; Gralla et al 2007; Meuhling et al 2008a; Petersen et al 2006; Recart et al 2005; Delaney et al 2003). Intention-to-treat analyses were not reported in

nearly half of the studies. Results of two studies that reported using an intention-to-treat analyses revealed that that they had not been used (Khoo et al 2007; Larsen et al 2008). These flaws or omissions may have added bias to the study results or have effected the validity of the study outcomes.

Blinding of medical staff and patients in the included studies was generally not possible owing to the nature of optimisation of perioperative care. However, many studies did aim to reduce bias. These methods included: the use of a single surgeon to operate on patients (Anderson et al 2003) or the use of a single researcher to assess patient outcomes (Gatt et al 2005); the use of two independent individuals to collect data (Anderson et al 2003; Kuzma 2008); blinding the surgeon who discharged patients to group allocation (Larsen et al 2008; Petersen et al 2006); blinding the person interviewing patients (Recart et al 2005); using questionnaires (Larsen et al 2008); using strictly defined endpoints (Gatt et al 2005); and keeping patient groups and healthcare staff separate (Larsen et al 2008).

Patient selection was not consistent between studies (see Table 3), although it appeared that relatively broad populations were included. There were no data from fast-track surgery specifically in high-risk patients requiring emergency operations, where it has been suggested that the multimodal approach could be very beneficial (Kehlet & Wilmore 2008).

Qualitative data component:

The aim of the qualitative data component of this review was to explore similarities or differences between surgeons' experiences and outcomes of fast-track programs to provide a more comprehensive report, and to explore the status of fast-track surgery in Australia and New Zealand. The small number of surgeons interviewed, however, may have resulted in findings that are not generalisable to the wider surgical community, depending on how many surgeons conduct fast-track surgery in Australia and New Zealand. In addition to this, interviewing as a qualitative data collection method can be influenced by researcher bias during the interview and reporting process.

Findings

Evidence from clinical trials as well as qualitative opinions of surgeons in the field suggest that fast-track programs can result in beneficial outcomes for patients. In particular, optimising conditions before, during and after surgery can reduce the length of hospital stay for patients with no increase in readmission rates. Of those studies that reported differences in complication rates between fast-track and conventionally treated patients, there appeared to be little difference between the two groups suggesting that fast-track protocols are as safe as conventional treatment regimes.

It has been suggested that reductions in length of stay after the start of fast-track program may relate to changes in organisation of care and not to a shorter recovery period (Maessen et al 2008), and that many of the beneficial outcomes attributed to fast-track protocols (such as faster return of gastrointestinal function and mobilisation) are

likely due to the positive goals set for patients before surgery. In this way, fast-track protocols use patients as a resource in planning and managing their own recovery and care. The impact of positive goal setting on hospital stay within fast-track programs warrants further investigation. Other factors, including societal expectations and the model of funding provided for surgical services may also influence the duration of postoperative stay (Kumar & Hewett 2007), and these may in some cases work independently of fast-track programs, and hence also deserve further investigation.

There appeared to be little difference in patient reported pain outcomes between optimised and conventionally treated patients, although patients in the optimised groups in two studies (Anderson et al 2003; Recart et al 2005) had less pain shortly after surgery. To determine whether this is a true and consistent finding, more studies are necessary. There were no equivocal differences in quality of life outcomes between optimised and conventional patients, but only two studies reported this outcome (Delaney et al 2003; Larsen et al 2008). One study reported a significantly improved outcome for optimised patients at three months, which was a longer follow-up than the second study. Future research could provide more informative data, especially if verified and standardised quality of life measures are used which would consider all components of patient well-being.

Evidence from both the international literature, and from the discussions with surgeons, indicates that there is no single defined protocol for fast-track surgery, for indications other than colonic surgery. The number of fast-track elements adopted by surgical units varies widely, and may relate to the experience of the surgical team. Some units have developed specific protocols for optimised surgery, while others have adopted individual elements in a piecemeal manner. A single consensus-based guideline has been published on colonic resection (Fearon et al 2005); however, it is unclear how well accepted this guideline has been within the colorectal surgery community.

Further work is required to define the key aspects of optimised surgery, together with the indications and possible patient groups who are most likely to benefit. It may be that specialist societies, hospitals, health care trusts, local or federal departments of health, could play a role in facilitating this work, to assist in standardisation and implementation of any protocols, and to reduce unnecessary duplication of effort.

