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Enhanced recovery program implementation: an evidence-based review of the art and the science

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Abstract

Background The benefits of enhanced recovery program (ERP) implementation include patient engagement, improved patient outcomes and satisfaction, better team relationships, lower per episode costs of care, lower public consumption of narcotic prescription pills, and the promise of greater access to quality surgical care. Despite these positive attributes, vast numbers of surgical patients are not treated on ERPs, and many of those considered "on pathway" are unlikely to be exposed to a majority of recommended ERP elements.

Methods To explain the gap between ERP knowledge and action, this manuscript reviewed formal implementation strategies, proposed a novel change adoption model and focused on common barriers (and corollary solutions) that are encountered during the journey to a fully implemented and successful ERP. Given the nature of this review, IRB approval was not required/obtained.

Results The information reviewed indicates that implementation of best practice is both a science and an art. What many surgeons have learned is that the "soft" skills of emotional intelligence, leadership, team dynamics, culture, buy-in, motivation, and sustainability are central to a successful ERP implementation.

Conclusions To lead teams toward achievement of pervasive and sustained adherence to best practices, surgeons need to learn new strategies, techniques, and skills.

Keywords Enhanced recovery · Implementation science · Quality and safety

Along with other fields of medicine, surgery is advancing toward precision care pathways, largely centered around the expansion of enhanced recovery programs (ERPs) into all surgical disciplines. Thanks to pioneers, most notably Dr. Henrik Kehlet, the benefits of these programs are multidimensional and profound [1–3]. For patients, ERPs improve patient engagement, outcomes and experience with care. Through a focus on functional recovery, ERPs are returning patients back to home, family, adjuvant therapy, work, life, and themselves faster and more reliably. For providers, the re-balanced focus on improving quality is gratifying and serves as an antidote to burnout induced by a prevalent regulatory focus on only measures of harm (e.g., wound infection rates). Further, team relationships are improved across all providers. For hospitals and hospital systems, shorter lengths of stay combined with lower complication and readmission rates lower per episode costs of care. Lastly, from a societal standpoint, ERPs lower the amount of prescription narcotics

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in the community, and create the promise of greater access to valuable surgical care.

With these known benefits, a decision to implement ERPs seems inevitable. In fact, we may be nearing the point that ERPs are standard of care. Yet, many surgical patients are not treated on ERPs, and of those that are included, most are unlikely to be exposed to a majority of recommended ERP elements. How can we explain this gap between knowledge and action? The most likely explanation is that there are skills required for successful implementation of best practices that we may not be familiar with or are not employing in our implementations.

In other words, there is both an art and a science to ERP implementation. For example, many surgeons have learned that the "soft" skills of emotional intelligence, leadership, team dynamics, culture, buy-in, motivation, and sustainability are central to a successful ERP implementation. Top-down proclamations, doing it the way we have always done it, and order set-only implementations do not engender enthusiasm, do not lead to pervasive adoption, and have no hope of sustainability.

To be successful, we need to learn new techniques and skills. The purpose of this study is to review formal implementation strategies, propose a novel model for change adaptation, and identify common barriers, with proposed solutions, that are encountered during the journey to a fully implemented and successful ERP.

A review of structured strategies based on the implementation science literature

Over the past 3 decades, multiple structured frameworks for best practice implementation in medicine have been designed in attempts to bridge the gap between knowledge discovery and wide-scale applicability [4–6].

The Promoting Action on Research Implementation in Health Services (PARIHS) framework was originally described in 1998, based on the dynamic and synchronous relationship between evidence (knowledge), context (setting), and facilitation [7]. Despite its flexibility, the original framework's success can be limited by lack of conceptual clarity, lack of important elements, and/or lack of clear evaluation methods. Fortunately, subsequent revisions have addressed some or all of these concerns [8]. In the field of enhanced recovery, the PARIHS framework has been used for the implementation of early feeding in older surgical patients [9].

