



Centre for
Perioperative Care

Impact of perioperative care on healthcare resource use

Rapid research review

June 2020

Foreword

This report provides evidence to justify the case for perioperative care, the integrated multidisciplinary care of patients from the moment surgery is contemplated through to full recovery.

In recent decades, many different facets of perioperative care have been developed and implemented across countries and healthcare organisations. This local evolution of practice does not lend itself to transformational change or large-scale data collection about impacts. Despite this, there is much research about the value of perioperative care. We have brought together, perhaps for the first time on this scale, a wide range of research about the effectiveness of perioperative care. We considered over 27,000 studies in preparing this review.

The results show that perioperative care is associated with high quality clinical outcomes, reduced financial cost and better patient satisfaction. This triad is the holy grail of healthcare.

A perioperative approach can increase how prepared and empowered people feel before and after surgery. This can reduce complications and the amount of time that people stay in hospital after surgery, meaning that people feel better sooner and are able to resume their day-to-day life.

Our review highlights the effectiveness of clear perioperative pathways, with an average two-day reduction in hospital stay across multiple types of surgery. Different interventions, including prehabilitation, exercise and smoking cessation can significantly reduce complications by 30% to 80%. This scale of benefits is far greater than many new drugs or treatments launched.

COVID-19 has underscored the need to develop COVID-19-light pathways for surgery, to reduce the number of inpatient beds required and to minimise risks to patients. Never has there been such an opportunity to deliver the triple value aim of healthcare, nor the opportunity to institute large-scale transformational change at pace.

Perioperative care can be at the heart of the Secretary of State for Health and Social Care's commitment to '[build back better](#)', and the [NHS People Plan 2020/21](#) commitment "to transform the way our teams, organisations and systems work together, and how care is delivered for patients."

This is a call to action to further implement and embed perioperative care rapidly. There is also a need for improved funding of medical research, to focus on other aspects of perioperative care where the evidence remains lacking or unclear.

Please do let us know what you think about the findings by emailing advocacy@rcoa.ac.uk or tweeting us @CPOC_News.



Dr David Selwyn
Director of the Centre for Perioperative Care

Key messages

Perioperative care

Around 10 million people have surgery with the NHS in the UK each year. The Centre for Perioperative Care wants to ensure that care before, during and after surgery is organised to provide the best outcomes for these people and for health systems. Perioperative care involves providing multidisciplinary person-centred care from the moment surgery is contemplated through to full recovery.

It has been proposed that perioperative care has the potential to strengthen Integrated Care Systems, support the NHS's population health agenda and embed changes to ways of working begun in response to COVID-19. We wanted to understand the underpinning evidence about perioperative care, particularly any impact on healthcare resource use.

We drew together learning from 348 systematic reviews and additional studies, about 10% of which were from the UK. To identify relevant research, we searched 14 bibliographic databases, reviewed more than 27,000 articles and summarised the highest quality studies about the impact of perioperative care pathways and their key components. Our focus was on care processes before and after elective surgery rather than the use of specific surgical techniques, medications or emergency surgery.

Benefits for people having surgery

Perioperative care pathways include components such as shared-decision making; preoperative assessment; help to get ready for surgery through exercise, nutrition, and smoking cessation; discharge planning; multidisciplinary working and follow-up after surgery. There is evidence from the UK and internationally that perioperative care pathways and their components can help to:

- increase how **prepared** people feel for surgery
- increase how empowered, active and **involved** people are in their care
- increase **communication** between people having surgery and healthcare teams
- increase people's **satisfaction** with their care
- **reduce complications** after surgery, meaning that people may feel well sooner and be able to resume their day to day life and employment more quickly

Benefits for health services and systems

There is also evidence from the UK and internationally that perioperative care pathways and their components can help to:

- reduce the amount of time that people **stay in hospital** after surgery
- reduce the **use of intensive care** units after surgery
- reduce complication rates after surgery, meaning **fewer resources** are spent on this
- **reduce the cost of care** or cost the same as conventional care

In general, perioperative care pathways and their components have been found to be **safe and effective** to implement, reducing people's stay in hospital by an average of 1-2 days without extra complications, unplanned readmissions or extra burden on primary care or social services. Both adults and children and those having surgery of many different types can gain benefits.

However, not all studies have found the same impact. The size of improvements depends on the initiatives tested and the surgical speciality and complexity. Whilst the overall trends are positive, the quality and quantity of evidence is varied. The table below shows that some perioperative initiatives have good quality evidence backing up beneficial effects (shown as green) whereas others have positive trends but may need more definitive research to be sure (shown as amber).

Perioperative care components	Effect on cancellations	Effect on complications	Effect on length of stay	Effect on healthcare costs	Effect on readmissions	Effect on survival	Effect on patient satisfaction
Integrated care pathways	Amber	Amber	Green	Green	Amber	Amber	Amber
Shared decision-making	Amber	Amber	Amber	Amber	Amber	Amber	Amber
Structured risk assessment	Amber	Amber	Amber	Amber	Amber	Amber	Amber
Prehabilitation	Amber	Amber	Amber	Amber	Amber	Amber	Amber
Managing long term conditions	Amber	Amber	Amber	Amber	Amber	Amber	Amber
Discharge planning	-	-	Amber	Amber	Amber	Amber	Amber
Follow-up after discharge	-	-	-	Amber	Amber	Amber	Amber

Green = Large amount of good quality evidence available to suggest a positive impact, Amber = Some evidence of positive impact but more quality or quantity needed to be definitive, Red = Available evidence suggests little or no positive impact or very mixed findings, Grey = Not enough evidence to draw conclusions

Effective components

The term 'perioperative care' includes many things. It is a philosophy of person-centred care, multidisciplinary working and wellness and prevention. It is also associated with pathways of care throughout the surgical journey. Research found that the components of perioperative pathways most likely to improve healthcare resource use were multidisciplinary working; communication across primary, secondary and community care; clear pathways; shared decision-making; prehabilitation and rehabilitation; discharge planning; clear discharge information and proactive follow-up after discharge.

Our rapid review suggests that there is significant evidence about the potential benefits of perioperative care, but much remains to be learnt. There are positive UK examples, but much of the most robust research is drawn from outside the UK. It remains uncertain which components of care pathways would be most effective, acceptable and easy to implement within current NHS structures and priorities.

Perioperative care is worth exploring further in the UK. It has the potential to improve the effectiveness and efficiency of care, the satisfaction of people having surgery and their families and to strengthen the integration and multidisciplinary ways of working now being embedded in the NHS.

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The Centre for Perioperative Care (CPOC) is a cross-specialty centre dedicated to the promotion, advancement and development of perioperative care for the benefit of both patients and the healthcare community. We are led by the Royal College of Anaesthetists and work in partnership with patients and the public, the Royal Colleges of Child and Paediatric Health, Physicians, Surgeons, General Practitioners, and Nursing, the Association of Anaesthetists and health and social care practitioners and organisations across the UK.

This rapid review was undertaken for us by an independent organisation, The Evidence Centre. The review describes published research and does not necessarily reflect our views or those of The Evidence Centre.

Perioperative care

The importance of perioperative care

Setting the scene

Surgery is a treatment option for around one third of the global burden of disease. It is estimated that with an aging population and increased incidence of some conditions, surgery worldwide will double in the next 15 years.¹

Around 10 million people currently have surgery in the UK each year, and about one third of all admissions to hospital are related to surgical procedures.² The NHS spends more than £16 billion each year on elective surgery. For most, surgery is a success, but it is estimated that around one in five people experience complications after surgery.³

There is an increasing need for well-coordinated care around the time of surgery, including deciding whether surgery is appropriate. In the UK, the number of people having surgery is growing and so too is the complexity of operations. The population is aging and many have long-term medical conditions or health behaviours that may increase the risk of complications from surgery. Over 250,000 people at higher risk have surgery each year in the UK and this number is set to rise.⁴

What is perioperative care?

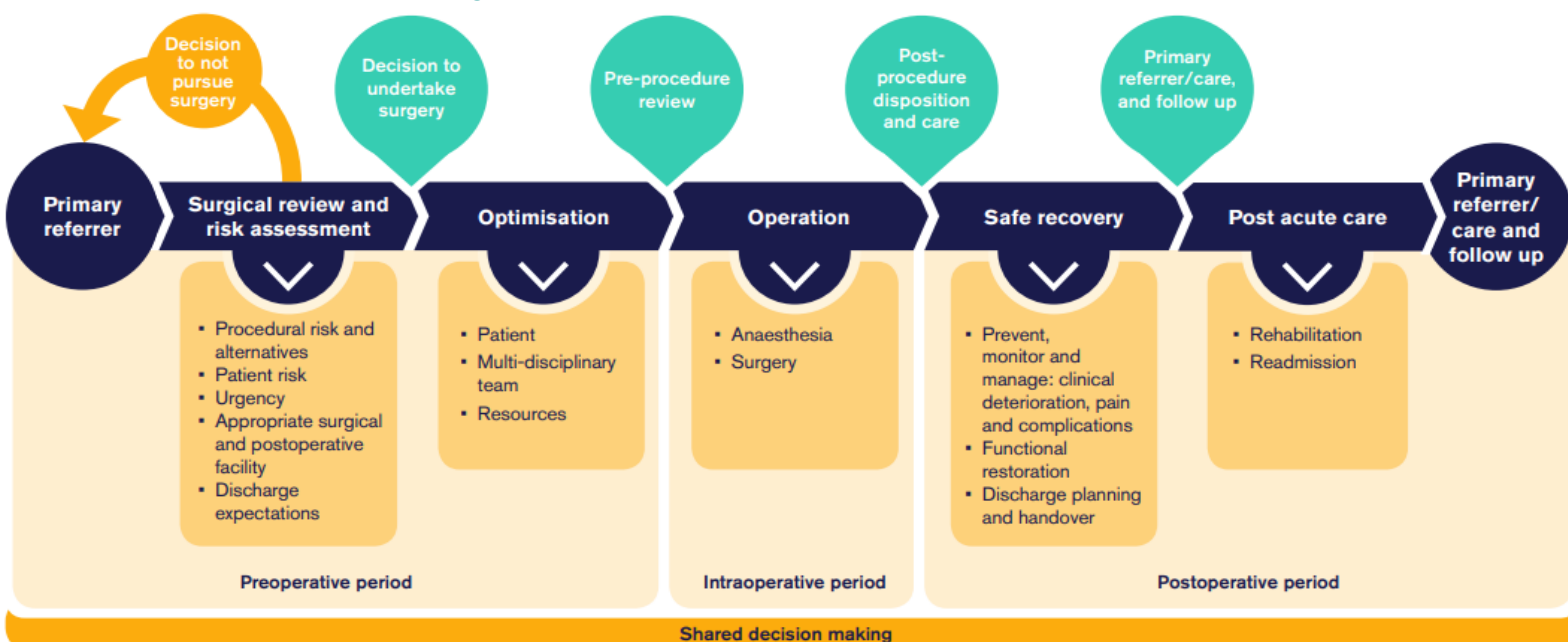
Perioperative care aims to ensure that people have the best integrated multidisciplinary and patient-centred care possible from the moment surgery is contemplated through to full recovery.

It seeks to help people, including the most vulnerable, get the best outcomes possible, increase patient satisfaction, reduce complication rates and provide effective and sustainable surgery.

Perioperative care has many components across the whole surgical pathway, including multidisciplinary teams working together, shared decisions with patients, supporting people to prepare for surgery, examining factors that might increase the risk of complications, using safe and effective processes during surgery and helping people to recover after their operation (see Figure 1).