A search of ongoing and unpublished trials (Table 15) demonstrates that more studies are currently underway that will investigate many of the issues discussed above. This suggests that fast-track is an area of increasing interest, and that more efficacy and safety data will continue to emerge.

Other considerations

From discussions with the surgeons it is clear that the implementation of a fast-track program is dependent primarily on surgeon enthusiasm and cooperation by support staff. A surgeon may be interested in implementing fast-track surgery as a comprehensive protocol; alternatively, the surgeon may adopt single elements of the protocol

independently, often driven by an interest or experience in that particular element.

For effective implementation of a fast-track program an entire surgical team must be actively involved, including surgeons, nurses, anaesthetists and physiotherapists (Wind et al 2006). Smaller surgical units with less transient staff may find adoption and implementation easier due to faster familiarity with the fast-track protocol and increased motivation. Although information from one surgeon suggested that it was difficult to implement a program in a relatively large unit, another surgeon did not appear to find the large size of his centre to be a problem. This may have been related to the fact that in the latter case a comprehensive protocol had been developed for local use. Therefore it seems that implementation of a fast-track program is centre-dependent, and may reflect surgeon and surgical team enthusiasm.

There is a belief that experience with the program is another important factor to success (Wind et al 2006). Many studies investigating fast-track surgery have small numbers of patients from single centres, and operations are conducted (and hence influenced) by a single surgeon, and the caseload that is seen in the institutions (Delaney et al 2003). Results from Delaney et al (2003) indicate that optimised patients treated by a surgeon experienced in the optimised program spend significantly less time in hospital than optimised patients treated by a surgeon less experienced in the program. There is an opinion that there is a considerable learning curve when implementing a fast-track program (Wind et al 2006). This was echoed by two surgeons who found that patients had better outcomes the longer their program had been running.

Although many of the individual elements of fast-track surgery and recovery programs are based on solid evidence derived from randomised trials or meta-analyses (Wind et al 2006), it has not been clearly established which combination of strategies provides the best patient outcomes in terms of postoperative hospital stay, quality of life, postoperative morbidity, readmission rate, overall costs and patient satisfaction (Wind et al 2006a; Fearon et al 2005). For some elements of fast-track programs there is solid evidence that implementation results in less morbidity or a faster recovery, yet for others there is less robust evidence. The implementation of some elements into an optimised program is therefore based on either common sense or on consensus interpretation of accumulating evidence (Fearon et al 2005).

Some authors state that the use of single method interventions in isolation may not lead to significant reduction in organ dysfunction and improved outcomes seen with fast-track surgery, but that it is the combined influence of individual strategies that lead to enhanced recovery (Khoo et al 2007; Zargar-Shoshtari & Hill 2008). This issue was corroborated by local surgeon opinion, and is also reflected in a single study that compared two modified versions of a fast-track program: one arm had a fast-track approach with laparoscopic surgery; the second arm had a fast-track approach with open surgery (Basse et al 2005). Although one might expect a less invasive approach to be a key element of any fast-track protocol, the results showed the outcomes of both arms to be similar.

Although input from a local surgeon suggested a significant cost saving per patient of a fast-track program, there is currently little published evidence examining this aspect of optimised surgery. It is anticipated that some local results may be published shortly. The concept of reducing the time patients spend in hospital after surgery is attractive because it may have beneficial effects through increasing the availability of hospital beds and reducing the overall cost of the hospital stay (Delaney et al 2003; Wind et al 2006). There is, however, a belief that early discharge may present the risk of transferring cost from the hospital to the post-discharge environment (Kumar & Hewett 2007). In addition to this, King et al (2006) state that enhanced recovery programs have been criticised for the risk of potentially serious complications such as anastomotic leakage occurring at home with a consequent delay in diagnosis. Studies with longer follow up periods are required to determine the significance, if any, of these criticisms.

7. Conclusion

This report aimed to use quantitative and qualitative data collection methods to explore the nature, safety and efficacy fast-track surgery programs. The systematic review component of the report found that fast-track programs can result in beneficial outcomes for patients. In particular, optimising conditions before, during and after surgery can reduce the length of hospital stay for patients with no increase in readmission rates. The published evidence covers a wide range of indications and outcome measures, together with a range of utilised fast-track measures. Surgeon opinion indicated that there is currently no consensus on a protocol for fast-track surgery for different indications, and that many surgical centres in Australia and New Zealand have adopted, or are in the process of adopting, some elements of optimised surgery. The implementation of an optimised program varies between surgical units, and depends on the enthusiastic participation of the whole surgical team.