The RE-AIM framework was originally developed as a tool to report clinical trial results, and later was adopted for the evaluation and reporting of published studies in terms of public health impact [10]. Subsequently, it has been used for implementation purposes. The RE-AIM framework is structured around five dimensions: reach (the number of individuals in a target population), effectiveness (addressing the impact of a given intervention), adoption (the construct of supporting the delivery of an intervention), implementation (consistency of delivery of an intervention as intended; cost and time aspects from the setting; target population's use of an intervention once delivered to them), and maintenance (integration of an intervention in routine institutional/setting practice; ongoing effect of the intervention at the individual level) [11]. Critics note some issues with using the RE-AIM framework, including confusion in terms of designing and reporting on the "Reach" and "Adoption" elements for a public health intervention.

In an attempt to streamline the application of theory in behavioral research, a panel of expert behavioral scientists developed the Theoretical Domains Framework (TDF) in 2005 [12]. In its latest refinement, the TDF includes 84 constructs grouped into 14 domains: knowledge, skills, social/professional role and identity, beliefs about capacities, optimism, beliefs about consequences, reinforcement, intentions, goals, memory, attention and decision processes, environmental context and resources, social influences, emotions, and behavioral regulations [13]. This framework has been successfully used as part of a system-wide implementation strategy for an enhanced recovery program in colorectal surgery [14]. Specifically, the group in Alberta, Canada, used TDF to systematically identify opportunities for change (at the individual and process levels), interventions needed to overcome barriers, and strategies to augment the impact of enablers.

The knowledge-to-action (K2A) framework was described in 2006 as a way to conceptualize the transfer of knowledge into action (practice) [15]. In this framework, knowledge creation and action are the two main concepts, each with multiple phases that can be interrelated and parallel. This framework has been used to identify barriers and facilitators in the practice of enhanced recovery [16,] implement actionable changes [17,] and optimization of recovery following elective colorectal surgery [18].

The Consolidated Framework for Implementation Research (CFIR) was first described in 2009, as a menu of 39 constructs based on previously published theories, centered over five domains: intervention characteristics, outer setting, inner setting, characteristics of the individuals involved, and the process of implementation [19]. This menu of constructs can be used as a guide for data collection, identification of barriers, and development of setting-specific optimal approaches. Although initially designed for improvement in diabetes care within the VA system, the framework has been widely adopted since its description [20]. The CFIR approach has been used for the small-scale implementation of a head and neck cancer

multidisciplinary clinical pathway aimed at improving nutrition, swallowing, and quality of life [21].

The decision to utilize one implementation framework/theory over another does not appear to be based on specific discipline or setting; rather more commonly a strategy is chosen based on previous investigator experience [22]. Although familiarity has advantages, if the theoretical assessment is not comprehensive the implementation team risks missing important constructs or overemphasizing unrelated ones. Furthermore, basing interventions on theories with overlapping constructs can lead to suboptimal long-term assessment and poor process improvement [13, 23]. Importantly, these theories, models, and frameworks can be used at different maturity levels of implementation projects, to first identify barriers and then create actionable to-do lists [24].

In summary, there are a number of formal implementation strategies that may be useful to speed and sustain enhanced recovery program implementation. Familiarity with these models can allow the implementation team to tailor frameworks to specific local needs.

A novel construct for managing change during ERP implementation

As healthcare wrestles with how to standardize patient care through evidence-based practices, there is widespread variation in thought about how best practices should be implemented into clinical settings. On one hand, strict adherence to implementation of the exact process as documented in literature is important to achieve similar outcomes to the published research. On the other hand, medical providers are uniquely individualistic and are trained to rely more on previously acquired knowledge in opposition to new information. As a result, an ask for rigid adherence to novel practices or protocols espoused by others may decrease local provider buy-in and increase resistance, two key factors that negatively influence change adoption. Customization to the local context and users' preferences can increase acceptance rates, yet risks the very patient care outcomes the new practices were designed to foster.

These apparent contradictions lead to questions on how to simultaneously standardize and customize implementation of evidence-based practices? Research from Luciano and colleagues suggests that the answer rests in engaging in a process of *responsible local adaptation*. They offer a framework consisting of four interrelated approaches to help guide change leaders through implementation, including data-directed, resource-based, goal-directed, and preference-based adaptations. This framework provides a tool to facilitate local adaptation while staying closely linked to the foundational evidence driving the ask for change.