This rapid review examines the impact of perioperative care pathways and their components on healthcare complications and resource use.

Figure 1: Example of the perioperative care pathway⁵



Helping to shape onward discussions

The Centre for Perioperative Care is a cross-specialty centre dedicated to the promotion, advancement and development of perioperative care for the benefit of patients and the healthcare community. We believe that collaborative perioperative care is the route to effective and sustainable surgery and that working in a patient-centred manner across the whole pathway is essential for the UK's developing Integrated Care Systems and Partnerships.

Perioperative care is not a new concept. There are many elements of perioperative care across the NHS and there are opportunities to expand this further, especially in the context of Integrated Care Systems, population health approaches and new ways of working introduced to address COVID-19.

There is renewed focus on prevention and integrated care as part of the NHS Long-Term Plan for England,⁶ Delivering Together in Northern Ireland,⁷ Realistic Medicine in Scotland,⁸ and Prudent Healthcare in Wales.⁹ Perioperative care can play a key role, offering an opportunity to improve surgical care pathways so that healthcare professionals are even better supported to work collaboratively with partners across primary, secondary and community care and can harness ways to enhance people's health.

Various research has explored the value of perioperative care, but as perioperative care has many components this research is spread across many publications.

We wanted to bring robust research together in one place to help us understand the potential healthcare resource impacts of perioperative care. We hope this will help policy makers, healthcare managers and health and care practitioners in the UK consider next steps with expanding person-centred perioperative care.

Our review approach

Review question

We undertook a rapid review to examine the question:

What impact do perioperative interventions before and after elective surgery have on surgical complications and healthcare resource use?

Perioperative components of interest

Perioperative care has many different components, so to keep the review manageable we focused on initiatives before and after surgery, rather than medications and techniques during surgery.

Interventions that we were particularly interested in were:

- **pathways** to improve components of care before and after surgery
- those which considered which **treatment route** to take, including shared decision-making about the suitability of surgery and assessments of the risk of surgery based on people's characteristics and behaviours
- initiatives to **prepare people for surgery** focusing on behaviour change or managing long-term conditions
- care **after surgery**, including discharge planning and follow-up support

Some of these initiatives may not be multidisciplinary or may not be explicitly labelled as 'perioperative care'. We did not focus on the outcomes of different types of multidisciplinary teams or team members in this review because we have undertaken a separate rapid review about teams to support perioperative care.

Studies types eligible for inclusion

Many thousands of studies have been published about perioperative care pathways and their components. To identify the most relevant and up to date research we focused on studies published between January 2000 and June 2020.

We prioritised published systematic reviews (that draw together all relevant research about a topic) and additional randomised controlled trials and cost-effectiveness analyses about perioperative care for elective surgery. Where these types of studies were not plentiful about a particular service or intervention, we included other comparative studies such as non-randomised trials and before-and-after studies that monitored changes over time. We did not include narrative descriptions of initiatives or articles that did not contain empirical research data.

Geographic focus

Our focus was on research from the UK and Europe, North America and Australasia.

The health systems of different countries vary widely, making it difficult to extrapolate the implications for the UK. We wanted to draw on international experience as well as UK studies because there is not a great deal of UK research. However, we did not want to include research from countries with significantly different population profiles or economic resources to the UK. The countries we focused on organise their healthcare systems and payment approaches in different ways to the UK, but we wanted to learn about the potential benefits in a range of contexts.

Systematic reviews from anywhere in the world were eligible for inclusion in our review because systematic reviews typically combine studies from several countries, including the UK and Europe.

Impacts of interest

We focused on studies that looked at the impact of any component of perioperative care before or after elective surgery on:

- cancelled surgery or appointments
- postoperative complications
- length of stay in hospital
- unplanned readmissions after surgery
- survival

Where reported, we also looked at data about patient satisfaction from studies that included a healthcare resource use outcome.

There are many other potential impacts of perioperative care, but our rapid review focused on healthcare resource use.

Identifying and summarising research

We worked with an independent team who searched 14 bibliographic databases to identify relevant research.¹ We screened 27,282 potential articles and identified 348 studies that met our inclusion criteria.

We did not prioritise individual studies for inclusion if they were already included in a systematic review that we were summarising.

We compiled themes in the findings narratively, including illustrations of quantitative findings.² We prioritised systematic reviews and UK studies to provide examples of the key themes. The interventions, methods and types of surgery were too diverse to compile findings numerically in a meaningful way. Researchers have already undertaken meta-analyses about some initiatives and these are included in this rapid review.

Although we searched extensively for research, we did not seek to include and quality assess every relevant study ever published.

1 The databases were CABI (multiple databases) Cochrane Library, CHBD, Dimensions, EBSCO (multiple databases), Embase, Google Scholar, Ingenta Connect, Jurn, Medline, Mendeley, Scopus, UpToDate, Web of Knowledge (multiple databases).

2 We rounded figures from published studies to the nearest decimal place. A p-value ≤ 0.05 was used to indicate strong evidence against the hypothesis that there was no difference between perioperative care and the comparator. In other words, $p < 0.05$ indicates the intervention likely made a significant difference.

Integrated care pathways

Overview

What are integrated pathways?

Some perioperative care initiatives span the pathway before, during and after surgery. In this section we summarise evidence about these 'pathway' approaches. In the following sections we explore the research about elements of these pathways in more detail.

Perioperative care pathways are not a single uniform intervention. The components of the pathway may vary, although they focus on similar elements to help people decide whether surgery is the right option for them, prepare for surgery and recover from surgery.

Examples of elements of perioperative care pathways include preoperative counselling, nutritional screening, smoking cessation, prehabilitation, avoidance of fasting for extended periods before surgery, increasing carbohydrates prior to surgery, avoiding preoperative sedatives, taking medications in advance to help avoid complications, short-acting or regional anaesthetics, nausea and vomiting control, fluid management, minimally invasive surgery, early removal of drains, avoidance of urinary catheters and early mobilisation after surgery.^{10,11}

An example is the Enhanced Recovery Programme launched by the Department of Health in England in 2009. This approach promotes a bundle of evidence-based 'best practices' for elective surgery delivered by a multidisciplinary healthcare team. The pathway includes numerous components focused around five key areas:

- **shared decision-making** with patients
- **assessment** before surgery
- increasing **fitness** to manage risk
- anaesthesia and **pain management**
- preparation for **hospital discharge**

Enhanced recovery pathways have also been implemented in many other parts of the world. They have been called perioperative pathways, enhanced recovery after surgery (ERAS) programmes, fast track surgery and perioperative surgical home models.¹² In this review we use the term perioperative pathways.

Key findings about care pathways

Our rapid review identified 152 systematic reviews and additional individual studies about the impact of perioperative pathways on healthcare resource use.

Across many types of surgery, compared to conventional care, perioperative pathways have been found to:

- reduce the number of days people **stay in hospital**^{13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43}
- reduce healthcare **costs**^{44,45,46,47,48,49,50,51,52,53,54,55,56}
- increase **efficiency**, such as increasing the number of people operated on within 24 hours of admission, reducing cancelled operations and reducing time spent in theatre^{57,58,59}
- reduce admissions to intensive care units^{60,61,62,63}
- potentially reduce nursing **workload** in some instances⁶⁴

There were variations in the extent of reductions in length of stay across studies and surgery types, but in general it appeared that **perioperative pathways reduced hospital stays by an average of about 2 days (range: 1 to 8-day average reduction)**.

Most research focused on surgery in adults, but some studies also found reduced postoperative length of stay after surgery in children.^{65,66}

Studies about healthcare resource use have also investigated other outcomes, finding that perioperative pathways can improve the quality of care and health outcomes for people having surgery. This includes:

- improving pain, fatigue and early **recovery**^{67,68,69,70,71,72,73,74,75,76,77,78}
- improving overall **survival**^{79,80,81}
- improving patient **satisfaction** and reducing anxiety⁸²
- improving surgical documentation and the use of **evidence-based care**^{83,84,85,86}

We found that perioperative pathways had variable impacts on the proportion of people who had complications after surgery and the proportion that needed to be readmitted to hospital after being discharged. Some studies found that perioperative pathways reduced complications and / or unplanned readmissions.^{87,88,89,90,91,92,93,94,95,96,97,98,99,100,101}

Others found no difference compared with conventional care, but also no negative effects.^{102,103,104,105,106,107,108,109,110,111,112,113} A small number of studies suggested that perioperative pathways may increase readmission rates for some people.^{114,115}

The overall trend was for research to suggest that perioperative pathways may reduce the time that people are in hospital and associated healthcare costs without increasing complication rates.

Many of the studies upon which the evidence is based are not of the highest quality. They may compare outcomes before and after a pathway was introduced in a single centre rather than randomly assigning people to pathway versus non-pathway care. The exact initiatives included in each pathway may also vary. However, the evidence is strengthened because of the consistency of findings across countries and different types of surgery. Many systematic reviews have drawn together all the highest quality evidence about perioperative pathways in specific surgical specialities. These reviews consistently suggest that perioperative pathways reduce the length of stay in hospital after surgery.

Length of stay

Findings from systematic reviews

Many systematic reviews have compiled research from around the world about the impacts of perioperative pathways. We present some examples here to give a flavour of the findings and show how they apply to different surgical specialities.

A robust recent systematic review quantitatively combined 18 randomised trials about perioperative pathways for elective **gastric cancer surgery**. Pathways were associated with:

- a reduced length of stay (average reduction 1.8 days, 95% confidence interval³ (CI) 1.4 to 2.2 day reduction, $p < 0.05$)
- lower hospital costs (average US\$650 less, 95% CI \$460 to \$840 less, $p < 0.05$, 2019 prices)
- and lower rates of pulmonary infections (risk ratio 0.5, 95% CI 0.3 to 0.8, $p < 0.05$)

There was no change in postoperative complications but pathways were associated with two times more unplanned hospital readmissions compared to conventional care (risk ratio 2.4, 95% CI 1.1 to 5.4, $p < 0.05$). The quality of evidence was low to moderate for all outcomes. The reviewers concluded that perioperative pathways may reduce the length of stay, costs and time to return of function after gastric cancer surgery compared to conventional care, but may increase the number of postoperative readmissions.¹¹⁶

Another systematic review of randomised trials about **abdominal or pelvic surgery** found that perioperative pathways reduced hospital stay (standard mean reduction 0.8 days, 95% CI 0.7 to 0.9, $p < 0.05$), postoperative lung infection (risk ratio 0.4, 95% CI 0.2 to 0.6, $p < 0.05$), urinary tract infection (risk ratio 0.4, 95% CI 0.2 to 0.8, $p < 0.05$) and surgical site infection (risk ratio 0.8, 95% CI 0.6 to 0.98, $p < 0.05$).¹¹⁷

A systematic review of 30 observational studies found that the duration of postoperative stay in hospital reduced after **gastrointestinal surgery** (mean reduction 2 days, 95% CI 2 to 3 days, $p < 0.05$). There was no change in overall postoperative morbidity (odds ratio 0.84, 95% CI 0.64 to 1.09, $p > 0.05$) or mortality, but these were improved when laparoscopic surgery was used. Perioperative pathways reduced the overall cost of surgery (mean difference per person US\$982, 95% CI \$597 to \$1368, 2018 prices).¹¹⁸

A systematic review with 16 observational studies in **gynaecological surgery** found that perioperative pathways were associated with an average 3-day reduction in the length of hospital stay compared to conventional care, without increasing complications, mortality or readmission rates.¹¹⁹

Another systematic review combined 27 comparative studies about **bladder surgery** (radical cystectomy). Perioperative pathways enabled a faster recovery of bowel function, faster return to regular diet and a shorter hospital stay with no increase in major complications or readmission rates compared to conventional care.¹²⁰

3 A confidence interval is the range of values we are fairly sure the true value from the population lies within. Throughout this review we report 95% confidence intervals, meaning that we have a high level of statistical confidence that the true value lies between the range presented.