Further research is required to define the essential elements of an optimised protocol; to establish the indications and patient populations that will most greatly benefit from optimised surgery; to define the actual improvements of optimised over conventional surgery; to determine whether there are long-term implications for patients; to determine whether there is any shift in the burden of health care beyond the hospital setting; and to determine the cost-effectiveness of implementing an optimised program (which should consider staff training costs). It may be that specialist societies, hospitals, health care trusts, local or federal departments of health, could play a role in facilitating this work, to assist in standardisation and implementation of any protocols, and to reduce unnecessary duplication of effort.

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Appendix 1

Main features of fast-track programs

Appendix 1. Summary of main features of optimisation programs* in the included studies

Study details	Main features of optimisation program			Measured outcomes
	Preoperative	Intraoperative	Postoperative	
Anderson et al 2003 Elective hemicolectomy Optimised n = 14 Control n = 11	• Preoperative visit • Pre- and pro- biotics • No bowel preparation • Oral carbohydrate loading	• 80% O_2. Analgesia via epidural • Traverse incision	• No nasogastric tubes or drains • Early nutrition • Epidural infusion • Catheter removal • Analgesia • Physiotherapy	• Hand grip strength • Forced expiratory volume • Time from surgery to walk to toilet • Time to normal gastrointestinal function
Gatt et al 2005 Elective colorectal resection Optimised n = 19 Control n = 20	• Preoperative visit • Pre- and pro- biotics • No bowel preparation • Oral carbohydrate loading	• 80% O_2 • Traverse incision	• No nasogastric tubes or drains • Early nutrition • Mobilisation plan	• Spirometry • Grip strength • POSSUM and POSSUM severity • ASA scores • Duration of catheterisation • Time to mobilisation • Fluid balance • Cognitive functioning, fatigue, pain • Time to tolerance of fluids and diet • Duration of intravenous fluids • Length of hospital stay • Morbidity • Mortality • Readmission rates • GP visits
Gralla et al 2007 Laparoscopic radical prostatectomy Optimised n = 25 Control n = 25	• Patients informed of treatment course and discharge policy • Single-shot antibiotic	• Intraabdominal pressure of 12 mmHg • Insufflated gas pre-heated to 37°C • Balanced anaesthesia • Prevention of postoperative nausea with Dexamethasone • Scrotal jockstrap • Tubes or drains only used if postoperative bleeding considered likely	• Pareccoxib for immediate pain relief • Opioid-free accelerated oral nutrition and mobilisation management with an adapted analgetic treatment with high dose COX-II inhibitors postoperatively.	• Duration of operation • Blood loss • Drainage • Transfusion • Nerve sparing • Morbidity • Mortality • Readmission • Time to discharge

Appendix 1. Summary of main features of optimisation programs* in the included studies *continued*

Study details	Main features of optimisation program			Measured outcomes
	Preoperative	Intraoperative	Postoperative	
Khoo et al 2007 Elective colorectal resection for cancer Optimised n = 35 Control n = 35	• No supplementary IV fluids until 3 hours before surgery, but encouraged to make up loss via oral hydration. • Received regular domperidone, magnesium hydroxide and liquid protein/calorie supplements from admission	• IV fluids restricted to 1500ml unless bleeding in excess of 500ml occurred. • Epidural infusion rate not adjusted unless there were features of narcotisation, • Epidurals discontinued 48 h postoperatively • Oral paracetamol and ibuprofen given in immediate postoperative period	• Allowed free oral fluids immediately after operation. • IV fluids disconnected when patient tolerated 200ml of water over 30 mins • Nasogastric tubes removed in recovery room • Diet allowed immediately after operation • Mobilisation encouraged from night of operation • Predefined mobility targets • Urinary catheters removed post op after 24 hours (colonic resection) or 72 hours (TME)	• Discharge criteria
Kuzma 2008 Open appendectomy Optimised n = 32 Control n = 25			• Oral feeding commenced 6 h after operation and gradually increased from fluids to solid diet as tolerated • Opioid-sparing analgesia	• Primary hospital stay • Morbidity • Bowel sounds • Passage of flatus or stool • Tolerance of solid diet • Facial pain score
Larsen et al 2008 Hip and knee replacement Optimised n = 45 Control n = 42	• Preoperative information day • Patients used own clothes for entire stay. • Preset daily goals established for information, pain relief, nausea control, nutrition, mobilisation and elimination.	• Special care rehabilitation unit formed		• Length of stay • Patient's gain in health related quality of life at 3 month follow up • Side effects • Mortality • Readmission • Complications
Muehling et al 2008 Lung surgery Optimised n = 30 Control n = 28	• Preoperative fasting limited to 2 h • Preoperative thoracic epidural catheter inserted • Ropivacaine	• Operating room temperature 24^{o}C, warm IV fluids air heater	• Ropivacaine and sufenanil in patient controlled manner accompanied by NSAIDS • Enteral feeding started on evening of the operation • Ambulation started on evening of the operation	• Length of stay • Temperature at end of operation • Postoperative ventilation • Pulmonary complications • Complications • FEV_1

