# Evidence-Based Surgical Care and the Evolution of Fast-Track Surgery

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**Background:** Optimization of postoperative outcome requires the application of evidence-based principles of care carefully integrated into a multimodal rehabilitation program.

**Objective:** To assess, synthesize, and discuss implementation of "fast-track" recovery programs.

**Data Sources:** Medline MBASE (January 1966–May 2007) and the Cochrane library (January 1966–May 2007) were searched using the following keywords: fast-track, enhanced recovery, accelerated rehabilitation, and multimodal and perioperative care. In addition, the synthesis on the many specific interventions and organizational and implementation issues were based on data published within the past 5 years from major anesthesiological and surgical journals, using systematic reviews where appropriate instead of multiple references of original work.

**Data Synthesis:** Based on an increasing amount of multinational, multicenter cohort studies, randomized studies, and meta-analyses, the concept of the "fast-track methodology" has uniformly provided a major enhancement in recovery leading to decreased hospital stay and with an apparent reduction in medical morbidity but unaltered "surgery-specific" morbidity in a variety of procedures. However, despite being based on a combination of evidence-based unimodal principles of care, recent surveys have demonstrated slow adaptation and implementation of the fast-track methodology.

**Conclusion:** Multimodal evidence-based care within the fast-track methodology significantly enhances postoperative recovery and reduces morbidity, and should therefore be more widely adopted. Further improvement is expected by future integration of minimal invasive surgery, pharmacological stress-reduction, and effective multimodal, nonopioid analgesia.

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Approximately 30 million operations are performed annually in the United States and this accounts for an appreciable portion of the country's health care resources. Recent studies on surgical outcomes have therefore focused on enhanced postoperative recovery determined by length of hospital stay, morbidity and mortality, length of time to return to full function, (be it work or activities of daily living) and patient satisfaction. Many of these metrics have improved in recent years because of increased attention to the many factors involved in surgical quality performance such as surgical technique, volume of patients undergoing a procedure at a specific site, and improved organizational structure within a specific institution.[1–7] Several of these changes are a result of collaborations between health care payers and providers. However, despite all of these advances an undesirable portion of the surgical patients still suffer from morbidity, mortality, and need for prolonged hospitalization.[1–7]

Surgical training has traditionally been based on the guild system, with teachers passing on their operative techniques and methods of perioperative care to their students (residents). Because these approaches were generally accepted and successful by traditional standards, neophyte surgeons would usually continue these methods of care throughout their professional life. Only recently have carefully structured scientific investigations of perioperative care been performed and these evidence-based studies have shown that many of the traditional approaches to surgical care, such as preoperative bowel clearance, the use of nasogastric tubes, drains placed in cavities, enforced bed rest, and the use of graduated diets are unnecessary or even harmful.[8,9] The replacement of some traditional approaches in surgical care with evidence-based practices has demonstrated that surgical recovery can be accelerated and convalescence decreased. This multimodal approach, referred to as "fast-track surgery," incorporates not only surgeons but also anesthesiologists, nurses, and physical therapists[8,9] as active participants of the care team. Fast-track surgery focuses on enhancing recovery and reducing morbidity by implementing evidence in the fields of anesthesia, analgesia, reduction of surgical stress, fluid management, minimal invasive surgery, nutrition, and ambulation.

The purpose of this article is to report on the current progress in the field of perioperative care, and show that using a combination of these factors has allowed evolution of programs of fast-track surgery leading to enhanced postoperative recovery. The literature search for this review was based on a synthesis of the many specific interventions and organizational implementation issues published within the past 5 years from major anesthesiological and surgical journals, using systematic reviews where appropriate instead of

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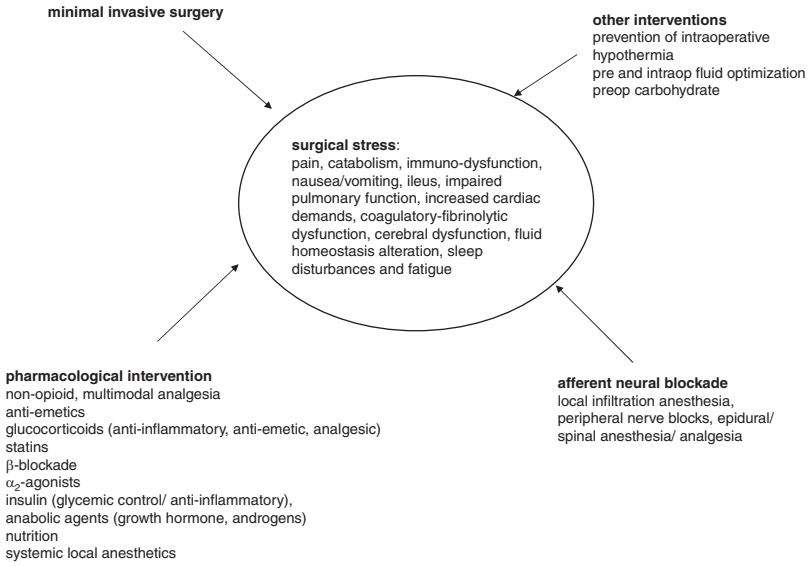