For the purposes of our review risk ratios and odds ratios provide a sense of how likely an outcome is with perioperative care versus conventional care. The odds ratio is a ratio of two odds whereas the risk ratio or relative risk is a ratio of two probabilities. A ratio of 1 means that there is no difference in the odds / probability between groups. A ratio of more than 1 means that there is higher odds or risk of something happening and a ratio lower than 1 means there is lower odds or risk of that outcome.

In people having **liver surgery**, a systematic review of five trials found that compared to conventional care, perioperative pathways reduced hospital length of stay (weighted mean reduction 2.8 days, 95% CI 1.7 to 3.9 day reduction, $p < 0.05$), overall complications (risk ratio 0.7; 95% CI 0.5 to 0.9, $p < 0.05$), and grade I complications (risk ratio 0.5, 95% CI 0.3 to 0.8, $p < 0.05$).¹²¹

Another systematic review of 20 case-control studies found that perioperative pathways reduced average hospital stay after **pancreatic surgery** by about four days (95% CI 3 to 6 days, $p < 0.05$). There was also a reduction in postoperative complications (odds ratio 0.6, 95% CI 0.5 to 0.7, $p < 0.05$), particularly mild complications (Clavien-Dindo I-II odds ratio 0.7, 95% CI 0.6 to 0.9, $p < 0.05$). There was no difference in readmission rates, reoperations or mortality.¹²²

In people having **colorectal surgery**, a systematic review with 16 randomised trials found that perioperative pathways reduced length of hospital stay (weighted mean reduction 2.3 days, 95% CI 1.5 to 3 days) and overall morbidity (relative risk 0.6, 95% CI 0.5 to 0.8, $p < 0.05$) without increasing readmission rates.¹²³

A systematic review of 11 studies of the **perioperative surgical home model** included an emphasis on preoperative education, standardisation of care protocols, use of opioid-sparing multimodal analgesia and multidisciplinary staffing. This model was often associated with decreased length of stay and decreased intensive care unit use. The model was not usually associated with changes in readmission rates. Findings about cost reductions were mixed, but it did not cost more than conventional care to implement this model.¹²⁴

Another systematic review of 16 studies found that compared to traditional management, perioperative pathways for **older people** decreased the rate of complications and this reduced the duration of hospital stay. The reviewers concluded that perioperative pathways were feasible for the elderly, though postoperative morbidity remained higher than in younger patients.¹²⁵

Examples from the UK

There are also specific examples from the UK.^{126,127} A number are briefly described here for illustration.

A systematic review of studies about perioperative pathways in the UK identified 17 systematic reviews and 12 additional randomised controlled trials about effectiveness. Most studies focused on **colorectal surgery**. The reviewers concluded that perioperative pathways may reduce hospital stays by 0.5 to 3.5 days compared to conventional care for people undergoing colorectal surgery. This did not lead to greater readmission rates. There were more varied results and limited evidence for other surgical specialities.^{128,129}

Many of the UK studies compare outcomes before and after implementing perioperative pathways. For example, a pathway with patient education, daily management goals, daily facilitated meetings and a day-of-surgery admission policy for **hip and knee replacements** reduced length of stay by about 1 day compared to conventional care. Elderly people and men had the greatest reductions in length of stay.¹³⁰

A similar UK study of a perioperative pathway for people having **knee replacements** found that average length of stay reduced by 2 days, as did the rate of reoperation within 60 days (2.2% vs 5.0%, $p < 0.05$). There were no differences from conventional care in 60-day complication rates or 30-day readmission rates. Patient quality of life and functional status was better at six months compared to usual care.¹³¹

Elsewhere in the UK, a hospital implemented a perioperative pathway to reduce pulmonary complications following **major elective surgery**. The rate of pulmonary complications in those admitted to critical care was 19% before the pathway and 9% one year after the pathway was implemented ($p < 0.05$). Median length of hospital stay reduced from 12 to 9 days ($p < 0.05$).¹³²

Not all UK research has found benefits. A before-and-after study found that people with **hip fractures** suffered fewer postoperative complications when a perioperative pathway was used, but there was no significant difference in length of hospital stay.¹³³

A before-and-after study in people with chronic **subdural haematomas** in England introduced an integrated care pathway, with most initiatives focused on preoperative optimisation. This increased the number of patients undergoing surgery within 24 hours of admission (43% vs 75%, $p < 0.05$) but did not reduce the length of hospital stay.¹³⁴

International examples

Many international studies have found reduced length of stay associated with perioperative pathways.¹³⁵ A number are briefly described here for illustration.

In the US a before-and-after analysis of a perioperative pathway for **colorectal surgery** found a reduction in postoperative surgical site infection (7% vs 17%, $p < 0.05$) and hospital length of stay (5 vs 7 days, $p < 0.05$) without any significant change in readmission rates (18% vs 19%, $p > 0.05$).¹³⁶

Another US study of a pathway for people undergoing elective open and minimally invasive **colon and rectal surgery** found that average length of stay reduced from 5 to 3 days, but the 30-day readmission rate was higher in the pathway group (15% vs 9%, $p < 0.05$).¹³⁷

Elsewhere in the US, a perioperative pathway for urogynaecology increased the proportion of same day discharges and patient satisfaction, but was associated with slightly increased hospital readmissions within 30 days.¹³⁸

Not all studies have found reduced length of stay.¹³⁹ For instance, in Canada a perioperative pathway was implemented across an entire health system. This 'real world' study is interesting because it did not exclude people with diabetes or those over the age of 80 years, who may not routinely be included in randomised trials. In people undergoing **colorectal surgery**, there was no significant difference in length of stay, 30-day death or readmission, after accounting for historical downward trends. Other before-and-after studies which have found benefits often do not account for historical trends whereby length of stay may already be decreasing without the introduction of pathways.¹⁴⁰

One reason for the differences in study findings may be that the exact components of the pathways and the surgical specialities differ. Differences in outcomes may also be due to the characteristics of the people undergoing surgery.¹⁴¹

Another reason may be the **extent of adherence** to the planned pathway, some of which contain 10 to 20 elements.^{142,143,144} In Canada a study of colon surgery in 15 hospitals found that only 20% of patients were compliant with all parts of a perioperative pathway. The poorest compliance was with postoperative interventions (40%). Postoperative compliance was most strongly associated with optimal recovery.¹⁴⁵

Similarly, a study in The Netherlands found that high adherence to postoperative elements of a pathway had the most impact on reducing length of stay.¹⁴⁶

A before-and-after study in Canada found that a perioperative pathway for **colorectal surgery** was associated with reduced complications (15% vs 32% usual care, $p < 0.05$) and average length of hospital stay (7 vs 10 days usual care, $p < 0.05$). Adherence to 12 components of the pathway was measured. High adherence was associated with a shorter average length of stay than the low compliance group (6 vs 9 days, $p < 0.05$) and a lower rate of complications (11% vs 20%, $p < 0.05$).¹⁴⁷

Cost of care

International examples

Systematic reviews have indicated that perioperative pathways can reduce the cost of care associated with various types of surgery,^{148,149,150} largely through reducing the length of hospital stay and time spent in intensive care or high dependency units.

It is difficult to extrapolate the cost savings to the UK context given varying currencies and the different ways that care is costed and reimbursed internationally. Furthermore, most studies explore costs from an institutional perspective and do not include costs related to changes in productivity and other indirect costs such as caregiver burden.¹⁵¹

Even so, international explorations of the financial impact of perioperative pathways are useful because they indicate that it is possible to implement this type of care without extra cost and in some cases pathways can be cost saving for many types of surgery.^{152,153,154,155,156,157,158,159,160}

Some examples of individual studies are provided here.

A before-and-after study in Belgium found that a perioperative pathway for **liver surgery** reduced average hospital stay from 8 to 4 days. There was no change in postoperative morbidity or readmission rates. There was a significant decrease in postoperative costs (€3667 vs €1912, $p < 0.05$, 2018 prices) and patient satisfaction was high.¹⁶¹

Similarly in Italy, a before-and-after study in people undergoing **colorectal surgery** found reduced hospital stay (4 vs 8 days) and nursing workload, with no increase in postoperative complications, 30-day readmissions or mortality. Patient satisfaction was high. Total average direct costs per patient were lower in the pathway group (€5339 vs €6797, 2018 prices).¹⁶²

A before-and-after study that implemented a pathway for **colorectal surgery** across an entire region in Canada found that this reduced length of stay (median 4 vs 6 days, $p < 0.05$) and complication rates (11% reduction, 95% CI 2% to 21%, $p < 0.05$). Net cost savings ranged between US\$2806 and \$5898 per patient (2016 prices).¹⁶³

Another before-and-after study in Canada found that a perioperative pathway for **gynaecologic oncology** reduced median length of stay from 4 to 3 days ($p < 0.05$) and reduced complications prior to discharge from 53% to 36% ($p < 0.05$). The net cost saving per patient was C\$956 (95% CI \$162 to \$1636, 2018 prices).¹⁶⁴

A systematic review of multidisciplinary working in surgical care included 43 studies. Whilst not all were explicitly about perioperative pathways, 91% of the studies found that multidisciplinary working was cost effective, with average cost savings across all studies of US\$5815 per person.¹⁶⁵

But not all studies have found cost savings. For instance, a before-and-after study explored the economic impact of implementing a perioperative pathway for **colonic surgery** in France. In an early implementation phase, the pathway was associated with reduced Clavien-Dindo I-II postoperative complications (15% vs 28% usual care, $p < 0.05$) and overall in-hospital stay (6 vs 7 days, $p < 0.05$). There was a trend towards lower hospital costs, but this did not reach statistical significance (€7022 vs €7501, average saving per patient €480, $p = 0.1$, 2018 prices).¹⁶⁶

Examples from the UK

We identified very few examples of robust studies examining the cost impacts of perioperative pathways in the UK. A systematic review of 17 reviews and 12 additional randomised trials of perioperative care for people undergoing elective surgery in UK hospitals found insufficient evidence to draw conclusions about cost-effectiveness.¹⁶⁷

One cost analysis of a randomised trial in the UK found that a perioperative pathway for **high risk patients** was £487 per person more costly than usual care over the 180-day trial follow-up period. Modelled over a lifetime, the pathway was more effective than usual care, but remained more costly (£1395 more per person, 2019 prices). The researchers suggested that the pathway may not be cost-effective (incremental cost effectiveness ratio £77,792 per quality adjusted life year gained).¹⁶⁸

On the other hand, a case-control study examined the cost impacts of a perioperative pathway for women having benign vaginal **hysterectomy** in the UK. Median length of hospital stay was shorter than conventional care (24 vs 43 hours, $p < 0.05$). The perioperative pathway was associated with increased visits to the emergency department for minor symptoms following discharge (16% vs 0%, $p < 0.05$), but there was no difference between groups in the inpatient readmission rate. Establishing the programme incurred expenditure including delivering a patient-orientated gynaecology 'school' and employing a specialist enhanced recovery nurse. Despite this, the pathway led to a 15% saving (£165 per patient, 2013 prices).¹⁶⁹

Another UK study found that a pathway for people undergoing **heart surgery** reduced the length of stay in intensive care compared to conventional care. The total hospital length of stay, incidence of complications, reintubation and readmission rates were similar between groups. The average cost of the perioperative pathway was lower than conventional care (£4182 vs £4553, $p < -0.05$, 2011 prices).¹⁷⁰

Overall, perioperative pathways appear to have the potential to reduce length of stay in hospital and healthcare costs, with about the same or fewer postoperative complications. Positive examples are available from the UK and internationally. Some studies have found increased rates of readmission to hospital, but this is not a consistent trend.

