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Enhanced Recovery After Surgery
A Review

Olle Ljungqvist, MD, PhD; Michael Scott, MD; Kenneth C. Fearon, MD, PhD†

IMPORTANCE Enhanced Recovery After Surgery (ERAS) is a paradigm shift in perioperative care, resulting in substantial improvements in clinical outcomes and cost savings.

OBSERVATIONS Enhanced Recovery After Surgery is a multimodal, multidisciplinary approach to the care of the surgical patient. Enhanced Recovery After Surgery process implementation involves a team consisting of surgeons, anesthetists, an ERAS coordinator (often a nurse or a physician assistant), and staff from units that care for the surgical patient. The care protocol is based on published evidence. The ERAS Society, an international nonprofit professional society that promotes, develops, and implements ERAS programs, publishes updated guidelines for many operations, such as evidence-based modern care changes from overnight fasting to carbohydrate drinks 2 hours before surgery, minimally invasive approaches instead of large incisions, management of fluids to seek balance rather than large volumes of intravenous fluids, avoidance of or early removal of drains and tubes, early mobilization, and serving of drinks and food the day of the operation. Enhanced Recovery After Surgery protocols have resulted in shorter length of hospital stay by 30% to 50% and similar reductions in complications, while readmissions and costs are reduced. The elements of the protocol reduce the stress of the operation to retain anabolic homeostasis. The ERAS Society conducts structured implementation programs that are currently in use in more than 20 countries. Local ERAS teams from hospitals are trained to implement ERAS processes. Audit of process compliance and patient outcomes are important features. Enhanced Recovery After Surgery started mainly with colorectal surgery but has been shown to improve outcomes in almost all major surgical specialties.

CONCLUSIONS AND RELEVANCE Enhanced Recovery After Surgery is an evidence-based care improvement process for surgical patients. Implementation of ERAS programs results in major improvements in clinical outcomes and cost, making ERAS an important example of value-based care applied to surgery.

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The Enhanced Recovery After Surgery (ERAS) protocol was developed by a group of academic surgeons in Europe in 2001 when they formed the ERAS Study group (**Table 1**). Although the term *fast-track surgery* had been described, the group wanted to emphasize that the key surgical end point is the quality, rather than speed, of recovery. The concept rested on several components: a multidisciplinary team working together around the patient; a multimodal approach to resolving issues that delay recovery and cause complications; a scientific, evidence-based approach to care protocols; and a change in management using interactive and continuous audit. This review describes the development of ERAS, how these ideas are brought into practice, and how they are now spreading to various disciplines of surgical practice, as well as some of the main outcome improvements and an implementation strategy to achieve sustained outcome improvements.

A project to improve outcomes of coronary artery bypass surgery by bundling perioperative treatments under a concept name, *Fast Track*, was published in 1994.[1] This study showed a reduction in length of stay in the intensive care unit by about 20%. A year later, Bardram et al[2] reported a substantial shortening of recovery time in 8 patients undergoing sigmoid resection who were discharged 2 days after surgery. This publication was followed by a report by Kehlet and Mogensen[3] of a larger series confirming a rapid recovery after sigmoid resection using a multimodal approach. Kehlet, a surgeon, promoted thoracic epidural anesthesia as a way of controlling pain, improving mobility, and reducing postoperative ileus. Concurrently, other ERAS group members were addressing perioperative care from an endocrine[4] and metabolic viewpoint. This approach included the roles of specific amino acids in perioperative nutrition,[5] inflammation and protein metabolism in surgical patients with cancer,[6] and metabolic preparation using a preoperative carbohydrate drink to avoid effects of fasting.[7] The group was focused on enhancing recovery and reducing complications by modifying the metabolic response to surgical insult rather than just limiting length of stay.