Certainly, any change implementation starts with external experience, usually collated from an extensive literature documenting practice outside of the implementing institution. The data-directed adaptation approach focuses the team on the similarities and differences between the context from where the original data were collected and the local environment where it will be applied. In general, to determine transferability, change leaders must consider whether the research data are from different patient populations, hospitals with different structures or cultures, and/or from countries with different regulatory environments and payment structures, and whether those differences will influence outcomes. For example, most published ERP studies include relatively young patients. For implementations that include a geriatric population some studies have suggested that ERP practices may need to be modified, as older patients may mobilize slower, be more sensitive to polypharmacy, and require additional anemia management both pre- and postoperatively [25].

Data-driven adaptations help overcome personal biases, anecdotal evidence, and resistance. Pilot projects and data collection after launch help to ensure that a data-related customization works. Ongoing reassessment and adjustment of the new practice promotes pervasive and sustained change adoption and optimizes practice effectiveness.

Resource-based adaptation is common and involves modifications to evidence-based practices required because the specific resources suggested in the foundational literature are not available, or are deemed too expensive, in the local environment. Resources that may necessitate adaptation include infrastructure, supplies, space, and staff. For example, to address the element of preoperative carbohydrate loading, some hospitals choose to use more expensive, specially formulated low-osmolality carbohydrate drinks. In contrast, others have found that the goals can be achieved with juices or sports drinks that are less expensive, readily available to patients at grocery stores, avoiding the need for the hospital to store and dispense. In addition, many surgeons advocate for the use of long-acting liposomal bupivacaine (Exparel) as a part of multimodal opioid-sparing pain control regimen. However, due to its expense, many hospitals limit its availability, encouraging their surgeons and anesthesiologists to use less expensive combinations of shorter-acting agents.

For adaptations related to resources, it is critical that team members have a deep understanding of the purpose or goal of the new practice in order to choose appropriate resource substitutes. As always, early data collection is needed to assure that substitutes achieve similar results to the initial evidence-based research and to identify potential for contraindications to substitutes in certain populations (e.g., certain forms of carbohydrate loading in insulin-dependent diabetic patients).

Goal-directed adaptations often occur in the absence of data to guide decisions. It is very common that a hospital launches their ERP in a single specialty, and then corollary programs in other specialties emerge. The internal transfer of practices that worked for the parent program may or may not apply to the child programs (e.g., Do evidence-based practices developed in colorectal cancer surgery apply in thoracic cancer surgery?). Luciano and colleagues have found that successful transfer of ERPs from one program to another within the same hospital relies more on the local success of the parent program and apparent cultural acceptance of the principals rather than an external body of evidence for the child program. As such, when internal best practice spreads, this is usually driven by the overarching goals motivating the new practices. These types of adaptations require deep reflection on why elements of a local evidence-based practice should be relevant in a new setting (e.g., reducing opioid use; patient engagement; minimizing variation) and how those goals may be achieved in a secondary context (e.g., patient-centered recovery is a universal surgical goal regardless of operation site).

To spread a new innovation across specialties, clarification of the overarching goals of implementing specific evidence-based practices (e.g., implementing multimodal pain control to both reduce narcotic dependence and speed recovery) may unify care providers in parallel fields and more rapidly move them beyond their personal preferences.

Finally, preference-based adaptations engage local preferences of patients and care providers. Although some adaptation to local practices is always necessary, indulgence in personal preference creates the largest risk of moving so far from the evidence base that the practice no longer retains efficacy. Preference-based adaptations that include subjective, idiosyncratic reasoning may unfavorably increase variance in workplace practices. Preferences of the patient (e.g., tolerance for pain, religious beliefs) may shape legitimate adaptations. However, even legitimate adaptation may not be medically optimal (e.g., patients preferring to rest as opposed to early and frequent ambulation, expectation of long length of stay). In these situations, it is paramount to educate and set expectations, optimally engaging the patient as an active participant in the recovery goals.

Notably, understanding the underlying desires and rationale for preferences of resisters can shape adaptations that increase the likelihood of implementation. To lower resistance, change needs to be made convenient, frequently by focusing more on how the evidence-based practice is *enacted*, rather than the *content* of the practice. Care providers may be happy to use specific equipment for a procedure or a specific brochure for patient education (content) provided it is easily accessible to the work area (enacted). Pervasive and sustained change adoption benefits from making compliance with the desired changes as easy as possible (e.g., assuring all required materials are located in the same area for easy retrieval; color-coded forms), but it is important to do so without unnecessarily changing the essence of the evidence-based practices. Given their frequency and risk-level, ERP team leaders need to consciously and explicitly manage preference-based adaptations to evidenced-based care.