Appendix 1. Summary of main features of optimisation programs* in the included studies *continued*

Study details	Main features of optimisation program			Measured outcomes
	Preoperative	Intraoperative	Postoperative	
Muehling et al 2008a Open infrarenal aortic aneurysm repair Optimised n = 37 Control n = 42	• Preoperative fasting limited to 2 h • No bowel washout performed • Preoperative thoracic epidural catheter inserted • Ropivacaine	• Gastric tube removed at end of operation • IV fluids restricted to 1000ml/24 h • Operating room temperature 22°C	• Ropivacaine and sufenanil in patient controlled manner accompanied by NSAIDS • Enteral feeding started on evening of the operation • Ambulation started on evening of the operation	• Morbidity • Mortality • Length of stay on ICU • Need for postoperative mechanical ventilation • Day of discharge
Petersen et al 2006 Total hip replacement Optimised n = 27 Control n = 30	• Standard goals for mobilisation and energy intake were described • Verbal and written supplementary information was standardised		• After surgery, transfer and walking techniques taught • Walking aids introduced and walking with sticks trained. • Mobilisation out of bed for 2 h on the day after surgery. • Scheduled time out of bed increased by 2 h a day, from 2 h on the first postoperative day to 12 h on the sixth postoperative day • Walking distance increased by 100 m a day from 100 m on the second postoperative day to 500 m on sixth postoperative day • Registration and calculation of daily fluid and energy intake • Supplementary energy intake: 200 cc of a protein-rich drink three times a day between the main meals	• Length of hospital stay • Complications 30 days after surgery • Readmissions 30 days after surgery • Pain • Mobilisation • Energy intake • Physical activities of daily living (PADL)
Recart et al 2005 Laparoscopic radical nephrectomy Optimised n = 13 Control n = 12	• Rofecoxib, sodium docusate, ranitidine orally 60 – 90 mins before surgery	• Bupivacaine injected at all port sites and irrigated in the renal fossa prior to surgical closure	• Sodium docusate and mobilisation was initiated 6 h postoperatively • Ondansetron, ketorolac and paracetamol at the end of surgery • Enteral nutrition started in the evening of surgery with a regular diet	• Pain and nausea • Need for rescue analgesics and antiemetics • Time from end of surgery to PACU discharge and discharge home • Patient satisfaction with postoperative pain management • quality of recovery • Side effects

Appendix 1. Summary of main features of optimisation programs* in the included studies *continued*

Study details	Main features of optimisation program			Measured outcomes
	Preoperative	Intraoperative	Postoperative	
Delaney et al 2003 Interstitial or rectal resection by laparotomy Optimised n = 31 Control n = 33	• Supporting information regarding expected postoperative milestones given	• (Epidural anaesthesia and analgesia not used)	• Orogastric tubes placed during anaesthesia removed before extubation • Patients encouraged to walk on evening of surgery • Offered liquids on evening of surgery • Analgesia supplemented with Ketorolac every 6 h as needed • POD 1: patients encouraged to walk 60 m up to 5 times, to sit out of bed between walks and regular incentive spirometry • Allowed non-carbonated drinks *ad libitum* and offered solid food without waiting for intestinal function • POD 2: oral analgesia started if liquids and diet tolerated. PCA discontinued.	• Pain scores • Quality of life • Complications

*Only the aspects unique to the optimisation arm are include in this table.