Table 1. Member Sites and Leads of the Original Enhanced Recovery After Surgery Study Group Formed in 2001

University and Hospital	Country	Lead(s)
University of Edinburgh	United Kingdom	Ken Fearon
Karolinska Institutet and Ersta Hospital Stockholm	Sweden	Olle Ljungqvist
University of Copenhagen and Hvidovre Hospital	Denmark	Henrik Kehlet
University of Northern Norway and Tromsö Hospital	Norway	Arthur Revhaug
University of Maastricht	The Netherlands	Martin von Meyenfeldt, Cornelius DeJong

The ERAS group gathered in London in 2001 to produce a protocol that would optimize outcomes based on published evidence.[8] The group also published reports of variable outcomes in similar surgical procedures and populations demonstrating that perioperative care, rather than the actual operation, dictated the outcomes.[9] Several surveys confirmed that perioperative care was variable across Northern Europe and that there was minimal adoption of evidence-based practices.[10] The group worked together developing ERAS by testing protocols, running symposia, and involving national health ministries (such as the Enhanced Recovery Partnership Programme in the United Kingdom). Although ERAS concepts became widely recognized, there was still minimal change across most health care systems. The ERAS Society (http://www.erassociety.org) was founded to focus and consolidate progress not only through research and education but also by developing models for implementation of best perioperative practices.

The Rationale of ERAS

A fundamental challenge in the care of the surgical patient lies with the journey the patient makes through various parts of the hospital: outpatient clinics, preoperative units, the operating room, postoperative recovery facility, and the ward. Each unit has its own focus, personnel, and specialists. Each unit affects the ones to follow by the treatment choices made. For example, if the surgeon orders oral bowel preparation, the anesthetist may face a dehydrated patient to manage on induction of anesthesia. Few stakeholders in the surgical pathway have the opportunity to see a patient through the entire journey. Hospital staff are often focused on managing the immediate clinical situation with little opportunity for strategic thinking. There are 24 core elements of ERAS care that have scientific support for their use (**Table 2**). These components are distributed along the patient pathway and delivered by different departments and professionals within the hospital (**Figure**), which explains why the surgeon, as the clinician with overall responsibility for the patient, has the best opportunity for a comprehensive view to guide the process.

Consistent agreement on the end points of management is critical for coordinated action. For example, the patient is medically suitable to leave the hospital when the following conditions are true: he or she can eat and drink to fulfill daily needs, the bowels are moving, pain is controlled by oral analgesics, he or she is capable of sufficient mobility for self-care, and there are no complications requiring hospital care.

Table 2. ERAS Society Guideline Elements for Colonic Resections[a]

