



# The economic benefits of enhanced recovery after surgery programmes

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**Abstract:** The global economic burden of healthcare is set to continue to grow for the foreseeable future and methods must be sought to mitigate this burden whilst maintaining the high standard of care we expect to deliver to our patients. There have been numerous studies abundantly demonstrating the benefits of enhanced recovery after surgery (ERAS) programmes and more recently these have included studies looking into the economic benefits. It has now been demonstrated that implementation of ERAS programmes can deliver an overall cost-saving per patient for the institution delivering the surgery itself but also the wider community including primary care providers. Initial implementation is likely to incur an initial cost to the provider, most commonly in the form of employing new, dedicated ERAS personnel or procurement of new medications. Subsequent savings are largely the result of patient's stay on critical care and within the hospital itself with both likely to be significantly reduced if a patient is enrolled on an ERAS programme. This article explores the literature currently available which has looked into the health economics surrounding ERAS programmes for a number of surgical specialities and from around the world.

**Keywords:** Enhanced recovery after surgery (ERAS); enhanced recovery; health economics

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Since the inception of enhanced recovery after surgery (ERAS) programmes, numerous papers, including systematic reviews with meta-analyses, have demonstrated significant benefits for patients. As a result, multiple institutions and healthcare systems which look after these patients have also seen the benefit of developing and introducing ERAS where possible. This article aims to explore the expected global burden of healthcare and how ERAS can help mitigate these costs whilst maintaining the high standard of perioperative care we and our patients expect.

The world's population is expected to grow by 10% from 7.7 billion in 2019 to 8.5 billion by 2030 according to the United Nations (1). Around the world, healthcare systems are having to find new ways to manage patients in a

more efficient and cost-effective manner whilst maintaining the standard of care. Global healthcare expenditure is expected to grow at an annual rate of 5.4% until 2022 from \$7.7 trillion in 2017 to \$10 trillion in 2022. This is from a previous rate of 2.9% from 2013–2017. There is, of course, tremendous global variation in per capita spending from \$11,674 in the US to \$54 in Pakistan (2). Ageing populations contribute to this issue, and have a higher incidence of neoplastic disease (expected to double by the year 2035 (3)), with many of these patients requiring surgery as part of their treatment, alongside diseases associated with old age, and the increased costs of novel therapies.

Often the primary outcome of studies looking into the efficacy of any ERAS programme is hospital length

of stay. This is seen as a suitable surrogate for a patient's initial recovery as it will be affected by the incidence of complications and the patient's ability to sufficiently mobilise and manage their pain prior to leaving hospital. The first paper to describe the use of a "fast-track" programme of recovery was pertaining to coronary bypass surgery and reported a significant decrease in critical care and hospital length of stay (4). A year later Henrik Kehlet's group published the first paper relating to a novel and successful approach to recovery following laparoscopic colorectal surgery and, again, hospital length of stay was one of their primary outcomes (5). Kehlet followed this up in the year 2000 with his landmark paper describing an accelerated recovery programme for open colorectal surgery. This paper further fuelled the enthusiasm for accelerated or enhanced recovery programmes predominantly on the basis of reduced hospital length of stay and reduced rate of complications (6).

There stands to reason that reduced critical care and overall hospital length of stay, coupled with reduced complication rates, will have a likely positive impact upon the overall cost of care for individual patients. This hypothesis has been confirmed by a number of studies demonstrating a cost-benefit for patients enrolled in ERAS programmes for many specialities and procedures.

It should be noted that the implementation of an effective ERAS programme is unlikely to be without cost. The extent of this is highly variable and can depend on the infrastructure and personnel already available within an organisation.

One of the first papers to link simple postoperative recovery strategies to cost saving was published in 2006 and noted the significant reduction in the rate of ileus as a result of gum chewing after elective sigmoid resection surgery. The resultant reduced length of stay was estimated to save nearly \$120 million with an extra expenditure of \$47,531 nationwide to purchase the chewing gum (7). Although this was not part of an overarching ERAS programme it demonstrates how evidenced-based changes in practice can produce considerable benefits to both patient and healthcare systems. In 2010, Sammour *et al.* from New Zealand published a paper which recognised the initial cost burden of setting-up an ERAS programme and asked whether this was offset by any savings made. They concluded that through significant reductions in hospital length of stay, fluid administration, time to remove epidural and complications there was an overall saving of NZ\$6,900 per patient despite an initial set-up cost of

around NZ\$102,000 (8).