**FIGURE 1.** Current principles available for reduction of perioperative stress responses.

multiple references of original work. In addition, Medline MBASE (January 1966–May 2007) and the Cochrane Library (January 1966–May 2007) were searched using the following keywords: fast-track, enhanced recovery, accelerated rehabilitation, multimodal, and perioperative care.

## The Components for Enhanced Postoperative Recovery

### Traditional Care Principles (Infection and Thromboprophylaxis, Drains, Tubes, Catheters, Etc)

By applying evidence-based principles of infectious prophylaxis, the Surgical Care Improvement Project was initiated in 2005 after demonstrating a reduction in the rate of wound infections.[10] Additional well-established components of care to reduce morbidity include thromboprophylaxis.[11] The potential for perioperative use of oxygen therapy to decrease wound and anastomotic complications requires further study.[12–15] In addition, a variety of studies do not support the routine use of drains,[8,16–19] nasogastric tubes in a variety of abdominal operations including gastric and hepatic surgery,[20–25] but necessary after esophagectomy.[26] Also routine use of bowel clearance procedures before colonic surgery[27–32] and prolonged use of urinary catheters[33] are not recommended. The use of transverse abdominal incision may reduce pain and pulmonary compromise and may be preferred to a vertical incision[34] provided sufficient exposure can be achieved. Adjustment of all these components of perioperative care is important to enhance recovery. In addition, other basic principles of care will be discussed below.

## Reduction of Surgical Stress

The reduction of stress during an elective surgical procedure, as characterized by attenuation of the neurohormonal response to the operation, not only provides a rational basis for increased recovery but also diminishes the risk of organ dysfunctions and complications.[35,36] Therefore, a major goal for the future is to provide a "stress and pain free operation." Those factors that modify and/or reduce the surgical stress responses and organ dysfunctions are multiple[35–37] and therefore require a planned and coordinated approach to stress reduction (Fig. 1). Prevention of intraoperative hypothermia is a well-established goal because it reduces sympathetic responses, undesirable cardiac events, and wound morbidity.[38,39] Recently, there has been a major focus on rational principle for perioperative fluid management[40,41] where accumulating evidence has been presented to demonstrate a careful need for avoiding fluid excess, which may increase morbidity. At the same time, the concept of "goal-directed fluid therapy" has evolved and requires individualized pre- and postoperative optimization of stroke volume determined by providing small challenges of colloid and assessing cardiac function by the esophageal Doppler or other techniques.[40,42] Several randomized trials have uniformly demonstrated improvement in postoperative outcome (reduced morbidity and hospital stay) using this approach[40,42] and call for increased use of this method and more procedure-specific studies. In addition, blinded randomized trials[43–45] are needed in different procedures to clarify the optimal amount and composition of fluid to be administered.[41] In contrast to fluid overload, too little fluid may lead to functional hypovolemia, an exaggerated vasoactive hormonal response, and delayed recovery.[41,43,45]

Neural blockades with different types of local anesthetic blocks are well established to be the most efficient technique to reduce the endocrine catabolic response leading to attenuated protein loss.[36,46] In major abdominal procedures continuous thoracic epidural analgesia with local anesthetics has also been demonstrated to be the most efficient technique to reduce postoperative ileus[46,47] and therefore serves as an important component of multimodal recovery strategies in major bowel procedures.[9,46,47] Finally, local anesthetic procedures are key components in opioid-sparing multimodal analgesia to facilitate recovery (see below).