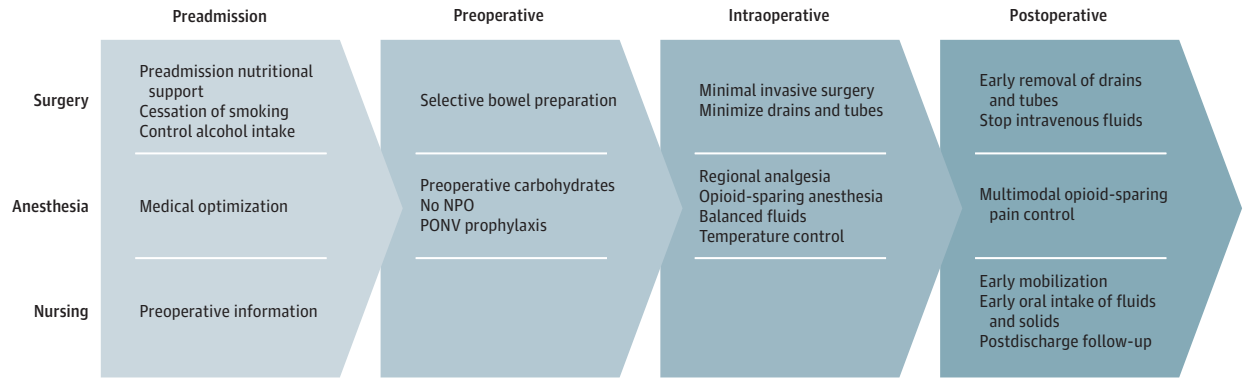
Element	Target Effect and/or Comment
Preadmission	
Cessation of smoking and excessive intake of alcohol	Reduce complications
Preoperative nutritional screening and, as needed, assessment and nutritional support	Reduce complications
Medical optimization of chronic disease	Reduce complications
Preoperative	
Structured preoperative information and engagement of the patient and relatives or caretakers	Reduce anxiety, involve the patient to improve compliance with protocol
Preoperative carbohydrate treatment	Reduce insulin resistance, improve well-being, possibly faster recovery
Preoperative prophylaxis against thrombosis	Reduce thromboembolic complications
Preoperative prophylaxis against infection	Reduce infection rates
Prophylaxis against nausea and vomiting	Minimize postoperative nausea and vomiting
Intraoperative	
Minimal invasive surgical techniques	Reduce complications, faster recovery, reduce pain
Standardized anesthesia, avoiding long-acting opioids	Avoid or reduce postoperative ileus
Maintaining fluid balance to avoid over- or underhydration, administer vasopressors to support blood pressure control	Reduce complications, reduce postoperative ileus
Epidural anesthesia for open surgery	Reduce stress response and insulin resistance, basic postoperative pain management
Restrictive use of surgical site drains	Support mobilization, reduce pain and discomfort, no proven benefit of use
Removal of nasogastric tubes before reversal of anesthesia	Reduce the risk of pneumonia, support oral intake of solids
Control of body temperature using warm air flow blankets and warmed intravenous infusions	Reduce complications
Postoperative	
Early mobilization (day of surgery)	Support return to normal movement
Early intake of oral fluids and solids (offered the day of surgery)	Support energy and protein supply, reduce starvation-induced insulin resistance
Early removal of urinary catheters and intravenous fluids (morning after surgery)	Support ambulation and mobilization
Use of chewing gums and laxatives and peripheral opioid-blocking agents (when using opioids)	Support return of gut function
Intake of protein and energy-rich nutritional supplements	Increase energy and protein intake in addition to normal food
Multimodal approach to opioid-sparing pain control	Pain control reduces insulin resistance, supports mobilization
Multimodal approach to control of nausea and vomiting	Minimize postoperative nausea and vomiting and support energy and protein intake
Prepare for early discharge	Avoid unnecessary delays in discharge
Audit of outcomes and process in a multiprofessional, multidisciplinary team on a regular basis	Control of practice (a key to improve outcomes)

Abbreviation: ERAS, Enhanced Recovery After Surgery.

[a] For details and references, see the guidelines at http://www.erassociety.org.

The ERAS elements of the program for colonic resection are listed in Table 2. Most of the solutions to problems delaying recovery are evident once the perioperative care pathway is exhibited in

Figure. Enhanced Recovery After Surgery (ERAS) Flowchart



A typical ERAS flowchart overview indicating different ERAS protocol items to be performed by different professions and disciplines in different parts of the hospital during the patient journey. The wedge-shaped arrows depicting each time period move into the period to follow to indicate that all treatments given affect later treatments. No NPO indicates fasting guidelines recommending intake of clear fluids and specific carbohydrate drinks until 2 hours before anesthesia; PONV, postoperative nausea and vomiting. Reprinted with permission from Olle Ljungqvist, MD, PhD.

total, which is often best achieved in a multidisciplinary meeting. This method is how the ERAS Society runs its various implementation programs.

Multimodal Care

No single element by itself will improve outcomes of surgery. The approach to perioperative care must be multimodal, using all available elements of care that improve recovery. The key is to seek synergy between one process element and the next. Since elements of ERAS are implemented by different medical and health care specialties working in different departments, a multidisciplinary approach is necessary. The elements of care are carried out by many professionals: nurses, dieticians, and physiotherapists alongside physicians and surgeons.