Responsible local adaptation

To optimize implementation, understanding how to adapt evidence-based practices to the local context and personnel is critical. Success requires considerations of both the technical (practice content) and human (practice adoption) elements. The process starts with consideration of the original source data as it has the most fidelity to the desired outcomes and will enable more objective decisions about potential customizations. Then, team leads need to systematically guide conversations about local adaptation based on the responses and resistance they receive, informally or formally classifying them into resource, goal, and preference related. A revise-and-adapt approach, using the four approaches described here and moving iteratively through the framework creates a more structured and objective strategy to focused adaptations in a way that promotes engagement in joint-problem solving, facilitates agreement, and manages the tensions associated with customizing evidence-based practices.

After any adjustments are made to evidence-based practices, leaders are encouraged to return to the framework, considering whether there are data to support the desired change, how it aligns with their goals, whether they have the resources to do it, and whether personnel will accept. For example, mooring the ERP to the overarching *goal* of improving the value of patient care dictates the need to reduce costs without comprising quality. To this end, *data*-related adaptations can inform which items have superior outcomes and which may be equivalent substitutes that would best utilize hospital *resources* while retaining characteristics that care providers *prefer.* Ultimately, maintaining a balance between the outside evidence supporting the change and targeted adaptations within the local environment is most likely to end with pervasive and sustained adoption of safe and effective best practices in healthcare (Fig. 1).

Team dynamics and managing conflict

Building the enhanced recovery team

When putting an Enhanced Recovery Protocol into practice, the Development Phase is a critical first step. This phase is used to review evidence on ERPs, review the current

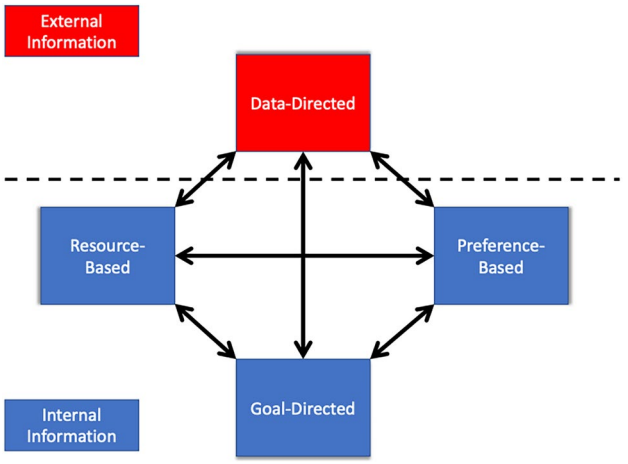

Fig. 1 Framework for responsible local adaptation of best practices in health care

outcome and process measure data for your institution, solicit administrative support, and, most importantly, gather your team. In order to be successful, an ERP requires active collaboration and participation from a multidisciplinary group of healthcare providers, who feel accountable for the Implementation and Maintenance phases [17] (Fig. 2).

When first building the team, there is an urgent need to identify leadership. Most commonly this person is a surgeon who is a zealous early adopter. This local clinical champion recognizes the benefits of enhanced recovery and is willing to commit substantial time in the Development Phase to launch the program. Although most ERPs have an identified leader, many have included several "ERP Champions" in their implementation [26]. The most successful systems have an ERP Champion in each discipline, whose responsibilities included leading the implementation through interdisciplinary stakeholder education and engagement; overseeing local data collection, reporting, and auditing; and liaising with leadership and administration [26]. The "ERP Champions" are more successful if they volunteer for the position, rather than if they are assigned or "voluntold" to participate [26]. This is exemplified by data demonstrating that sites that assigned Champions had more reports of poor team cohesion than the sites that asked for volunteer leaders [26].