Appendix 2

Supplementary Information

Background

Following the completion of the report, three additional elements were addressed in order to increase its comprehensiveness. These elements are summarised in Table 16.

Table 16. Additional elements

Item	Issue to be addressed	Reference
Item 1	• Reporting of themes arising from discussions within each article.	Appendix 2.1
Item 2	• Summary of interventions (Appendix 1) by each component in Figure 1 or principles in table 5 or similar. • Definitions of each component/principle identified.	Appendix 2.2
Item 3	• Interview an additional clinician regarding fast-track surgery • Comments on the likelihood of adapting or correlating elements to the Victorian peri-operative environment	Below

Response to comments

Item 1 – Further reporting of themes within each included article

The discussion section of each included study was read and themes tabulated (Appendix 2.1). A great deal of the discussion sections were concerned with positioning the outcomes of the studies within the arena of fast-track surgery research, and hence did not report a great deal on implementation and workforce issues. Some studies, however, did report that motivation and coordination were important aspects of successful optimisation programs (Anderson et al 2003; Gatt et al 2005; Gralla et al 2007; Larsen et al 2008; Wind et al 2006). Little information was provided regarding the importance of protocols, and organisational change. In relation to bundling of services, the authors of some studies reported that the combination of multiple fast-track elements resulted in better patient outcomes than single interventions alone; however, this information was subjective in nature. Nearly all of the authors of the included studies reported that some form of further research was required into fast-track surgery. A common theme was that multi-centre studies with larger sample sizes are necessary.

Item 2 – Summary of interventions by each component

Appendix 2.2 provides an overview of the most commonly reported components of fast-track surgery within the included studies. The complexity of individual programs resulted in an inability to directly compare each component across studies. The most commonly reported components of the fast-track protocols within the included studies was allowing fluids up to two hours before surgery, early nutrition, early mobilisation and clearly defined discharge criteria. This is not dissimilar to the information gathered qualitatively during the semi-structured interviews with the four surgeons.

The differences between each study protocol, as well as the use of different fast-track components for various indications, prevented the ability to create standard definitions of each component or principle. Further research, utilising the experience of surgeons in specific specialty areas would be required to create such a document. The consensus

statement published by Fearon et al (2005) provides the most comprehensive description of each component currently available, although this is specifically for colonic surgery (see Table 14).

Item 3 – Interview with an additional clinician

The clinician had similar views in relation to the other interviewees in relation to the *ad hoc* manner in which fast-track surgery is conducted in Australia. Many people are too busy or do not have enough resource support to be able to implement a fast-track program successfully. He believes that there has to be good coordination and communication with all of the people involved in a fast-track program. He commented that most of the procedures within a program are not difficult to do, but that they have to be brought together as a bundle for best results. All of the interventions need to be utilised as a package, partially due to the fact that as yet research has not proven which specific elements, if any, of the program are most effective.

The interviewee is working to create a fast-track protocol for use within the Victorian health system. He is working towards conducting multi-centre pilot studies. The research will include a broad range of abdominal surgery, such as hernia repair, and other major resections. It is anticipated that a project officer and perioperative care coordinators will be employed for protocol development, communication, liaison, audit and data collection. He believes that the savings made in relation to reductions in hospital stay will cover the costs of these additional staff, which he believes are essential for the successful implementation of the program. He anticipates that the program will commence in July 2009, and that it will run over a 12 month period. The initial part of the project will involve the collection of baseline data across the health services, hospitals and surgeons. Protocol development and staff education will then take place, followed by implementation of the protocol. It is anticipated that the actual fast-track program would run for approximately four months.

In relation to epidurals, it was thought that they were not essential to the fast-track protocol. The most important aspect of analgesia is to reduce opioid use. He commented that in Melbourne, many anaesthetists use TAP blocks (abdominal wall block), and that they are as effective as epidurals without the side effects, and that these may be a simple option that could be incorporated into a fast-track protocol.

Cost effectiveness analysis on length of stay, ICU stay, and drug acquisition costs etc are planned as part of future research. This data is being collated for other studies that are currently being conducted.

Tools such as the World Health Organisation surgical safety checklist could be incorporated into a fast-track program, and that it would help people understand their responsibilities.