The ERAS Team

The core of changing practice and realizing the benefits of ERAS is a team of the key individuals from the involved units. The medical leadership is most commonly a surgeon, supported by an anesthetist. The ERAS clinical leaders hold the medical responsibility for the ERAS program, and their role as local champions is important.[11] The ERAS project manager is commonly a nurse, who facilitates the resources and management approval to enact change. The ERAS coordinator (in Europe often a nurse or, in the United States, a physician assistant) fills a key role as the "engine" of the ERAS team, with time devoted to managing practical matters, which might include such tasks as composing and distributing memos and instructions, managing reporting and feedback to the units, and arranging for continuous training of new personnel. This individual is well positioned to manage the audit process. Participation from the other disciplines, including special services such as dietetics, occupational therapy, and physiotherapy, is critical to sustained performance.

The Patient's Journey

Consistent and well-attended team meetings are critical to implementation and improvement of the ERAS program (Figure). At the outset, a unit should meet weekly to audit compliance and implement necessary changes to improve practice. After some time, the meeting frequency can be reduced to every other week, but attendance at meetings must remain an established commitment for each team member.

Evidence-Based Guidelines

The ERAS Group published an initial consensus document on perioperative care for colonic resections[8] and later one for colorectal surgery.[12] After the ERAS Society was formed in 2010, the Society published a series of guidelines (**Table 3**) and special papers with procedure-specific recommendations, which form the basis for the protocols built into the audit system. Society members have also tested the efficacy of the guidelines. For example, in a single-center report of more than 900 consecutive patients, improved compliance with the colorectal surgery guidelines resulted in a shorter length of stay, fewer complications, and fewer readmissions.[13] A follow-up study from the ERAS Interactive Audit system with more than 2300 consecutive patients in 13 units in 7 countries confirmed these results.[14]

Audit

Because of the complexity of the care process, the team is helped by performing continuous audit of the care process and patient outcomes to maintain a comprehensive view. Based on the guidelines, the ERAS Society has developed a specific audit system for this purpose, the ERAS Interactive Audit System, which is used in the ERAS Implementation Programs (http://www.erassociety.org) and is

Table 3. ERAS Society Guidelines[a]

Procedure and Topic	Year of Publication
Colonic resection	2012
Rectal resection	2012
Pancreaticoduodenectomy	2012
Cystectomy	2013
Gastric resection	2014
Anesthesia protocols	2015
Anesthesia pathophysiology	2015
Major gynecology (parts 1 and 2)	2015
Bariatric surgery	2016
Liver resection	2016
Head and neck cancer surgery	2016
Breast reconstruction	2017
Hip and knee replacement	Under production
Thoracic noncardiac surgery	Under production
Esophageal resection	Under production

Abbreviation: ERAS, Enhanced Recovery After Surgery.

[a] For updates and free download, go to http://www.erassociety.org.

currently available in France, Germany, Norway, Portugal, Spain, the Netherlands, the United Kingdom, Sweden, Canada, the United States, Mexico, Brazil, Colombia, Argentina, Singapore, the Philippines, New Zealand, Israel, Uruguay, Chile, and South Africa.

Health care professionals, and perhaps surgeons in particular, tend to believe that their care and outcomes are better than they actually are. During years of work with the ERAS programs, we have rarely encountered surgeons who believed that their patients who underwent colorectal surgery are hospitalized for more than 3 to 4 days. However, even in the countries that adhere most strongly to the ERAS protocol, national and individual hospital data for these patients still reflect an average length of stay of 7 to 8 days. In many countries, the hospital stays are longer or data on length of stay are not available (Swedish Colorectal Cancer Registry[15]; National Health Service Scotland; National Bowel Cancer Audit report 2015[16]; and Office fédéral de la statistique médicale des hôpitaux, Suisse 2016[17]). Finally, some surgical teams believe that they adhere to ERAS principles while, in fact, they are using them only in part. Compliance with 70% to 80% or more of the elements of the ERAS protocol appears to be important to improve outcomes.[11]