Beginning before surgery

The previous section suggests that perioperative pathways can reduce the length of time people spend in hospital, which has the potential to reduce overall healthcare costs. However, there are variations in the findings. The components included in perioperative pathways vary, and this may be one reason for the differing outcomes.

In this section and the next, we summarise research about the impacts of interventions that may form part of a perioperative care approach. This section focuses on interventions that can be begun before surgery (some of which may continue after surgery).

Much can be done between the time when surgery is first contemplated and the procedure itself to engage people in decisions about their care, assess the needs and risks of individual patients, optimise the treatment of long-term conditions and support people with modifiable risk factors such as smoking, nutrition, anaemia and diabetes.

A significant amount of research has been undertaken into 'preoperative optimisation' initiatives. For example, a review of high-quality systematic reviews identified 409 trials in 51 countries. The interventions varied widely.¹⁷¹ Our goal in this section is to provide a flavour of the types of components that might be included in an integrated perioperative approach. We focus on some of the most cited elements of perioperative care:

- shared decision making about surgery as a treatment option
- surgical risk assessment
- prehabilitation, which encourages people to improve their fitness ready for surgery
- managing long-term medical conditions to be better prepared for surgery

Key findings: care before surgery

Our rapid review identified 162 systematic reviews and additional individual studies about the impact on healthcare resources of initiatives to support people before surgery.

Across many types of surgery, we found:

- **shared decision-making** can improve patient satisfaction with care but the impact on healthcare resource use is unclear. There is little evidence about whether shared decision-making influences if people proceed with surgery, although some studies have found a reduction in surgery after shared decision-making initiatives are implemented
- **structured assessment** to identify the risk of complications can refer people to services to help them prepare for surgery and may reduce short-notice cancellations
- **prehabilitation** to help people get as healthy as possible ready for surgery may include physical exercise, smoking cessation, psychological support, interventions to reduce alcohol consumption and nutritional supplementation. Prehabilitation has been associated with reduced length of stay after surgery
- various interventions have been tested to help people **manage long-term conditions** such as diabetes. The evidence is too varied to draw conclusions about the impact on healthcare resource use. Specific pathways and liaison services for older people have also been tried and these have been found to reduce the average length of hospital stay

Shared decision-making

Extent of shared decision-making

Person-centred care is an important component of perioperative care and shared-decision-making is part of this.

Shared decision-making is a collaborative process in which patients and family members make healthcare decisions together with their clinician. This is often recommended in guidelines, and research suggests that patients want more involvement in making decisions about their health and healthcare.¹⁷² A systematic review of 36 studies about surgery in children examined patient, parent and surgeon preferences towards shared decision-making. Three quarters of the studies found that patients or parents preferred shared decision-making (73%) compared with 11% of studies that found that surgeons preferred shared decision-making.¹⁷³

The extent of shared decision making between people considering surgery and health professionals may be low,¹⁷⁴ although there is a wide range. For instance, a study in Canada examined the proportion of surgical consultation visits at which some shared decision-making was evident. This ranged from 0% to 97% of consultations for each person. Higher levels of shared decision-making were observed when surgeons spent more time with patients during the consultation.¹⁷⁵

Surgeons may feel that they are facilitating shared decision-making more than they are. A study in the Netherlands found that surgeons perceived that they were facilitating shared decision-making but observation suggested that this was not the case. Surgeons hardly ever asked patients for their preferred ways of receiving information, whether they understood the information provided, how they would like to be involved in decision-making or what treatment option they would prefer.¹⁷⁶

A systematic review included 32 studies that measured shared decision-making during consultations in which surgery was a treatment option. 36% of patients and surgeons perceived the consultation to involve shared decision-making as opposed to being patient-led or surgeon-driven. Surgeons were more likely than patients to perceive decision-making as shared (44% vs 29%). Between 7% and 39% of objectively observed consultations involved shared decision-making. The reviewers concluded that shared decision-making in surgery is in its infancy, although patients and surgeons both think of it positively.¹⁷⁷

Factors found to influence shared decision-making in surgery include the quality of the doctor-patient relationship, time available in consultations, whether choices are framed as avoided losses or potential gains, choices reported by others, emotional cues, educational barriers, perceived level of patient autonomy and choice, patient and family expectations, having a social support system and decision-making advocates.^{178,179,180}

Effects of shared decision-making

Effect on decisions

We identified little empirical evidence about whether facilitating shared decision-making may result in a decision not to proceed with surgery. The evidence that did exist was mixed and did not come from the UK.

A systematic review containing 24 studies of ways to improve shared decision-making in surgery found that most used multimedia / video or written decision aids or personal coaching. **38% of studies found that shared decision-making reduced surgical procedures,** 4% found an increase in surgery, 33% found no difference and the rest did not report on the impact on surgery.¹⁸¹

A randomised trial in Canada examined the impact of patient decision aids about joint replacement for people with arthritis. One group received usual education. Another group received usual education plus a decision aid and a surgeon preference report. There was a trend towards decreased wait time for surgery (3 weeks shorter in the intervention group in those seen in the community). There was **no difference between groups in the proportion who had surgery**.¹⁸²

A randomised trial in the US examined an online patient decision aid about the benefits, risks and alternative treatments for people with coronary artery disease. The decision aid increased people's **knowledge** of the options and their interest in shared decision-making. It did not change their treatment preferences, including their desire for surgery. Providing the preferences that patients expressed using the tool to clinicians did not make clinicians more likely to progress with the treatment preferred by patients.¹⁸³

Studies of various other types of decision aids found limited impact on treatment choice where surgery is an option.¹⁸⁴

Effect on satisfaction

Research from the UK and other countries suggests that adults and young people who actively participate in decision-making about their surgery and care are more satisfied with their surgery.^{185,186} For instance, a systematic review with 11 studies found that women with early stage breast cancer who used decision aids were 25% more likely to choose breast conserving surgery over mastectomy (risk ratio 1.2, 95% CI 1.1 to 1.4, $p < 0.05$). Decision aids were associated with **increased patient knowledge and satisfaction** with the decision-making process.¹⁸⁷

Effect on healthcare resource use

Some researchers suggest that there is **sparse evidence about the economic impact** of shared decision making or decision-making aids as part of surgical pathways. For instance, a systematic review identified little published evidence about shared decision-making or patient decision aids in joint replacement surgery.¹⁸⁸

Encouraging shared decision-making

Research has explored various types of patient education and tools to support shared decision-making and behaviour change.¹⁸⁹ We provide some examples here to give an indication of the research available.

Patient education

Various types of education and information have been tested to support people prior to surgery. Although not all of this focuses on supporting shared decision-making, we provide examples here because patient information may be an important component of perioperative care.

A systematic review including six trials reported mixed findings about patient education prior to heart surgery. Some trials found **improved physical and psychosocial recovery** whereas others found no effect on patient anxiety, postoperative pain or hospital stay.¹⁹⁰

A systematic review of 34 trials of the **timing and format** of providing patient information prior to surgery found that multimedia formats increased knowledge more than text-based information, which in turn increased knowledge more than verbal formats. The information format or timing of provision of information did not affect preoperative anxiety, postoperative pain or length of stay.¹⁹¹

A children's hospital in the US implemented various initiatives to reduce cancellations on the day of surgery including improved communication with families, decision-making prior to the day of surgery, colourful simplified preoperative instruction sheets, text message reminders to parents' mobile phones and a pathway to allow rescheduling before the day of surgery if the child was unwell. The average theatre **time lost to cancellation** on the day of surgery decreased from 6.6 to 5.5 hours per day.¹⁹²

Decision aids

Decision aids which contain information, question prompts and the pros and cons of various treatment options are well regarded by people considering surgery. For instance, a systematic review included 17 randomised trials about patient decision aids about breast reconstruction after mastectomy. The reviewers found that decision aids improved **patient satisfaction** with information and perceived involvement in the decision-making process.¹⁹³

In the US, researchers tested the feasibility of using a shared decision-making tool during a consultation about hysterectomy. At six-month follow-up, 97% of patients indicated that they were **satisfied** with their decision to undergo a minimally invasive procedure. They were grateful to have received information about care options. Using the tool did not add substantial time to a consultation visit. The researchers did not report whether any woman changed her decision as a result of the tool. No-one decided not to have surgery.¹⁹⁴

In the Netherlands, women on an obstetric ward were given a card prompting them to ask three questions: what are my options; what are the possible benefits and harms of those options; how likely are each of those benefits and harms to happen to me? The study was not specific to surgery, though surgery was an option in some cases. The initiative was feasible and well regarded by patients, but it did not impact on the proportion who said that there had been shared decision-making.¹⁹⁵

Online and multimedia information

Decision aids are feasible in a variety of formats, including paper, DVD and online.

A systematic review found that multimedia information and consent resources for surgical procedures increased patient understanding and **satisfaction** compared to standard consent information alone. Multimedia provision of information was found to be feasible, accessible and easy to use. There was no clear evidence that such resources reduced preoperative anxiety.¹⁹⁶

Type of information provided

The way that information is provided may influence people's decisions about whether to have surgery. A randomised trial in Spain compared giving people diagnosed with rotator cuff tears information about the **benefits of surgery** versus information about potential adverse effects. Patients were asked to comment on a hypothetical situation rather than this being actual clinical practice. Those receiving information about the benefits of surgery chose to have surgery more frequently than those where potential complications were discussed (84% vs 46%, $p < 0.05$).¹⁹⁷

Risk assessment

Another component of perioperative care is assessing people to help understand whether they are good candidates for surgery and ensure they have support to reduce their risk of complications. Several approaches to risk assessment have been tested and we provide examples here. We have not focused on the efficacy of specific risk assessment scoring tools, though studies are available about these.¹⁹⁸

Assessment clinics

UK examples

People may be referred to a preoperative assessment clinic to help decide whether to have surgery, after the decision to proceed has been made or just prior to surgery. These clinics can help to **reduce short-notice cancellations** of operations because they help people address any risks and prepare for having surgery.