The concept of minimal invasive surgery has been applied in all surgical specialties and continues to be a major innovation, predominantly by reducing wound size and

thereby decreasing the undesirable inflammatory responses, pain, and catabolism.[48,49] Accumulating data suggest that the reduction of inflammatory responses is important for early functional recovery.[37,48,49] In certain operations where the alternative approach to minimal invasive surgery is a large incision (adrenalectomy, splenectomy, reflux surgery, bariatric surgery, etc), the clinical advantages for early recovery may be readily apparent. However, in other procedures (cholecystectomy, inguinal herniotomy, colonic surgery) the advantages are less apparent, especially when treatment of open procedures is performed within the concept of a multimodality fast-track approach.[50,51] Only 3 blinded studies comparing minimal invasive operations to the conventional open approach are available within the context of a fast-track recovery program and these studies show no obvious clinical advantages after colonic surgery,[52] appendectomy,[53] and hip replacement.[54] Another blinded study in laparoscopic cholecystectomy[55] provided traditional care principles with about 3 days hospitalization and 3 to 4 weeks convalescence, and therefore found no differences compared with open mini-cholecystectomy. However, the minimal invasive approach is physiologically rational and definitely will be an important component in future accelerated recovery programs when combined with other perioperative care principles (see below).

Preliminary evidence of preoperative carbohydrate administration shows promising results on reducing insulin resistance and attenuating catabolism.[56–58] However, the clinical consequences remain to be established because the data are debatable in minor procedures[59,60] and this approach requires more large-scale randomized studies in major procedures[58,61,62] before final recommendations can be made.

More recently, different pharmacological interventions have been studied to reduce stress responses with subsequent improved recovery. These have included glucocorticoids that have an important role in minor procedures to reduce pain, nausea, and vomiting.[63,64] Other pharmacological modifiers include $\alpha_2$-agonists,[65] multimodal antiemetics,[66,67] and systemic local anesthetics.[68,69] The use of anabolic agents in certain high-risk patients (burns, hip fracture, etc) may shorten long-term rehabilitation and should also receive increased attention.[70–72] Insulin may serve as a future important component for stress-reduction (and reduced organ dysfunction) because of its demonstrated anti-inflammatory effects.[73] In addition, accumulating data suggest that maintenance of euglycemia is important to reduce morbidity in both cardiac and noncardiac procedures.[74,75] Statins and $\beta$-blockade may be of advantage in certain high-risk patients but initial positive findings need to be confirmed in larger trials or specific patient populations before general recommendations can be made.[76–80] Finally, early oral nutrition[81] facilitated by antiemetics[66,67] and anti-ileus interventions[47,82] (epidural analgesia, mild laxatives, peripheral opioid-antagonists) may reduce catabolism.

In summary, the multimodal approach to reduce surgical stress responses continues to be essential to improve outcome. However, there is a need for continued research on basic cellular mechanisms of the different stress responses[83,84] to devise interventions that reduce the undesirable aspects (catabolism, increased cardiac demands, exaggerated inflammatory responses, etc) and yet preserve the necessary aspects for survival (immune function, wound healing, resistance to infection, etc).

## Pain Relief

Optimized pain relief allowing early mobilization is a prerequisite for enhanced recovery.[9,85] Recent progress in perioperative pain management has focused on nonopioid multimodal analgesia[86] where increasing evidence has demonstrated that opioid sparing reduces nausea, vomiting, and sedation.[87] Several agents have been evaluated in randomized, controlled, single-intervention studies and they demonstrate effectiveness (nonsteroidal anti-inflammatory drugs, COX-2 inhibitors, ketamine, gabapentin, local anesthetic techniques).[88] Studies should continue to evaluate combinations of the agents in an effort to further reduce perioperative opioid use. Local anesthetic techniques such as infiltration anesthesia for minor procedures[9] or major orthopedic procedures[89]; continuous wound perfusion[90,91]; peripheral blocks, that can be continued after discharge;[92,93] and epidural techniques[94] are all well established to be effective and serve as important components for fast-track programs.[9] To facilitate implementation of evidence-based, procedure-specific pain management, clinicians may refer to www.postoppain.org.[95]

In conclusion, perioperative pain relief continue to be a key prerequisite for a successful fast-track program and contemporary programs should apply the appropriate scientifically based evidence on a procedure-specific basis.