Implementation of ERAS

Recently, interest in ERAS has grown substantially, revealing a deficit in education and training, as few courses are targeted to hospital teams. Implementation of new practices is difficult, and new treatments are slow to disseminate to active practice. Evidence suggests that change in clinical practice occurs 15 years after clear evidence is available.[10] There is a need to support the medical and surgical community to implement new and better care more quickly. About 310 million major operations are performed annually.[18] Data suggest that ERAS processes can reduce complications by 10% to 20% or more by supporting units to adopt evidence-based care.[13,14,19,20] The primary vision of the ERAS Society is to help units use current best practice. Since its foundation, the ERAS Society has been actively involved in implementation of these evidence-based processes. To develop an implementation program, the ERAS group worked with change-management specialists in the Netherlands and Sweden to help implement ERAS guidelines and protocols. By using this method, the Dutch team helped more than 30 colorectal units improve their outcomes by using ERAS recommendations. With a structured implementation program that lasted 10 months, the units' mean length of stay decreased from 9 to 10 days to 6 days.[21] A subsequent follow-up in the 10 most successful units showed that length of stay in most of the units had increased again. This increase correlated with a reduction in compliance with ERAS pathway elements in the absence of ongoing education and audit.[22] Based on this experience, the ERAS Society developed an implementation program rooted in sustainability.[23] A growing amount of literature on barriers to implementation reports that factors that enable the successful implementation of ERAS include not only a willingness to change to ERAS, formation of multidisciplinary teams and thereby improved communication and collaboration, and support by hospital management but also standardization of order sets and care processes and the use of audit.[24,25] Good local leadership and local champions are important success factors.[11] Conversely, barriers to implementation are a general resistance to change, lack of time and staff, and poor communication, collaboration, and coordination between departments.[24,25]

It is also important to implement additional changes in light of new evidence. In colorectal surgery, the ERAS Society has revised the guidance 3 times in 10 years and a fourth revision is under way. Building a system that is ready to make the next change is the key to quicken the pace of implementation of better care.

An important goal for the ERAS Society is to build a network of hospitals around the world that uses a consistent audit tool. The resulting data set will facilitate research, including the development of new ERAS protocols. The ERAS Society includes active centers in several countries that are trained to implement ERAS processes in their country or region. These centers can use the centralized, internet-based audit system that establishes the platform for the introduction of the next change. Enhanced Recovery After Surgery pathways continue to be developed, and current evidence is reexamined by the ERAS guidelines group to keep up to date with changes in practice. An example is the move away from routine thoracic epidural anesthesia for laparoscopic colorectal surgery[26] in favor of combining spinal analgesia or transverse abdominis plane blocks with general anesthesia. By having many centers contribute to the audit process, changes in care pathways can be introduced and the downstream effect measured. It is equally important to maintain consistent compliance with the ERAS protocol once it is introduced. A follow-up study 3 to 6 years after a successful implementation of the ERAS protocol revealed that loss of continuous feedback with audit during a postimplementation program was a reason for diminishing effectiveness.[25] Reminders and boosters in education, updates in small groups, and retaining the ERAS coordinator were other factors believed to be important for sustainability.

Elements of ERAS

The ERAS Society guidelines for colonic resections in Table 2 and the Figure are examples of elements commonly used in this

procedure.[27,28] Enhanced Recovery After Surgery programs typically contain several elements with 1 emphasis in common: they minimize stress and improve the response to stress. By maintaining homeostasis, the patient avoids catabolism with consequent loss of protein, muscle strength, and cellular dysfunction.[29] The reduction of insulin resistance promotes adequate cellular function during injury to the tissue. The following series of elements contributes to this goal: preoperative nutritional support for the patient who is malnourished, carbohydrate loading before surgery to minimize postoperative insulin resistance, epidural or spinal analgesia to reduce the endocrine stress response, anti-inflammatory drugs to reduce the inflammatory response, early feeding after surgery to secure energy intake, and optimal pain control to avoid stress and insulin resistance.