An observational study in the UK described a consultant-led preoperative assessment clinic for people having major vascular surgery. People were stratified for risk, referred for multidisciplinary support and prescribed medication and care to help manage any long-term conditions. The clinic was associated with **fewer last-minute cancellations** of surgery for medical reasons and increased patient satisfaction.¹⁹⁹ Similar results have been found in preoperative clinics for children.²⁰⁰

Another UK study explored the benefits of a multidisciplinary preoperative assessment clinic for people having hip or knee replacements. Compared to assessment by an anaesthetist on the day of surgery, multidisciplinary assessment was associated with fewer admissions to the post-anaesthesia care unit (10% vs 22% usual care, $p>0.05$) and shorter length of stay in the high dependency unit (1.6 vs 2.1 days, $p<0.05$) and intensive care unit (1.9 vs 2.3 days, $p<0.05$), resulting in estimated **savings** of £50,000 per annum (2011 prices).²⁰¹

International examples

Studies from other parts of the world suggest that preoperative assessment clinics can reduce the length of hospital stay and postoperative mortality in a range of surgical specialities.²⁰²

A US study examined adding structured medical preoperative evaluation to standard anaesthesia preoperative assessment. There was a trend towards reduced same day surgical cancellations, but this did not achieve statistical significance (5% vs 9% usual care, $p=0.06$). Medical preoperative evaluation was associated with **lower inpatient mortality** (0.4% vs 1.3% usual care, $p<0.05$). Those with an American Society of Anaesthesia score of 3 or higher had reduced length of stay.²⁰³

However not all findings are positive. In the US, a case-control study compared people undergoing urology surgery who were referred for additional medical and cardiology preoperative evaluation versus those who were not. Only 2% of those referred for additional evaluation had extra diagnostic testing and 8% had changes in medical management as a result. There were **no differences** between groups in perioperative outcomes. The researchers suggested that routine referral for additional medical evaluation may not be beneficial.²⁰⁴

In Canada a retrospective review of the notes of people over 50 who underwent elective non-cardiac surgery found that preoperative evaluation sessions **did not improve care management** or surgery outcomes.²⁰⁵

Other assessment approaches

UK examples

Screening, risk assessments and reminders may help to **reduce short-notice cancellations** and surgery postponements.

In the UK, a before-and-after study examined posting people **screening questionnaires** before minor surgery and following up with telephone screening if there was a lack of response. People screened using this approach had a cancellation rate of 2% compared to 8-12% the previous year without such screening. The researchers concluded that combining questionnaires and telephone screening helped to reduce cancellations and postponements of day case surgery.²⁰⁶

A randomised trial in four UK hospitals compared **appropriately trained nurses** versus pre-registration doctors providing preoperative assessment for elective general surgery. Having a nurse perform preoperative assessment was acceptable to patients and was cost neutral.²⁰⁷

International examples

A review of **cardiopulmonary exercise testing** found that there is limited evidence that this improves outcomes, although it can be used to help make decisions about potential prehabilitation activities.²⁰⁸

The pros and cons of various risk assessment tools and indicators have been researched,²⁰⁹ but there is no consensus about which are most effective.²¹⁰ For instance an evidence review found that common ways to measure the risks associated with bladder removal may not provide the most accurate risk assessment for perioperative complications. The reviewers suggested that rather than focusing mainly on people's age and other health issues, standardised assessments of dependency, comorbidity severity, sarcopenia, malnutrition, physical and cognitive frailty and comprehensive geriatric assessments may offer more precise estimates and help to identify useful ways to improve readiness for surgery.²¹¹

Prehabilitation

Prehabilitation involves supporting people to **enhance their fitness and functional capacity before surgery, with the aim of improving postoperative outcomes.**

The aim is to optimise patients for a "surgical marathon" similar to the preparation of an athlete. By helping people to increase their fitness, stop smoking or reduce alcohol consumption, prehabilitation also has the potential to help to prevent other health issues in the longer term.

Prehabilitation programmes may include multiple components, such as nutritional support, exercise and psychoeducation, or they may focus primarily on one element.

We first explore evidence about the effect of multicomponent prehabilitation programmes on healthcare resource use before looking at programmes focused on single elements.

Multicomponent initiatives

Effect on functioning and complications

A number of systematic reviews and individual studies have found that prehabilitation is feasible for a people undergoing surgery for various conditions, is associated with improved patient satisfaction and may have positive impacts on functional status, postoperative complications and length of stay, with no adverse effects.^{212,213,214,215} However sometimes the study designs are of insufficient quality to draw definitive conclusions.^{216,217,218, 219} And the long-term findings are sparse and not always positive.^{220,221}

A systematic review identified 17 studies about multicomponent prehabilitation in people having surgery for **cancer**. Prehabilitation was associated with improved functional status and mood and reduced urinary continence up to 30-days after surgery, but the results were inconsistent across studies. Greater benefits to functional status were gained when prehabilitation was combined with rehabilitation after surgery.²²²

Another systematic review of **cancer** prehabilitation programmes included 12 randomised trials; seven focused on exercise, three on psychological interventions and two on multicomponent interventions. There were positive trends but the variation in programmes made it difficult to draw conclusions.²²³

A systematic review of 16 studies explored prehabilitation programmes lasting at least seven days and including structured exercise, nutritional optimisation, psychological support and cessation of unhealthy behaviours prior to **major abdominal surgery**. The studies varied widely, with many surgical subspecialties, prehabilitation techniques, outcomes and levels of compliance. There were reduced postoperative complications in programmes that used either preoperative exercise, nutritional supplementation in malnourished patients or smoking cessation.²²⁴

However, there are conflicting findings. A systematic review of 17 studies concluded that there was no evidence that prehabilitation improved function, quality of life or pain. There was some indication of reduced readmissions after **hip or knee surgery** for arthritis.²²⁵

We provide some examples of individual studies to give a flavour of the types of interventions included.

Researchers in Wales tested the feasibility of initiating prehabilitation for people with suspected **cancer** via primary. Twelve general practices took part. All patients were simultaneously referred to secondary care using 'urgent suspected cancer pathways' and offered prehabilitation if required at the initial primary care consultation. The approach was feasible. Out of the total sample, 44% required prehabilitation in primary care. 8% of the total sample were diagnosed with cancer and these people were more likely to require prehabilitation optimisation than others (63% vs 43%, $p < 0.05$).²²⁶

In England older people having a **hip or knee replacement** took part in a randomised trial to reduce sedentariness prior to surgery. The intervention included motivational interviewing, setting behavioural goals and regular follow-ups from eight weeks prior to surgery. 14% of people invited to take part did so and 86% completed the programme. Participants were satisfied with the approach. This was a feasibility test so the focus was not on measuring resource use outcomes, but the programme was associated with improved functional status at six weeks after surgery.²²⁷

There have been some concerns that extending the time between diagnosis and surgery to allow for prehabilitation could have adverse effects. However, a systematic review of five studies examining the effect of treatment delays found no impact on overall survival in people with colon cancer.²²⁸

Effect on length of stay

Multicomponent prehabilitation has been associated with reduced hospital stay in some studies,²²⁹ but not in others.

In a systematic review of eight studies in **frail older people** undergoing surgery, three focused on exercise alone and the rest were multicomponent. Reductions in mortality and the length of hospital stay were more likely to be reported in interventions that included both exercise and nutritional interventions, but the quality of evidence was very low.²³⁰

A review of 18 studies of prehabilitation for people with **cancer** included psychological support, education and/or exercise. Preoperative exercise programmes significantly reduced the length of hospital stay (mean reduction 4.2 days, 95% CI 2.9 to 5.4 reduction, $p < 0.05$) and post-surgery complications (odds ratio 0.2, 95% CI 0.1 to 0.7, $p < 0.05$) in people with lung cancer. Psychology-based prehabilitation significantly improved mood, physical well-being and immune function for prostate cancer patients and improved fatigue and psychological outcomes among women with breast cancer.²³¹

Not all results are favourable. A systematic review of six studies of exercise prehabilitation, nutrition or both in older people with **colorectal cancer** found no benefit on length of stay, survival or readmission rates.²³²

Effect on healthcare costs

The effect of multicomponent prehabilitation on healthcare costs is uncertain. The evidence here is sparse.

A busy tertiary centre in England worked with others to implement a community-based prehabilitation service for people awaiting **major elective surgery**. The service included a multidisciplinary cross-sector team undertaking a comprehensive assessment and management of risk factors in the weeks prior to surgery. Over a year-long pilot period there were 159 referrals from five surgical specialities and 75 people choose to take part in the programme, which was about eight weeks long. The initiative was associated with improved physical functioning and quality of life by the end of the intervention and three months after surgery. Patient satisfaction was high. The average cost of the intervention was £405 per patient, equating to £52 per week. Impacts on length of stay were not reported.²³³

In the US, a prehabilitation programme engaged people in four activities prior to **colon surgery**: physical activity, pulmonary rehabilitation, nutritional optimisation and stress reduction. There was a significant reduction in Clavien-Dindo class III to IV complications (30% compared with 38% usual care, $p < 0.05$). Total hospital charges averaged US\$75,494 compared with \$97,440 for the usual care group (2018 prices),²³⁴

Preoperative exercise programmes

Exercise is a key component of prehabilitation and can take various forms. Here we illustrate evidence about exercise programmes prior to surgery.

It is important to bear in mind though that exercise programmes vary a great deal. A systematic review of eight studies of prehabilitation in people undergoing major **abdominal cancer surgery** emphasised difficulties interpreting the literature. Most studies included low-risk surgical patients and there was considerable variation between prehabilitation programmes in terms of exercise location, supervision, frequency, intensity, duration and training type. Most studies did not objectively monitor training progression or include nutritional or psychological support. Studies did not examine the impact on postoperative complications or people's wellbeing and neither did they explore long-term postoperative outcomes.²³⁵

Effect on complications and recovery

Many systematic reviews and individual studies have suggested the exercise prehabilitation can reduce postoperative pain and complications, improve functional recovery and quality of life and reduce hospital stay amongst people having various types of surgery.^{236,237,238,239,240,241} The effect sizes tend to be small to moderate^{242,243} and the quality of studies is diverse, making it difficult to draw conclusions.^{244,245}

For example, a systematic review of 81 studies of prehabilitation in people having major **abdominal surgery** or cardiothoracic surgery found significantly lower rates of overall complications (odds ratio 0.6, 95% CI 0.4 to 0.9, $p < 0.05$), pulmonary complications (odds ratio 0.4, 95% CI 0.2 to 0.7, $p < 0.05$) and cardiac complications (odds ratio 0.5, 95% CI 0.2 to 0.96, $p < 0.05$). However, the reviewers said that the evidence was weak because there was a lot of variation in the exercise regimes.²⁴⁶

Another systematic review of 8 trials agreed that exercise prehabilitation before major **abdominal surgery** was associated with a significant reduction in postoperative pulmonary complications (odds ratio 0.4, 95% CI 0.2 to 0.7, $p < 0.05$) and overall postoperative morbidity (odds ratio 0.5, 95% CI 0.3 to 0.9, $p < 0.05$). There was no significant difference between groups in the length of hospital stay. The methodological quality varied between studies, most of which were small single-centre trials. The reviewers concluded that physical exercise programmes may reduce postoperative pulmonary complications and increase survival compared with standard care in people undergoing major abdominal surgery.²⁴⁷

In people with **lung cancer**, a systematic review of 10 randomised trials of exercise programmes prior to surgery found a reduction in postoperative pulmonary complications (risk ratio 0.5, 95% CI 0.4 to 0.7) and improved functional outcomes. Combining preoperative aerobic, resistance and inspiratory muscle training was found to be effective if it lasted from one to four weeks and comprised one to three sessions per week of moderate intensity.²⁴⁸

A systematic review of six studies of exercise prehabilitation for people undergoing **colorectal surgery** found no significant difference between groups in the rate of complications or length of stay in hospital, but exercise was associated with improved functional capacity and self-reported physical activity after surgery.²⁴⁹

Another systematic review of 12 studies with people undergoing **knee surgery** identified only one randomised controlled trial about prehabilitation. This found that prehabilitation may reduce the time to return to sport.²⁵⁰

Not all studies have found benefits. A systematic review with five studies in **older people** found no significant reduction in postoperative complications or length of hospital stay.²⁵¹

Similarly, a review of 33 studies found that no dose of physical prehabilitation improved quality of life, postoperative functional status, readmissions or nursing home placement for people undergoing **knee or hip surgery** for arthritis. Prehabilitation of more than 500 minutes reduced the need for postoperative rehabilitation.²⁵²

Effect on length of stay

Several studies have suggested that preoperative exercise programmes can reduce the length of stay in hospital after surgery,²⁵³ but others have found no change in length of stay.