## Evidence to Support Fast-Track Surgery

Initial results of multimodal programs to enhance recovery have generally been nonrandomized, single-center observations from investigators developing the initial concept. More recently, information from randomized trials and systematic reviews has become available, especially in fast-track colorectal programs[96–98] (Table 1). In the available series, which should serve primarily to stimulate further research, postoperative organ dysfunctions seem to be significantly attenuated, and as a consequence hospital stay has been reduced to levels unreported in the past (Table 1). Importantly, these observations suggest that the risk of "medical" complications is reduced.[96–99] Reports also suggest that the costs are decreased[100] although there has been some skepticism of this information because of the potential for transfer of costs to another postdischarge environment. However, this is not supported by comparative data from colonic surgery.[101] Furthermore, costs for hospital stay in the later postoperative period are less when compared with the first days, and the opportunity costs of having additional beds available with short-term surgical stay is rarely included in these evaluations. Therefore, large, more sophisticated economic analyses are needed within all aspects of fast-track surgery. So far, the data suggest that the amount of nursing care per patient course is reduced by a fast-track program.[102]

There has been a call for randomized trials of this process,[96] but because most of the individual components of fast-track surgery are evidence-based, it may be difficult to perform a proper randomized trial within the same institution. Another approach may be to obtain additional evidence from

**TABLE 1.** Results From Selected Fast-Track Surgical Programs

| Procedure | Postoperative LOS | Comments |
|---|---|---|
| Groin hernia repair | 1.5–6 h | Large consecutive series (n = 1000–3000) using local infiltration anesthesia[134,135] |
| Cholecystectomy | Same day discharge >80% | Large consecutive series and randomized trials. Further improvement with antiemetics/multimodal nonopioid analgesia[136–140] |
| Bariatric surgery | ~80%, <23 h | n = 2000 consecutive laparoscopic Roux-Y gastric bypass[141]; gastric banding[142] |
| Colonic resection | 2–4 d | Documentation of benefits on recovery of all organ functions and reduced morbidity from multi-center series and randomized trials. Only minor differences between open and laparoscopic fast-track surgery[96–102,143–148] |
| Complex colorectal procedures | 3–5 d | Single-institution series, laparoscopic and open approach[149–154] |
| Pulmonary resection | 1–4 d | Single-institution series, open, and thoracoscopic[155–157] |
| Reflux surgery | 98%, <23 h | Large (n = 557) consecutive, single-institution series, laparoscopy[158] |
| Esophageal resection | 7–8 d | Small single-institution series[159–161] |
| Pancreatic resection | 7 d | Consecutive series before vs. after pathway, cost reduction[162] |
| Radical prostatectomy | ~75%, 1 d | Large consecutive series[163] |
| Nephrectomy (donor) | 1–2 d | Shortest (23 h) with laparoscopic approach, 2 d with open surgery[164,165] |
| Nephrectomy (other) | 2–4 d | Consecutive patient series, shortest with laparoscopic approach[166–168] |
| Adrenalectomy | <1 d in 80% | Laparoscopic approach, small, single-institution series[169,170] |
| Abdominal aortic aneurysmectomy | ~3 d | Consecutive series, revised criteria for intensive care stay, fluid-restriction[171–174] |
| Mastectomy | <1 d in 90% | Large consecutive series[175–177] |
| Parathyroid and thyroid surgery | 80%–90% ambulatory | Single-institution consecutive series[178–180] |
| Hip, knee, and elbow arthroplasty | ≤1 d | Small, single-institution series with or without minimal access operation[181–184] |
| | ~3–4 d | Well-designed pathways, cost-reduction[185,186] |
| Ovarian cancer surgery | 5 d | Single-institution, consecutive series[187] |

multi-institutional series using the same fast-track approaches for the same procedures and with well-described patient demographics to compare these results with traditional care provided during the same time period. Unfortunately, there are no data from fast-track surgery in exceedingly high-risk patients requiring emergency operations, where the multimodal approach would be expected to be most useful. Although there is sufficient evidence to document enhanced recovery and reduced need for hospitalization by the fast-track methodology, initial concern on safety has not been confirmed (Table 1). Similarly, readmission rate is not increased,[96–98,103] which is important in the all-over assessment of fast-tracking.

## The Processes

Figure 3 summarizes some of the organizational processes necessary to achieve a successful fast-track recovery program. An important component is assessment of preoperative organ dysfunction and subsequent optimization of function,[104–111] which has been demonstrated to be relevant, especially in patients who smoke, who are alcoholic, are immobile, who have preoperative cardiac and pulmonary dysfunction or are malnourished. However, it must be recognized that the basic mechanism for an increased perioperative risk in patients with preoperative organ dysfunction is the surgical stress response associated with the operation resulting in increasing demands on the already impaired organs. The problem of perioperative risk may therefore not be solved by preoperative optimization alone unless it is combined with the other care principles related to stress reduction (Fig. 1).