The likelihood of adapting or correlating elements to the Victorian peri-operative environment

Optimisation programs, from the available evidence, appear to confer some benefits to surgical outcomes, whilst causing no apparent detrimental effects to the patient. However, further research is needed to establish standard approaches and elements within such programs; to define standardised outcomes so that results across studies (including patient-related outcomes) can be more easily combined; and to provide Australian data for the local healthcare system.

It appears as if many surgical units in Australia are moving toward some element of a fast-track recovery program. There are a variety of approaches within the surgical community. Many surgeons are adopting fast-track principles in a piecemeal manner. This is often driven by specific preferences of members of the surgical team, which may or may not be based on available evidence. This approach may only include a small number of the possible elements of a comprehensive program, and may result in only a minimal overall clinical benefit. Conversely, some clinicians are actively pursuing a protocol-based approach, which is evidence-based and considers all the possible elements of a comprehensive optimisation program across all levels of surgical and anaesthetic departments. While this latter approach requires time and dedication from the senior unit heads for successful implementation, it's long-term success and acceptance by the surgical team is likely to be higher than in the first approach.

It may be that state departments of health may be able to play a role in co-ordinating the approaches to, and uptake of, optimisation programs across hospital sites. Departments could:

- Encourage the enthusiastic participation of all departmental heads represented in the surgical team
- Encourage the teaching and understanding of all the surgical team members so that any barriers to implementation are reduced
- Encourage an evidence-based approach, rather than an approach based on individual preferences
- Encourage a protocol-driven approach, in which time is taken to develop and implement a comprehensive protocol
- Encourage the open dissemination of pre-existing protocols across departmental, hospital and state health services to avoid unnecessary duplication of effort
- Encourage the standardisation of protocols, where possible, both within and across specialties
- Encourage the undertaking of high-quality randomised controlled trials to establish the true nature of clinical outcomes of fast-track programs compared with standard surgical approaches, with a focus on validated patient-related outcomes (such as appropriate quality of life outcomes). This would provide a

local evidence base.

- Encourage economic analyses which consider all costs involved in a fast-track recovery program (including implementation, staff training, infrastructure, additional clinician time, and patient costs which may be acquired in the home care setting)
- Encourage future research to establish the effects of individual elements within the fast-track recovery program

Appendix 2.1. Supplementary information from discussion sections of included studies

Study	Implementation	Workforce issues	Importance of protocols	Bundling of services	Organis-ational change	Other issues of interest	Further research
Anderson et al 2003	To achieve mobilisation, nutrition and discharge targets, a high level of motivation was required from patients and medical staff, all of whom needed to be fully informed of the expected perioperative course.	NR	NR	NR	NR		Further randomised trials are required.
Delaney et al 2003	NR	Authors believed that increasing experience of the physicians, residents, and nursing and paramedical staff with the optimised program would make it difficult to ever have a true 'traditional' care pathway as a comparison group.	No prospective, randomised study has defined a standardised postoperative care protocol evaluating patients undergoing major intestinal and rectal surgery. Before beginning study, a controlled rehabilitation with early ambulation and diet (optimised program) was implemented in hospital.	NR	NR	This study also conducted analyses of people under and over 70 yrs. Patients < 70 received greatest benefits from program. Potential cost savings discussed	NR
Gatt et al 2005	High levels of motivation are necessary to achieve some optimisation targets, and to achieve theses, staff and patients must be fully informed of what is expected of them.	NR	NR	Authors believe that all of the 10 points in the optimisation package have a direct or indirect effect on gut function, which authors believe is fundamental to success of multimodal optimisation	NR	Authors believe that earlier return of gut function is important to the success of multimodal programs	An improved understanding of the phenomenon on intestinal failure and the effects of directed therapies may lead to further improvements in perioperative care.
Gralla et al 2007	Effective and best possible post-surgical mobilisation can only be accomplished with a completely instructed nursing and physiotherapeutic staff.	NR	NR	NR	NR	Combining fast-track principles with laparoscopic surgery should give further improved outcomes	Further studies with larger numbers of patients, a longer follow up, and subjective outcome measures, such as quality of life, need to be conducted to comprehensively explore the costs and benefits of fast-track concepts in urological surgery.