A systematic review found that preoperative physical activity programmes for people aged over 65 having **hip or knee surgery** reduced the length of stay and may help people recover more quickly after surgery, though the findings were mixed and the quality of evidence was poor.²⁵⁴

Another systematic review of combined preoperative aerobic and resistance exercise training in people having surgery for **cancer** included ten studies. Exercise prehabilitation was associated with improved physical capacity after surgery and some domains of quality of life. It was also associated with reduced length of stay and postoperative pulmonary complications in some studies, but there was variation in the results here.²⁵⁵

Another systematic review of 15 randomised trials found that prescribed respiratory and exercise interventions prior to **abdominal surgery** reduced morbidity (odds ratio 0.6, 95% CI 0.5 to 0.9, $p < 0.05$) and pulmonary morbidity (odds ratio 0.4, 95% CI 0.2 to 0.7, $p < 0.05$). There was no significant difference in length of stay.²⁵⁶

There may also be practical issues with prehabilitation. A small randomised feasibility trial in the UK found that 42% of people undergoing **colorectal surgery** who were screened were deemed ineligible for exercise prehabilitation due to having insufficient time prior to their scheduled surgery. Less than one in five eligible people agreed to take part (18%). Participants did not have shorter length of stay than a control group (median 10 vs 8 days control group).²⁵⁷

Novel approaches to delivering exercise prehabilitation have been tested. A US study examined prehabilitation using a telehealth system prior to **knee surgery**. The initiative provided exercises, nutritional advice, education about home safety and reducing medical risks and pain management skills prior to surgery. Compared to a group who did not use the programme, the prehabilitation group had shorter length of stay (2 vs 3 days, $p < 0.05$) and more went home without assistance (77% vs 43%, $p < 0.05$).²⁵⁸

Effect on healthcare costs

Many studies do not explore the cost implications of preoperative exercise programmes,²⁵⁹ but a small amount of evidence is available. A cost analysis of a randomised trial in Spain found that the average cost of endurance exercise prehabilitation in high-risk patients undergoing major **digestive surgery** was €389 per patient (2019 prices). Prehabilitation did not increase the total costs associated with surgery.²⁶⁰

A systematic review of three trials about spinal surgery found that prehabilitation reduced the total cost of healthcare spending. Prehabilitation that included education improved the extent to which people reported feeling prepared for surgery and their positive outlook about surgery.²⁶¹

On the other hand, a systematic review of 22 studies of preoperative physiotherapy in people planning to undergo **joint replacement** surgery found no improvement in quality of life, length of stay or total hospital cost.²⁶²

Effect of prehab plus rehabilitation

Some studies have explored combining prehabilitation with rehabilitation exercise after surgery. Findings about the effects on complications and healthcare resource use are mixed.

A systematic review found that home-based rehabilitation alone or combined with prehabilitation had positive trends in reducing complications and improving function in people with **lung cancer**, but the quality of evidence was low. The most favourable components were supervision and personalisation.²⁶³

Another systematic review of studies in people undergoing surgery for **cancers of the oesophagus** found that exercise prehabilitation (inspiratory muscle training) was associated with reduced respiratory complications. Postoperative rehabilitation was associated with improved clinical outcomes.²⁶⁴

In the UK, combined prehabilitation and rehabilitation was tested to optimise physical status, prepare for the inpatient journey and support people through recovery after **cancer surgery**. Interventions included exercise classes, smoking cessation, dietary advice and patient education. There was no significant difference in postoperative complications or readmissions due to complications, though trends were positive.²⁶⁵

In Denmark, people having **spinal surgery** had prehabilitation combined with early rehabilitation. A randomised trial found that the integrated approach meant people returned to work earlier and used less primary care after discharge. The programme resulted in €1,625 less cost per person than conventional care (€494 direct costs and €1,131 indirect costs, 2008 prices).²⁶⁶

Nutritional supplements

A lack of good nutrition in people having surgery has been associated with a higher rate of complications and prolonged hospital stay. Some have argued that routine nutritional assessment may not be undertaken due to insufficient awareness among health professionals of nutritional problems, a lack of collaboration between surgeons and clinical nutrition specialists and a lack of dedicated resources.²⁶⁷ Interventions have been tested to change this.

Nutritional interventions can take various forms, including dietary changes and supplements for several weeks prior to surgery or supplements just before surgery. We provide examples of the impact of various types of nutritional interventions here.

Effect on complications and recovery

There are mixed findings about the impact of nutritional interventions on postoperative complications and recovery, though there are positive trends.²⁶⁸

A systematic review of five randomised trials of preoperative oral protein supplements in people having **colorectal surgery** found no significant reduction in the overall complication rate. Compliance ranged from 72% to 100%.²⁶⁹

A systematic review of 14 studies and 15 reviews of preoperative nutritional interventions in people with **Crohn's disease** found that malnutrition was a major risk factor for postoperative complications. Both enteral and parenteral nutrition reduced postoperative morbidity. The studies included various nutritional regimes and provided only a modest level of evidence.²⁷⁰

A systematic review about perioperative supplementation with **probiotics or synbiotics** for surgical patients included 34 trials. Compared to a control group, people taking probiotics and synbiotics had a lower rate of surgical site infection (relative risk 0.6, 95% CI 0.5 to 0.8, $p < 0.05$). Probiotics and synbiotics also reduced the incidence of other infectious complications including any infection, pneumonia, urinary tract infection, wound infection and sepsis; shortened antibiotic therapy, intensive care unit stay and hospital stay; and was associated with reduced hospital costs. Synbiotics were more effective than probiotics.²⁷¹

On the other hand, in France a randomised trial with people undergoing surgery for **liver cancer** tested perioperative nutrition with supplements given three times daily for seven days before and three days after surgery. There was no improvement in hepatic function, immune response or resistance to infection.²⁷²

Another trial in France examined immunonutrition for people with **head and neck cancer**. A control group received a formula without immune nutrients. Another group received formula with nutrients before surgery, but a placebo after surgery. A third group received a formula with nutrients before and after surgery. The formulas were available for oral or enteral consumption and were given for seven days before surgery and for 7-15 days afterwards. There was no difference between groups in infectious complications or surgical site infections. Those who had consumed at least 75% of the expected intake had reduced infections and lower median length of postoperative stay, suggesting that compliance rates may influence some of the less positive findings.²⁷³

In Australia a randomised trial of preoperative and/or postoperative immunonutrition found no improvement in complications over standard nutrition for people with **oesophageal cancer**.²⁷⁴

Effect on length of stay

Some studies have suggested that nutritional interventions can reduce the length of hospital stay.²⁷⁵

A systematic review and meta-analysis of 17 trials found that using the IMPACT nutritional formula before and/or after elective surgery was associated with significant reductions in infectious complications (39% to 61% decrease) and length of stay in hospital (average reduction 2 days). The greatest improvements were associated with people receiving specialised nutrition support as part of preoperative care.²⁷⁶

A systematic review included 27 studies about nutritional interventions to support **colorectal cancer surgery** within perioperative pathways. Patients had solids, liquids or supplements high in carbohydrates and immune-nutrients 2 to 8 hours prior to surgery. The conventional care groups usually fasted for between 3 and 12 hours prior to surgery. The nutritional changes were associated with faster bowel recovery, fewer infections and shorter hospital stay.²⁷⁷

A systematic review of 9 studies examined at least seven days of nutritional prehabilitation, with and without exercise, for people having **colorectal surgery**. Prehabilitation reduced the length of hospital stay (weighted mean reduction 2.2 days, 95% CI 0.9 to 3.5 day reduction, $p < 0.05$). There was some evidence that combined nutritional and exercise prehabilitation resulted in better functional improvements.²⁷⁸

Not all evidence is positive. In Switzerland, morbidly obese people undergoing **gastric bypass** were randomised to usual care or carbohydrate loading drinks consumed 12 and 2 hours before surgery plus immediate postoperative peripheral parenteral nutrition. There was no difference between groups in operative outcomes, complication rates or length of stay.²⁷⁹

Effect on healthcare costs

There is limited evidence about the impact of nutritional interventions on healthcare costs, but there are some positive trends.

A systematic review of six studies found that immunonutrition was cost-effective in people undergoing surgery for **cancer**.²⁸⁰

Another review found that immunonutrition for people undergoing elective surgery for **gastrointestinal cancer** resulted in savings per patient of US\$3300 with costs based on a reduction in infectious complication rates or US\$6000 based on reduced length of hospital stay (2012 prices).²⁸¹ A similar review of 43 studies also found cost benefits for people having surgery for gastrointestinal cancer.²⁸²

Psychological interventions

People having surgery may experience stress, anxiety and depression after diagnosis of their condition and around the time of surgery. Various psychological interventions have been tested as part of prehabilitation, but the evidence about these is relatively sparse.

A systematic review of 105 studies of psychological preparation for **surgery in adults** included procedural information, sensory information, cognitive interventions, relaxation, hypnosis and emotion-focused interventions. Psychological preparation techniques were associated with reduced postoperative pain and length of stay (average reduction 0.5 days, 95% CI 0.2 to 0.8 day reduction, $p < 0.05$).²⁸³

A systematic review of psychological prehabilitation in people having surgery for **cancer** identified seven studies. There was improved quality of life and psychological outcomes but no change in length of hospital stay, complications or mortality.²⁸⁴

Another systematic review with seven studies about **orthopaedic surgery** found that psychoeducation alone was not effective at improving patient-reported joint outcomes.²⁸⁵

Fatigue is common after surgery and may last longer than physical symptoms, delaying a return to normal activity. Relaxation interventions have been implemented prior to surgery to try to address this. In New Zealand, a randomised trial tested giving people having **abdominal surgery** a 45-minute relaxation session with a psychologist plus CDs with relaxation exercises to take home. There was no major change in complications or healthcare resource use.²⁸⁶

Smoking cessation initiatives

Smoking is a risk factor for postoperative complications and has an impact on longer term survival.^{287,288} Though the evidence is conflicting,^{289,290} people who stop smoking at least one month prior to surgery have been found to have better postoperative outcomes,^{291,292,293} therefore research has explored ways to support smoking cessation prior to surgery.

A number of such studies focus on the extent of smoking abstinence rather than the impact on postoperative complications or costs.^{294,295,296,297,298,299} Interventions which incorporate education, counselling and goal setting as well as nicotine replacement therapy have been found to be more effective than nicotine replacement therapy alone.^{300,301}

There are many descriptions of smoking cessation initiatives. For instance, a hospital in the UK tested having surgeons refer people to smoking cessation services during a consultation for suspected head and neck cancer. 78% of smokers accepted a referral to stop smoking services and almost half of these quit or reduced smoking, at least temporarily (46%). The researchers concluded that a possible diagnosis of cancer provides a 'teachable moment' to encourage positive health behaviour change.³⁰²

In the US an online smoking cessation initiative was tested. The e-learning module described the benefits of quitting smoking before surgery, how to quit and how to cope while quitting. Around one quarter of smokers quit smoking by the day of surgery and maintained this at six-month follow-up (22%).³⁰³

Two hospitals in Canada implemented a 'stop smoking before surgery' programme. A before-and-after study found that this programme increased reductions in smoking and raised people's awareness of smoking-related surgical complications. Before the programme, the same proportion of people reported being advised to stop smoking, but providing surgery-specific resources encouraged more people to do so.³⁰⁴

In Australia, people who smoked 10 or more cigarettes per day awaiting non-urgent surgery were offered free nicotine patches for around five weeks. 39% took up the offer and 14% used the patches for more than three weeks. People offered patches were more likely than a control group to attempt to quit, but there was no difference in the proportion who quit smoking for four or more weeks prior to surgery (9% compared to 6% in a control group, odds ratio 1.5, 95% CI 0.7 to 3.2, $p > 0.05$) or for 24 hours prior to surgery.³⁰⁵

There are many other similar studies looking at rates of smoking cessation, but they do not explore the healthcare resource impacts.