Much evidence has accumulated that surgical/anesthetic expertise (as characterized by the volume of patients

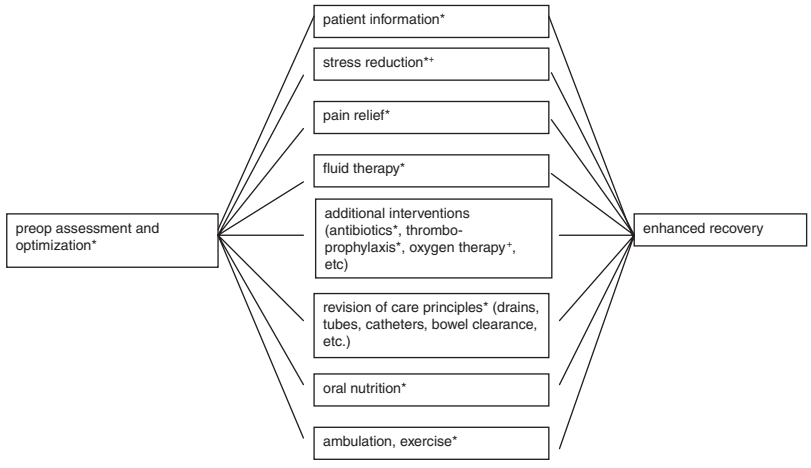


**FIGURE 2.** Components of interventions to facilitate postoperative recovery (*, evidence available, ready for implementation, +, less evidence available, need for further study).

cared for by an individual or institution) improves outcome.[1,112] However, in all these studies no information is available on the more-detailed components of care (Fig. 2). An acute pain service serves as an important prerequisite for overall implementation of fast-track surgery in major hospitals to achieve optimal pain relief. However, unless the pain service is integrated with the perioperative surgical care along the principles of fast-track surgery, limited advantages are achieved on outcome except for improved analgesia.[113] Because the principles of enhanced perioperative recovery include many components (Fig. 2, Table 1) a multidisciplinary collaboration between anesthesiologists, surgeons, surgical nurses, and physiotherapists is required. In this context increased collaboration with anesthesiologists within the concept of perioperative medicine is important.[88] Thus, in selected operations such as the insertion of a hip prosthesis or fixation of a hip fracture, it may be advantageous to include rounds by anesthesiologists[114] and geriatricians. The same principles may be extended to the so-called "out-reach services" or "medical emergency teams" where simple scoring systems are used as early warning signals to recognize organ dysfunction before organ failure and intensive care is required.[115–118] The preliminary evidence that supports such hospital services either managed by nurses or intensive care physicians suggests reduced morbidity,[115–119] but more research is required to evaluate the optimal structure and cost efficiency. Because the first postoperative 24 hours may be associated with most risk,[120] another approach to be considered is a structured 24-hour initial stay in a specialized postoperative recovery unit.[121]

In the multidisciplinary approach nursing care is essential to both adjust the care to both somatic and psychologic needs, and more attention should be paid to nurse specialization and overall nurse structure in surgical departments because the educational levels of nurses may have an important impact on postoperative morbidity and mortality.[122,123]

## Implementation and Future Strategies

Despite the large body of evidence to document the benefits of the fast-track methodology to enhance postoperative outcome, several multinational European and US surveys have shown slow change of surgical practice to adapt evidence-based care.[124–128] The problem associated with adoption of these practices is similar to the implementation of other guidelines in medicine.[129] There is a lack of awareness of evidence-based fast-track data, a lack of agreement with the data (difficult to accept), or a lack of belief that their own institution can actually perform fast-track surgery. Other external barriers include time-limitation, unavailability of outcome data, insufficient expertise or staff support, reimbursement problems, liability issues, etc.[129] There is therefore a need to provide information and education to reduce the potential barriers to fast-track methodology. However, in the implementation process a balanced view must be positioned, because there may be a small risk in publication bias where the best results are publishable but may not be generalizable to the population. Also, it must be recognized that much, but not all data come from single institutions or rather small trials that may be a reason for slow wide-spread adaptation. For the same reasons, many of the positive results listed in Table 1 may be considered as preliminary or hypothesis-generating rather than to serve as final bench-marking data.