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Appendix 2.1. Supplementary information from discussion sections of included studies *continued*

Study	Implementation	Workforce issues	Importance of protocols	Bundling of services	Organis-ational change	Other issues of interest	Further research
Khoo et al 2007	NR	NR	The occasional protocol violations, which are difficult to guard against in a complex multipronged trial, do not appear to be detrimental to outcome.	There appears to be synergism between modalities. Individually the intervention modalities appear to improve outcome, but the degree of improvement is not usually marked. In combination however, the improvements to the rate of recovery appear to be strong and very robust. In addition, no one intervention appears to be critical to the process.	NR		Authors believe that the use of more physiologically friendly fluids (as opposed to 0.9% saline which as potential metabolic and haemodynamic adverse effects) needs further investigation. Studies investigating differences between laparoscopic and open surgery should include robust control of perioperative and postoperative management to ensure that altered surgical and patient expectations do not influence management.
Kuzma 2008	NR	NR	NR	NR	NR		The fast track program made the assessment of the correlation between single elements of the program and the length of postoperative ileus impossible. Therefore, further studies powered to investigate those relations would be needed. More females than males had appendicitis in this study (and in PNG in general). This is contrary to epidemiological studies on appendicitis in other populations and it would be interesting to investigate this further.
Larsen et al 2008	Authors believe that the results seen with length of stay and quality of life were achieved mainly because of the new nurse-led organisation, with an information day and early and aggressive mobilisation.	NR	NR	NR	NR	Some groups of patients may be less likely to want to be fast-tracked (eg older females needing knee replacements)	Authors recommend focusing as much on adverse effects, such as perioperative infections, implant dislocation, and any readmissions, as on length of hospital stay when implementing accelerated programs.

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Appendix 2.1. Supplementary information from discussion sections of included studies *continued*

Study	Implementation	Workforce issues	Importance of protocols	Bundling of services	Organis-ational change	Other issues of interest	Further research
Muehling et al 2008	NR	NR	NR	NR	NR		Due to the relatively small number of patients in this study, further multicentric studies with more patients are warranted to confirm the encouraging results in this pilot study.
Muehling et al 2008a	NR	NR	NR	Single interventions do not seem to be able to improve patients' outcomes after major vascular surgery. No fast-track protocol exists for infrarenal aneurysm repair.	NR		The encouraging results of this study should be confirmed by further multicentric studies.
Petersen et al 2006	NR	NR	NR	NR	NR	Differences between per-protocol analysis results and intention-to-treat-analysis results	A solid evidence base would make the case for provision of the necessary conditions for fast-track surgery more powerful.
Recart et al 2005	NR	NR	NR	NR	NR		NR
Wind et al 2006 (systematic review)	A fast-track program requires a dedicated and motivated team consisting of anaesthetist, surgeon, dietician, physiotherapist, social worker and nursing team. Experience with the program is another important factor to success.	NR	NR	The relative contribution of each of the single elements in the optimised programs remains uncertain.	Slow uptake partly explained by need to break long standing traditions.		Studies on fast-track surgery are scarce, and further research is warranted. To distinguish the critical elements in a fast-track program, further studies that assess the protocol compliance to each element are needed. Multicentre prospective randomised trials are needed to confirm the broader applicability and favourable results of fast-track programs in colonic surgery.

Appendix 2.2. Supplementary information: summary of most commonly reported components of fast-track surgery within included studies

Study	Patient information / counselling	No bowel preparation	Feeding or fluids up to 2h before surgery	Avoidance of opioids	Prevention of hypothermia	High O_2 concentrations	Prophylactic antibiotics	Epidural anaesthesia	No nasogastric tubes	No drains	Early nutrition	Early mobilisation	Clear discharge criteria
Anderson et al 2003	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓
Delaney et al 2003	✓		✓					×	✓		✓	✓	✓
Gatt et al 2005	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	×
Khoo et al 2007		×	✓					✓	×		✓	✓	✓
Gralla et al 2007	✓	×		✓	✓		✓	×	✓	✓	✓	✓	✓
Kuzma 2008				✓				×	✓	✓	✓	✓	✓
Larsen et al 2008	✓		✓									✓	✓
Muehling et al 2008			✓	✓	✓			✓			✓	✓	×
Muehling et al 2008a		✓	✓	✓	✓			✓			✓	✓	×
Petersen et al 2006	✓			×				✓			✓	✓	✓
Recart et al 2005		×		×	✓			×			✓	✓	✓

✓ Reported as implemented in fast-track program
× Reported as not implemented in fast-track program