In 2006 a study was published in the *Br J Surg* which was designed to demonstrate how laparoscopic surgery can be as effective as open for colorectal cancer surgery. Both arms of the study were enrolled in an ERAS programme, but the study also looked into costs up to three months postoperatively. The overall conclusion was that laparoscopic surgery is as safe as open with improved short-term outcomes but they also demonstrated a small but significant cost benefit favouring laparoscopic surgery (9). This has been previously reported in a case-matched and a randomized-controlled trial (10,11). Conversely, regarding cost, another paper found that theatre costs themselves were higher with laparoscopic surgery due to longer operating times and increased use of disposable equipment. These costs were more than offset, however, by perioperative savings including reduced re-operating and indirect costs giving an overall saving of £353 per patient (9).

### Gynaecological surgery

There have been several papers reporting cost-savings having implemented ERAS programmes for gynaecological surgery (12-15). Pache *et al.* included details of the costs of implementing an ERAS programme for gynaecological surgery. The main areas of expenditure were personnel, such as employing a specialist nurse for ERAS, administrative time, consumables, including carbohydrate pre-load drinks, and investment in an ERAS audit database system. Overall the average cost per patient for ERAS-specific expenditures was calculated to be approximately \$687. Total costs, however, were found to be \$4,381 lower for ERAS patients compared to their pre-ERAS programme. Intraoperatively costs were higher for ERAS patients although the difference was not found to be statistically significant. The savings were found to come predominantly from reduced critical care, medical care and nursing care costs (although the latter, again, was not statistically significant). The group also evaluated the evolution of costs over the three year period during which the study took place and found that costs decreased during this time. The decrease was noted in intraoperative costs (although not statistically significant) and perioperative costs with an overall cost reduction from \$15,190 per patient in year one to \$12,640 in year three. Costs-savings were more pronounced in patients undergoing major debulking surgery with costs in pre-ERAS patients of \$35,872 per patient compared to \$18,971 per patient in the ERAS group. Owing to a small sample

size this was not statistically significant. Interestingly costs remained stable over the three years of the study for these patients. Overall the group reported a saving of \$1.4 million over the study period having implemented their ERAS programme for gynaecological surgery patients (16).

### Urological surgery

Urological surgery is a popular speciality for the implementation of ERAS and subsequent publication of the resulting cost implications. Nabhani *et al.* [2016] looked into implementing ERAS for radical cystectomy patients and the short-term (30-day) costs. They found a statistically significant reduction in overall costs from \$31,139 for standard management down to \$26,650 for those in an ERAS programme giving an overall saving of \$4,488 ( $P < 0.0001$ ). They reported the most significant savings came from reduced critical care needs, surgical ward costs, ancillary treatment and supplies although medication costs were considerably higher in the ERAS group. One of the more expensive medication expenditures was in acquiring alvimopan, and opioid antagonist used to help in the prevention of ileus. This drug has independently been found to help reduce overall cost of care for patients undergoing radical cystectomy (17). Interestingly, Nabhani *et al.*'s study reported increased outpatient attendances and associated costs within 30 days of surgery. This was felt to be attributable to the increased level of contact with the multidisciplinary team patients received thus giving them easier access to outpatient services and encouragement to use them if felt necessary. The authors commented that as this was a new programme there was a heightened level of concern amongst the healthcare team regarding their patients, not least as they were being discharged from hospital earlier, thus the threshold for asking patients to attend outpatients postoperatively was lower. These extra postoperative costs were incorporated into the overall cost analysis which remained considerably in favour of the ERAS group (18).