Enhanced Recovery After Surgery processes also aim to minimize fluid shifts. Too little fluid can cause a reduction in perfusion and organ dysfunction, whereas intravenous salt and fluid overload is recognized as a major cause of postoperative ileus and its complications.[30,31] Maintaining euvolemia, cardiac output, and delivery of oxygen and nutrients to the tissues are important to preserve cellular function, particularly when there is tissue injury and need for repair. Once patients are euvolemic, vasopressors may be used as required to maintain mean arterial pressure. Targeting minimal weight change (≤30 mL/kg net intake of intravenous fluid, keeping weight gain within 2 kg) is typically recommended. Postoperative intravenous fluids are generally discontinued at about 24 hours after surgery. A patient progressing normally on an ERAS pathway should be drinking, eating, mobilizing, and sleeping on the day after operation. The ERAS program also avoids several traditional care elements that have been shown to be harmful, such as the routine use of nasogastric tubes, prolonged urinary catheterization, and prolonged or inappropriate use of abdominal drains.

Outcomes With the ERAS Protocol

There are many stakeholders in surgical care, with ERAS processes putting the patient at the center. Professionals from various disciplines as well as managers, politicians, payers, and the general public are involved, as are the medical device and pharmaceutical industries.

Length of Stay

The broader ERAS principles have been published for many types of procedures in all major surgical specialties. The early studies showing a 2-day hospital stay after sigmoid resection[2,3] were often met with disbelief, and some thought (incorrectly) that it was careful selection of patients that resulted in a shortened length of stay. Now, diverse groups publishing on consecutive series and using ERAS principles show consistent results,[32] and, with the addition of laparoscopic techniques, the same results have been demonstrated in patients with complex medical conditions.[33]

Complications

A meta-analysis of randomized trials of the ERAS protocol in patients undergoing colorectal surgery showed that complication rates were reduced by up to 50% when ERAS principles were used.[19] This finding was confirmed in a larger series.[20] Further data from more than 900 consecutive patients with colorectal cancer showed the effectiveness of ERAS protocols and highlighted the importance of compliance: the better the compliance to the protocol, the better the outcomes in terms of complications, length of primary and total stay, and readmissions.[13,14] These studies revealed that not only were overall complications reduced with better compliance, but the most severe complications, which resulted in reoperations or admission to the intensive care unit, decreased as mortality improved.[14,34] Fit patients undergoing colorectal cancer surgery using ERAS principles and laparoscopic surgery can be discharged within 24 hours, with a mean length of stay of 2.7 days.[35]

Colorectal surgery was the basis for the development of ERAS and still dominates the literature; however, in many other surgical domains, the implementation of ERAS patient care and principles of process improvement have improved outcomes. Studied areas include liver resections[36]; pancreatic, gastric, and esophageal surgery[37,38]; thoracic surgery[39]; major urologic surgery[40]; gynecologic surgery[41]; orthopedic surgery[42,43]; and emergency surgery.[44]

Financial Effects of the Implementation of ERAS

Although most reports of ERAS come from single units, with developers and early adopters achieving some of the best results, the challenge lies with having most surgical procedures performed using ERAS principles. In the United Kingdom, the National Health Service ran the Enhanced Recovery Partnership Programme,[45] based on lectures by experts and early adopters along with the provision of treatment protocols and advice. The program encompassed not only colorectal surgery but also cystectomy, gynecologic surgery, and hip and knee replacement. Adoption of some of the ERAS elements was incentivized by bonus payments, but most of the maintenance of ERAS pathways relied on local peer groups to continue the pathways in whatever manner they considered appropriate. Although some units continue to produce excellent results, the Enhanced Recovery Partnership Programme lacked resources to support sustainability, and the overall results have been difficult to discern in national statistics.