An accelerated recovery program requires successful organization of a multidisciplinary group.[9,88,130,131] Thus, although a single individual or department can initiate such an approach (Fig. 3), it will not succeed without the active and committed participation of other healthcare professionals. One immediate consideration is the scheduling of individuals in departments that use rotating hospital shifts. The team approach requires a commitment of individuals to meet specific time obligations throughout the week that are required for operations, planning, patient rounds, and data gathering (Fig. 3). In addition, the same anesthesiologist should preferably interact with the patient before, during and after the operation, which is at variance with current practices in many large institutions. The contribution of the hospital administration is also essential, for such programs require nurse specialization, care of patients in specific areas of the hospital (specialized units), planning, data collection, and ongoing assessment of outcomes and costs.

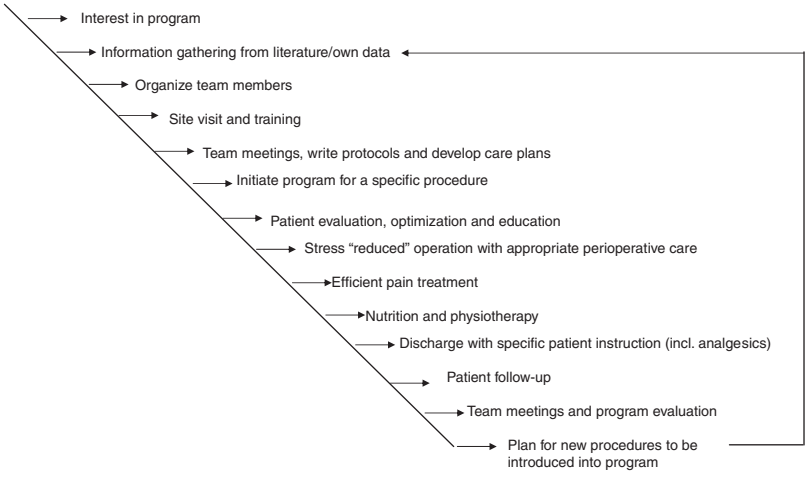


**FIGURE 3.** Process for initiation and implementation of an enhanced postoperative recovery program.

A proposal for the initiation of an accelerated recovery program for an individual institution is shown in Figure 3. Interested individuals, or a team leader, can visit an institution with a fast-track program and observe the organization and pattern of patient care. This information can then be disseminated to other members of the local team, the training initiated, and the program gradually started. It is crucial to currently discuss the implementation and results, because the establishment of a fast-track program per se is not enough to secure a successful outcome.[131] A multidisciplinary shared learning experience provides for consultative services, group meetings, and periodic site visits all of which support the more rapid evolution of efficient fast-track programs. Private payers, government insurers, health planners, and large group practices are appropriate underwriters of this initial effort. As efficiency improves, the program should become its own cost center to objectively evaluate the economic impact of such change and allow independence from outside funding. Hospital administrators must realize that the financial benefit accrued from rapid turnover is linked to increasing bed availability, and appropriate credit should be afforded to the fast track group for this contribution.

The initiation of the pay for performance programs and the recent withholding of payments for many complications by Medicare[132] may provide another incentive to formalize an accelerated recovery program. Many of the benchmarks used in these programs include indicators like the incidence of wound infections and length of postoperative hospital stay. Optimized performance in these and other key areas will thus provide appropriate financial incentives to both the professional and the hospital.

If surgical outcomes are to be objectively evaluated and health professionals graded, it is important that physicians falling into the lower quartile of the performance evaluation are provided with the educational support to improve their care. This task seems best suited for professional groups, such as the American College of Surgeons, the American Board of Surgery, and societies of subspecialty groups. Although these organizations have provided educational formats that determine and promote best practice, they have been reluctant to mandate quality improvement by providing the specific structure to objectively measure outcomes and report these findings. However, with the changing healthcare environment (such as pay for performance) and increasing pressures from payers to provide health care in a more efficient manner,[133] it is anticipated that professional groups will respond with specific programs to improve quality and thus fulfill their responsibilities to their membership and society at large.

In summary, significant progress within the concept of fast-track surgery has been achieved to document a combined effort of preoperative optimization and information, "stress-reduced" surgery, efficient postoperative pain treatment, adjustment of perioperative care principles to existing evidence, and nursing care focusing on early mobilization and oral nutrition to enhance recovery, decrease morbidity, and hospital stay. This multidisciplinary approach requires further refinement in its individual components to provide the ultimate goal, the "stress, pain, and risk-free" operation based on answering the simple question "why is the patient in hospital today?"

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