Effect on complications

A small number of studies looked at the impact of smoking cessation initiatives prior to surgery on complications or resource use, with mixed findings. A systematic review of 11 randomised trials found that smoking cessation interventions significantly reduced the occurrence of complications after **various types of surgery** (risk ratio 0.6, 95% CI 0.4 to 0.8, $p < 0.05$). Intensive interventions were more effective than medium to less-intensive interventions.³⁰⁶

In Sweden a randomised trial started smoking cessation support four weeks prior to general and **orthopaedic surgery**. The smoking cessation group had a lower complication rate than usual care (21% vs 41%, $p < 0.05$).³⁰⁷

But other studies have mixed findings.^{308,309} In the US smoking cessation support was integrated into **routine perioperative care** in an Integrated Health System. Comparing before and after implementation found an increase in smoking cessation counselling referrals (38% vs 3% before, odds ratio 11.1, 95% CI 3.8 to 32.7, $p < 0.05$). At 30 days after discharge, more people were likely to report abstaining from smoking since hospital discharge and in the past seven days. There were no significant differences in surgical complications.³¹⁰

Effect on healthcare resource use

The evidence about the impact of smoking cessation programmes on healthcare costs is very mixed.

A US cost analysis modelled that the total direct medical costs for people who underwent a preoperative smoking cessation programme were on average US\$304 lower per person than usual care during the first 90 days after surgery (95% CI \$40 to \$571, 2017 prices).³¹¹

However, another US cost-effectiveness analysis found that the average 90-day cost of care was about the same as usual care for people enrolled in a mandatory smoking cessation intervention prior to **joint replacement surgery**.³¹²

Another US study found that those who took part in a smoking cessation programme at a **vascular surgery** clinic had decreased readmissions up to 30 days after surgery.³¹³

A systematic review with 32 studies found that many initiatives recruited people for smoking cessation very near the time of surgery, meaning that the benefits may not be optimised.³¹⁴

Research suggests that barriers to helping people stop smoking before surgery are a lack of healthcare professional time / prioritisation and low staff confidence in their counselling abilities.³¹⁵

A UK study found that surgeons underestimated both the benefits of preoperative smoking cessation on outcome and the efficacy of smoking cessation interventions.³¹⁶ Another UK study found that whilst surgeons may believe that addressing smoking would be difficult or unwanted, patients often wanted to have smoking cessation support integrated into routine preoperative care.³¹⁷

After surgery

In Sweden smoking cessation was tested whilst in hospital after orthopaedic surgery (not pre surgery). Those randomised to smoking cessation had fewer postoperative complications than a control group (20% vs 38%, $p < 0.05$).³¹⁸ Other studies have also suggested benefits from smoking cessation started or rigorously followed-up after surgery.³¹⁹

Reducing alcohol consumption

Risky drinking is associated with increased postoperative complications such as infections, cardiopulmonary complications and bleeding,³²⁰ but there is relatively little research about the impacts of alcohol reduction programmes on healthcare resource usage.

A review of perioperative alcohol cessation interventions included three randomised trials. Interventions were associated with a **reduced risk of postoperative complications** (risk ratio 0.62, 95% CI 0.40 to 0.96). The reviewers concluded that intensive four to eight week alcohol cessation interventions for people undergoing various types of surgical procedures probably reduced the number of postoperative complications, but there were insufficient data to assess the effect on postoperative mortality, length of stay or the prevalence of risky drinking in the longer term.³²¹

Managing conditions

Another component of perioperative care involves supporting people to manage other medical conditions that may influence their surgical outcomes. For instance, research has explored support for people with diabetes and integrated older people's services. There are many other examples, but they do not usually report on the impact on healthcare resource use.

As the research is sparse it is not possible to draw conclusions about the resource use benefits of helping people manage their long-term conditions or other medical needs around the time of surgery. Examples of the types of research available are provided here for illustration.

Diabetes care

It is uncertain whether interventions to help people manage their diabetes before surgery impact on healthcare resource use, though there are some positive trends.³²² Such interventions may begin before surgery and continue during and afterwards.

For instance, in England people with diabetes having surgery for another reason were given a '**perioperative passport**' containing information about diabetes management. Compared to a group who did not receive the passport, these people were more likely to say that they received information about diabetes management, that they had helpful advice about medication adjustment, that they were more involved in planning their diabetes care, better prepared to manage their diabetes upon discharge and less anxious whilst in hospital.³²³

In the Netherlands, a before-and-after study in six hospitals examined ways to improve perioperative care for people with diabetes. The initiative included review of baseline performance, education for patients and professionals and a **multidisciplinary protocol**. There was an increase in the proportion of people who had their blood sugar control evaluated before (9% increase, $p < 0.05$) and after surgery (29% increase, $p < 0.05$).

There were no significant changes reported in complication rates or healthcare resource use.³²⁴

A US programme compared the impact of strict (90-120 mg/dL) or liberal (121-180 mg/dL) **blood sugar control protocols** for people with diabetes undergoing coronary bypass surgery. Over almost a year of follow-up, there were no differences in survival or health-related quality of life. The researchers concluded that liberal blood sugar control strategies before and after coronary artery bypass surgery work just as well as strict control.³²⁵

Elsewhere in the US, a hospital implemented an approach for **tight blood sugar control** in people with diabetes during and after heart surgery, including in intensive care. Good control was defined as glucose less than 130 mg/dL for more than 50% of measured time. The rate of inflammation of the chest cavity decreased from 1.6% to 0% ($p < 0.05$).³²⁶

Preventive medications

Some studies have looked at preventive medicines prior to surgery in those with specific conditions. A before-and-after analysis of implementing a prophylaxis guideline about medications such as amiodarone, beta-blockers and high-intensity statins for people undergoing cardiothoracic surgery found greater preventive medication use after the guideline was implemented. There was no significant difference in length of hospital stay or postoperative adverse events, but people who were adherent to two or three of the medications had reduced postoperative atrial fibrillation, length of hospital stay and length of intensive care stay.³²⁷

In the US, a modelling study at one hospital found that between 560 and 801 people at risk of heart problems who underwent non-cardiac surgery per year could benefit from beta-blockers. Using beta-blockers was estimated to result in 62 to 89 fewer deaths per year, saving \$US33,661 to \$40,210 per year (2002 prices).³²⁸

Initiatives to support older people

Examples from the UK

Research has also specifically explored the benefits of integrated assessment and care for older people.^{329,330} A systematic review of 218 studies explored **hospital-led multicomponent interventions** to reduce hospital stay for older people undergoing elective procedures. 39 of the studies were conducted in the UK and focused on effectiveness. Most of the studies in the review were about perioperative pathways and prehabilitation, predominantly in people having colorectal surgery or knee replacement surgery. Meta-analysis found that perioperative pathways reduced hospital stay by an average of 1.5 days among people having colorectal surgery and an average of 5 days in those having upper abdominal surgery. The evidence from the UK had very mixed study designs so was not quantitatively pooled, but had the same trends. Across the studies, patient-reported outcomes were not frequently reported. 15 varied studies included cost and cost-effectiveness evidence and this was less conclusive.³³¹

In the UK, a hospital changed the hip fracture pathway from a geriatric consultation service to a completely integrated service on a **dedicated orthogeriatric ward**. Analysing data for two years before and after this change showed that despite an increase in case complexity, an integrated older people's pathway reduced the average time to surgery (from 42 to 27 hours after hospital admission, $p < 0.05$), reduced average length of stay in hospital (from 28 to 21 days, $p < 0.05$) and reduced 30-day mortality by 22% ($p < 0.05$).³³²

Another hospital in the UK introduced a **structured geriatric liaison service** for older people undergoing surgery. This comprised a daily board round, weekly multidisciplinary meeting, targeted geriatrician-led ward rounds and a geriatric surgery checklist. The length of inpatient stay was reduced by 19% (mean 5 vs 4 days, $p < 0.05$) and postoperative complications also reduced (risk ratio 0.2, 95% CI 0.1 to 0.5, $p < 0.05$).³³³

International examples

International studies have found similar trends. A systematic review of 24 studies found that **prehabilitation targeting older people** and comprehensive geriatric assessment prior to surgery was associated with reduced length of stay.³³⁴

A hospital in **Australia** implemented a perioperative geriatric service in an acute surgical unit. A retrospective before-and-after analysis found that having a specific geriatric service helped to identify more medical complications (14% vs 33%, $p < 0.05$), increase geriatric admissions by 32% and increase surgical intervention by 11% ($p < 0.05$). There was no change in the rate of surgical complications, length of hospital stay or mortality, despite potentially increased complexity.³³⁵

Comprehensive geriatric assessment is a multidisciplinary approach to assessing the medical, psychosocial and functional capabilities and limitations of an older person to help establish a treatment and follow-up plan. A systematic review of comprehensive geriatric assessment for people awaiting surgery included eight randomised trials. The reviewers suggested that comprehensive assessment probably leads to slightly reduced length of stay but makes little or no difference to readmission rates.³³⁶

Care after surgery

Some components of perioperative care may begin after an operation. This section summarises examples of initiatives begun largely after surgery. We focus on:

- immediate support after surgery
- discharge planning
- follow-up after discharge

We do not focus on pain medications or other pharmacological approaches.

Key findings: care after surgery

Evidence about the impact on healthcare resource use of initiatives begun after surgery is relatively sparse. This may be because much information about postoperative interventions is included in studies about combined perioperative pathways.

We found 34 systematic reviews and other studies about initiatives started after surgery.

The available evidence suggests that:

- more research is needed about the effect on complications and healthcare resource use of surgical special care units, patient education after surgery and **early mobilisation** after surgery. There are some positive trends so these interventions may be worth exploring further
- **discharge planning** and early supported discharge can reduce the length of hospital stay, but it may also be associated with increased unplanned readmissions in some instances if support is not available or accessed in the community
- **proactively following up** people after discharge from hospital may help to reduce unplanned readmissions but the most effective and cost-effective way to do this remains uncertain

Immediate support

Postoperative care models

A systematic review of 21 studies compared two different models for delivering postoperative care: 1) a two-level model with wards plus intensive care units and 2) a three-level model with wards, surgical special care units and intensive care units. Surgical special care units are implemented to improve surveillance and the management of high-risk surgical patients. The review found no overall difference in in-hospital mortality, but a higher rate of intensive care unit mortality in a three-level model of care. The reviewers postulated that this may be due to lower acuity patients being moved from the intensive care unit to the surgical special care unit. There was **no difference in hospital length of stay** between the models. Two studies found that surgical special care units were associated with reduced hospital costs. The reviewers emphasised that the quality of evidence was varied and that there were many clinical and methodological differences between studies. They concluded that surgical special care units are widespread so there is a need for more robust evidence of their impacts.³³⁷

Supporting pain management

Various initiatives have been tested to support pain management. We have not reviewed medications, but we provide some examples of other interventions explored to support pain management after surgery because pain management is a component of many perioperative care pathways.