In Alberta, Canada, the state health care service worked with the ERAS Society to implement ERAS, starting with colorectal surgery. The ERAS Society provided training in the first 2 hospitals, which are now supporting training in other hospitals using the same principles. The first results are promising, with shorter stay (reduction from 6 to 4½ days) and an 11% reduction in complications.[46] There were 8% fewer readmissions and a shorter stay for those readmitted, saving $2800 to $5900 per patient.

Long-term Benefits of ERAS

The longer-term benefits of rapid, uncomplicated recovery using ERAS principles are less well known. Medium-term outcomes have been sparsely studied,[47] and long-term data on outcomes are now beginning to appear. One observational study in 4500 patients undergoing hip and knee replacement showed that 2-year mortality was significantly lowered after the introduction of ERAS principles.[48] A report on more than 900 patients with colorectal cancer showed that, with compliance above 70% with the ERAS preoperative and

intraoperative protocol, mortality fell by 42% compared with patients with compliance below 70%.[34] In this study, the data were adjusted for several variables, including age, sex, body mass index, American Society of Anesthesiologists score, surgical procedure, and pathologic findings. The data show an association rather than causation and other biases may have contributed directly or indirectly. For example, the group with higher compliance had fewer complications, which may have affected the observed outcomes. Perioperative complications have been shown to be strongly associated with poor long-term outcomes in very large surgical series.[49] In cancer treatment, surgical complications may also delay the initiation of postoperative chemotherapy which in turn may contribute to reduced long-term survival. Complications also increase the cost of care.[50] Enhanced Recovery After Surgery programs are thus supporting a combination of better outcomes and cost savings.

The Future of ERAS

As ERAS principles are applied across all surgical specialties, ongoing innovation must continue to allow processes to improve. There is increasing focus on procedure-specific specialty items to attempt to improve outcomes. The ERAS Society continues to work alongside various national ERAS Societies in the European Union, Asia, and the United States. The ERAS Society and its national societies also collaborated with established professional specialty groups, such as the Society of American Gastrointestinal and Endoscopic Surgeons, by co-authoring the *Manual of Enhanced Recovery*[51] and have worked closely with ERAS USA (the ERAS Society chapter that is recently formed in the United States) as well as supported the slightly older American Society of Enhanced Recovery. The goal of the ERAS Society is to complement the programs of these national groups and to offer additional value by coordinating activity worldwide and by hosting professional meetings and events for many national groups. The ERAS Society has hosted an Annual World Congress since 2012 and is active in currently mining the substantial data available from the ERAS Interactive Audit System. The system provides the basis for both prospective trials and audit research. Audit-based research is completed using large numbers of patients on the same pathway. Making a single-step change and analyzing the downstream effect using regression analysis may be a complementary way to study new interventions rather than relying on expensive randomized clinical trials.

Conclusions

Enhanced Recovery After Surgery programs represent a paradigm shift in how surgical care is delivered and how changes in practice are disseminated and implemented. These results rely on a new approach to teamwork, continuous audit, and support of data-driven change and improvement. Enhanced Recovery After Surgery practices improve the opportunity for rapid, uncomplicated recovery after surgery with both short- and long-term benefits for patients while improving quality and saving money.

There is financial pressure surrounding health care spending, as limited societal funds to support health care meet rising demands owing to expensive technology, increased patient expectations, and a growing elderly population. In the United States, the 2010 Patient Protection and Affordable Care Act has also delivered specific challenges for health care systems by introducing broadened coverage of the population and has gradually implemented changes in payment models to make health care systems more responsible for costs. Enhanced Recovery After Surgery pathways can be a key strategy in addressing these issues by offering improved quality care for less cost.

ARTICLE INFORMATION

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Study concept and design: All authors.
Acquisition, analysis, or interpretation of data: All authors.
Drafting of the manuscript: All authors.
Critical revision of the manuscript for important intellectual content: All authors.

Conflict of Interest Disclosures: Dr Ljungqvist reported being the founder and a shareholder in EnCARE AB, Sweden (http://www.encare.se), the provider of the ERAS Interactive Audit System. No other disclosures were reported.

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