### Colorectal surgery

A systematic review by Lee *et al.* in 2014 showed early evidence that ERAS for colorectal surgery was likely to be cost-effective, albeit with limited quality of evidence at the time (19). In the same year Lemanu *et al.* also published a systematic review looking into cost savings and all the studies they found reported savings but with huge variation

and some not statistically significant (20). A study from Xi'an, China, in 2014 looking into the implementation of a fast-track programme alongside laparoscopy broadly stated that this would reduce hospital costs as a result of improved recovery and shorter hospital length of stay (21). In 2015 Lee's group from Montreal, Canada, reported a cost-saving for colorectal surgery having implemented an ERAS programme of a mean of just under \$3,000 per patient. They also reported earlier return to work and reduced caregiver burden which will have an impact on the wider health economics involved in caring for these patients (22). The most striking paper to report on cost-savings for patients enrolled in an ERAS programme for colorectal surgery came from Nelson's group in Alberta, Canada. This was a large study (over 1,500 patients) incorporating six hospital sites within the province. They demonstrated a saving of \$1,768 per patient and, perhaps more usefully, showed a return of \$3.8 for every \$1 invested in developing and implementing the ERAS programme (23).

### Hepatobiliary surgery

Several papers have been published demonstrating costs savings for hospitals having implemented ERAS for certain surgical procedures within this speciality. Joliat *et al.* reported a roughly \$7,000 saving per patient undergoing pancreatoduodenectomy surgery. The majority of this saving coming from reduced critical care costs (€9,139 *vs.* €13,793 for ERAS and pre-ERAS patients respectively) (24). A team from the same hospital in Switzerland also reported savings for patients undergoing liver surgery. The saving was more moderate at €3,080 per patient but still important albeit not statistically significant (25). As yet unpublished data from a study by Jones *et al.* demonstrated a cost saving of £864 per patient having introduced an ERAS programme for open liver resection surgery. This in-hospital cost-saving did not appear to result in higher costs to the community (26) on the basis of a health economics analysis which suggested the savings were also demonstrated outside hospital (27). Finally, in China, a group from Qingdao demonstrated a saving of 8,998.48 Yuan (US\$1367.51) per patient undergoing hepatectomy surgery with their greatest cost saving arising from reduced medication requirements (28).

### Vascular surgery

A study from Japan reported reduced costs for patients

**Table 1** Summary of costs savings

Author/Year/Country	Speciality	Saving per patient (US\$ as per August 2019)
Relph <i>et al.</i> /2014/UK	Gynaecology	£165 (\$200)
Torbe <i>et al.</i> /2012/UK	Gynaecology	£198 (\$240)
Yoong <i>et al.</i> /2014/UK	Gynaecology	£106 (\$129)
Kalogera <i>et al.</i> /2013/USA	Gynaecology	\$7,600
Pache <i>et al.</i> /2019/Switzerland	Gynaecology	\$4,381
Lemanu <i>et al.</i> /2014/NZ	Colorectal	€153–6,537 (\$170–7,249)
Feng <i>et al.</i> /2014/China	Colorectal	Approx. RMB5,000 (\$708)
Sammour <i>et al.</i> /2010/NZ	Colorectal	NZ\$6,900 (\$4,429)
Lee <i>et al.</i> /2015/Canada	Colorectal	\$2,985
Nelson <i>et al.</i> /2016/Canada	Colorectal	\$1,768
Nabhani <i>et al.</i> /2016/USA	Urology	\$4,488
Joliat <i>et al.</i> /2015/Switzerland	Hepatobiliary	Approx. €7,500 (\$8,317)
Jing <i>et al.</i> /2018/China	Hepatobiliary	\$1,367
Tatsuishi <i>et al.</i> /2012/Japan	Vascular	8% less than pre-ERAS cost

ERAS, enhanced recovery after surgery.

undergoing open abdominal aortic aneurysm repair as part of an ERAS programme. Largely through a significantly reduced hospital length of stay costs in the ERAS group was 92% that of those in the control group (29).

## Conclusions

There is overwhelming and wide-ranging evidence that ERAS programmes offer sometimes considerable cost savings for healthcare systems which implement them (Table 1). This is despite the initial costs of implementation and certain elements of the programmes such as medications and personnel. It is highly likely that as these programmes become more established within these organisations that the costs savings will become more pronounced as practices become more engrained into the day-to-day workings of surgical teams. More research is required to look into the longer-term cost implications of ERAS programmes to ensure any savings are not transferred into community settings but early indications suggest that this is not the case.

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## Footnote

*Conflicts of Interest:* The authors have no conflicts of interest to declare.

*Ethical Statement:* The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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