A systematic review of 15 trials examined **perioperative psychotherapy** for persistent post-surgical pain and physical impairment. Perioperative education was ineffective but active psychotherapy (cognitive-behavioural therapy, relaxation therapy or both) reduced persistent post-surgical pain and physical impairment.³³⁸

A hospital in Ireland tested **training nurses** as 'pain subject matter experts' to support people after major surgery. Feedback from patients before and after the introduction of the nurse initiative suggested that nurses had a positive impact on pain management and patients' pain beliefs, increasing satisfaction with care.³³⁹

There is preliminary evidence that personalised **music programmes** implemented on postoperative wards can help to reduce pain and anxiety after surgery for older adults.³⁴⁰

Early mobilisation

It has been hypothesised that helping people get out of bed to walk around as soon as possible after surgery may have some benefits. A review of early mobilisation on the day or day after spinal surgery reported that many studies found **reduced complications** and morbidity and a trend towards shorter length of stay.³⁴¹ Early mobilisation is also a component of many studies of enhanced care pathways, but the effects are not usually studied separately.

Postoperative patient education

Research has also explored the healthcare resource impacts of different types of postoperative education. For instance, a systematic review with eight studies explored **individualised education** and discharge planning by nurses after heart surgery. The reviewers concluded that providing tailored information increases patient self-care and empowerment which reduces readmissions.³⁴²

A systematic review of 10 studies found that patient education interventions reduced readmissions by about 23% amongst people undergoing high-risk surgeries.³⁴³

In Norway people having colorectal surgery were randomised to receive standard education from a nurse or **extended education and counselling**. Both groups received care under an integrated perioperative pathway. People who received extended counselling (before and after admission) had shorter length of stay in hospital (median 5 vs 7 days, $p < 0.05$). The authors hypothesised that perioperative counselling encourages patients to comply with postoperative elements of the pathway, thus reducing the length of hospital stay.³⁴⁴

In the US, people recovering in hospital from heart surgery were provided with iPads containing a **personalised care plan**. The plan included daily patient 'to do' lists with self-assessment modules, recovery-related patient reported outcomes, an early screen for discharge planning and daily pain and mobility self-assessments. This was a feasible approach, with patients completing 98% of the self-assessments. The self-assessments predicted length of stay and helped to plan for discharge.³⁴⁵

Discharge support

Discharge planning

Discharge planning to coordinate care has been found to reduce healthcare resource use in some instances, particularly length of hospital stay, but the evidence is mixed and some studies have found no economic benefits.

A systematic review with 10 studies found that discharge planning reduced readmissions by around 12%.³⁴⁶

A before-and-after analysis found that compared to doctor-led discharge, nurse-led discharge following laparoscopic surgery was associated with increased same day discharge (17% vs 5% doctor-led, $p < 0.05$), particularly for those who had surgery in the morning (44% vs 11%, $p < 0.05$). There was no difference between groups in readmission rates or the number seeking primary care support after discharge.³⁴⁷ Other studies have similar findings.^{348,349}

On the other hand, a systematic review included five trials of individualised discharge plans for people undergoing surgery compared to routine discharge care that was not tailored to individual patients. The reviewers concluded that individual discharge planning may improve patient satisfaction but the impact on mortality and other outcomes was unclear. There was little evidence that discharge planning reduced health service costs.³⁵⁰

Rapid discharge

A number of operations are performed on a day-case basis, whereby people can be discharged on the day of surgery. UK studies have found that day-case surgery is feasible and safe various conditions and that **patient satisfaction** is equal to or greater than those who stay in hospital longer.³⁵¹

Other countries have also suggested high satisfaction and fewer negative clinical outcomes from early discharge programmes. For instance, a hospital in Canada implemented a same-day discharge protocol for women undergoing laparoscopic hysterectomy. In the year after the protocol was introduced, 79% of women were discharged the same day compared to 18% the year prior, with no changes in complications or readmission rates. **Patient satisfaction** was high.³⁵²

A systematic review of early discharge versus standard discharge following heart surgery included eight studies. Early discharge was not associated with increased 30-day mortality or need for permanent pacemaker implantation. Early discharge patients were **less likely to be readmitted** compared with standard discharge patients (odds ratio 0.6, 95% CI 0.4 to 0.98, $p < 0.05$).³⁵³

However, there are some potential impacts for other healthcare sectors. 33% of people undergoing day-case laparoscopic gallbladder removal in England sought advice from primary care within 14 days of their operation. The researchers suggested that whilst day-case surgery was feasible and acceptable, the potential burden for primary care providers (and cost to the healthcare economy) needed further exploration.³⁵⁴

Follow-up support

Various types of follow-up support may be implemented as part of a perioperative care pathway after people are discharged from hospital. Here we provide a small number of examples to illustrate the type of initiatives that have been researched.

Step-down care

Hospital at home early discharge programmes involve active care by healthcare professionals in the patient's home for a condition that otherwise would require hospital inpatient care. A systematic review included three randomised trials of hospital at home initiatives after elective surgery. On average people were discharged from hospital four days earlier than those receiving usual care. There was no difference in readmission rates or mortality. The impact on costs was unclear.³⁵⁵

In the US women received care at home following outpatient mastectomy. There were no significant differences in emergency department visits, reoperation or readmission rates as a result.³⁵⁶

The '**patient hotel**' model was developed in Northern Europe. It combines non-acute hospital care with hospitality and can act as an interface between hospital and primary care. A systematic review identified studies of the patient hotel model in perioperative care and post-acute rehabilitation, amongst others. The approach was associated with reduced overall healthcare costs and improved patient satisfaction. However, the studies included diverse initiatives.³⁵⁷

Primary care communication

Hospital discharge summaries are the main way that UK hospitals relay information to primary care after surgery. The quality of such summaries varies and this may result in primary care contacting hospitals for clarification, particularly about wound care. A hospital trust in England distributed a wound closure information document to general practice surgeries and tested a patient-held wound care card. The intervention improved satisfaction amongst primary care professionals and **reduced follow-up appointments** or requests for further information from secondary care.³⁵⁸

Following up patients

Other studies have explored ways to follow-up patients after discharge. A systematic review of 10 studies found that primary care follow-up reduced readmissions by 8% for patients after high-risk surgeries and home visits reduced readmissions by 8%.³⁵⁹

A hospital in Northern Ireland tested following up people who had elective and minor emergency surgery. A nurse undertook a structured review with the patient six weeks after their operation. Telephone follow-ups reduced the need for an average of 410 outpatient appointments per year at this hospital, saving £41,509 per annum (2010 prices). 100% of patients were satisfied with the nurse-led telephone review. The researchers concluded that nurse-led telephone follow-up after surgery is acceptable to patients, cost-effective and **reduces the number of face-to-face outpatient reviews** needed.³⁶⁰

In Scotland nurse specialists followed up people after colorectal cancer surgery. The approach was feasible, efficient, improved patient **quality of life** and was expected to demonstrate cost savings.³⁶¹

Examples are also available from outside the UK. A randomised trial in the Netherlands tested an **online perioperative care** programme aiming to improve convalescence and speed women's return to work after gynaecological surgery. Each day that the intervention group returned to work earlier than the control group was associated with cost savings of €56 (2018 prices). The researchers stated that on average the costs of a day of sickness absence are €230 so the care programme was considered cost-effective until women could return to work.³⁶²

In the US, people undergoing hip and knee replacements used an **automated digital patient engagement platform** that provided guidance and remote monitoring. A before-and-after comparison found that the automated support system reduced the cost of follow-up care and complication rates.³⁶³

In the US, people who had knee or hip replacement received **automated text messages** after surgery. A randomised trial found that the text message group exercised for longer each day, stopped narcotic pain relief 10 days sooner and made fewer telephone calls to the surgeon's office compared to those who received conventional patient education alone.³⁶⁴

Rehabilitation

Various types of rehabilitation programmes have been found to improve patient satisfaction and functioning after surgery, whether begun in hospital or in the community.^{365,366} However many studies have found limited benefits for healthcare resource use.

In Denmark an accelerated and intensive rehabilitation programme was found to be cost saving compared to usual care for hip and knee replacement surgery (average cost reduction US\$4000 per person, 2009 prices).³⁶⁷

But many studies have found limited benefits and not been able to differentiate between types of rehabilitation.³⁶⁸ A systematic review with seventeen trials of post-discharge interventions to reduce the severity of chronic pain after knee replacement included studies about physiotherapy interventions, nurse-led interventions, multidisciplinary support and neuromuscular electrical stimulation. No intervention was associated with improved long-term pain outcomes and no type of physiotherapy was more effective than others.³⁶⁹

A systematic review of 22 trials of rehabilitation after spine surgery found that rehabilitation programmes begun immediately after surgery were not more effective than their control interventions, which included exercise. There were no differences between specific rehabilitation programmes such as multidisciplinary care, behavioural graded activity, strength training and stretching that started four to six weeks after surgery.³⁷⁰

In the US people having vocal fold cysts removed had surgery with or without postoperative voice therapy. A small before-and-after analysis found that postoperative voice therapy did not improve outcomes over surgical removal alone.³⁷¹

Summary

Impacts

This rapid review suggests that perioperative care can have clinical benefits for patients and improve healthcare resource use, particularly the length of hospital stay. Research has highlighted benefits across various types of surgery. However, there are mixed findings about some types of interventions.

The strongest and most consistent evidence is available about the following interventions

- perioperative **pathways**
- **prehabilitation**, particularly programmes including exercise alongside other initiatives

These interventions have been associated with reduced complications after surgery as well as reduced length of hospital stay. Both things may affect healthcare costs. However, the economic impact varies and the overall quality and quantity of evidence about healthcare costs and savings needs to be strengthened for most interventions. The evidence about the economic impact of perioperative care in the UK is almost non-existent.

At the time of writing there is little research about the impact of COVID-19 on the outcomes and feasibility of perioperative care. A scoping review of studies about surgery and COVID-19 found that several perioperative guidelines have been issued recently, many with contradictory suggestions. The reviewers found that, as yet, there is little empirical data about how COVID-19 has affected people needing surgery or their perioperative care nor about the role that such care could play in future pandemic planning, owing to its cross-cutting nature across health systems.³⁷²

Effective components

Perioperative care initiatives vary widely, but effective interventions typically share some common components. These include infrastructure investment, strong leadership, cooperation across a multidisciplinary team, a person-centred approach with patient education and shared decision-making, standardised protocols and documentation, and monitoring to review improvements and share learning.^{373,374,375,376,377} Preoperative education and counselling, physical conditioning, avoiding excessive alcohol and smoking, good nutrition and having patients out of bed and walking around within 24 hours of surgery may be particularly effective elements for reducing length of stay.^{378,379,380,381,382} The relative value of each component has not been studied robustly.³⁸³

There are some caveats about the available evidence, not least of which deciding what 'counts' as perioperative care. Many of the interventions included in pathways include changes to medications or surgical techniques, rather than multidisciplinary care before, during and after surgery.³⁸⁴ Much of the evidence is about surgery in adults, rather than in children.³⁸⁵

Even recognising these issues with definitions, scope and the limited information about cost impacts, this review suggests that perioperative care initiatives can reduce complications and length of stay in a range of different types of surgery.

Many components of the perioperative care pathway already exist within the NHS. Our rapid review suggests that drawing on and strengthening these existing skills and services further has the potential to improve the health and satisfaction of people having surgery and better use NHS resources.

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