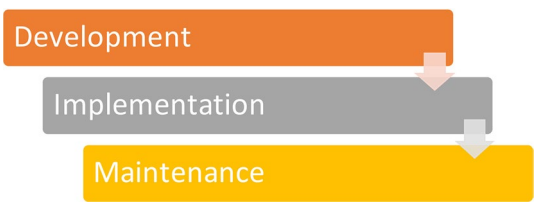

Fig. 2 Phases of enhanced recovery program adoption

Once leadership is defined, a multidisciplinary working group should be assembled, identifying at least one member from all stakeholder specialties and allied health professionals that support patient care during the perioperative experience. Optimally, the working group should be composed of similar-minded individuals excited about and educated on the initiative. The ability to communicate the ERP protocols and their associated clinical and economic benefits to their constituencies is crucial for pervasive adoption.

This multidisciplinary team is recommended to include surgeons, anesthesiologists, internists, surgical house staff (in teaching hospitals), physiotherapists, pharmacists, nutritionists, social workers, a librarian (in centers planning to publish research from their ERP), Wound Ostomy Care Nurses, information technology support personnel, and nursing representatives from the clinic, preoperative area, operating room, post-anesthesia care unit, and surgical ward (Fig. 3) These working group members represent essential constituencies in the patient's perioperative journey, and each will take the lead in changing the culture to implement and maintain their discipline's respective roles in the ERP.

A dedicated ERP facilitator/abstractor is an essential element for successful ERP implementation and the subsequent audit processes [27, 28]. The ERP facilitator is usually a nurse or nurse practitioner, whose responsibilities include reviewing the literature and evidence-based guidelines, steering the pathways through the approval process, assuring training and compliance with protocols after surgery, maintaining momentum, creating and coordinating education for staff, and conducting postlaunch feedback and audit [27].

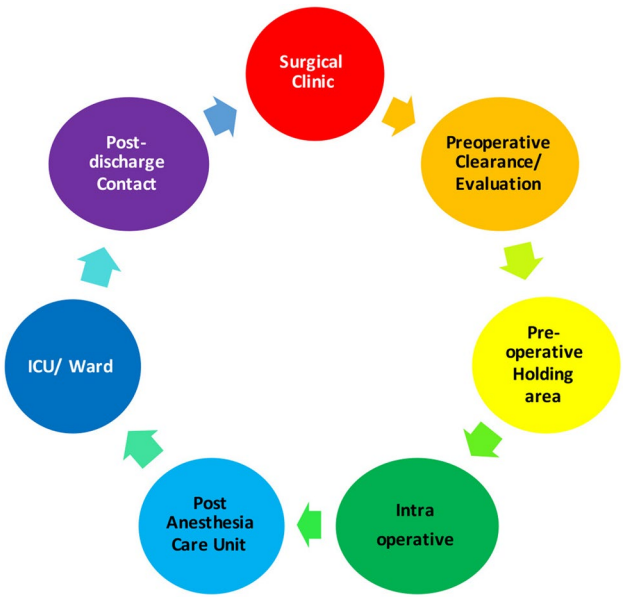

Fig. 3 The nursing continuum of care in enhanced recovery programs

The importance of nursing involvement (from all points of patient care) cannot be understated, as their engagement ensures education, acceptance, and compliance with the ERP items during the surgical experience [27]. In reality, nurses and advanced practice providers will spend more time with the patient than the doctors, so having them involved in the development phase, compliant with the care protocols, and enthusiastic about the benefits when interfacing with patients and other staff is key.

Implementation can be a true culture change for nursing. Although literature is conflicting on whether an ERP implementation increases or decreases total nurse effort, it is clear that patients who move faster through the perioperative continuum compress the time available for care, education, and documentation tasks. As such ERPs can be met with resistance based on concern for escalated work, meeting pain goals with limited narcotics, and apprehension regarding rapid diet advancement, among other concerns.

Multiple steps can be taken to remediate these concerns and to facilitate success. In addition to having nursing representation in the larger working group, it is wise to schedule meetings with each constituency when developing the protocol to educate them on the goals, communicate your ideas, and to hear their input in order to develop the most representative plans. After drafting the protocols, meeting with the groups again to review the draft and to solicit additional comments is recommended. Targeted educational materials and presentations should be created specifically for the nursing groups, and team meetings should be held at multiple time points to include staff members that only work at night shifts or on weekends. Enthusiastically advertising the roll-out and being available to answer questions or address issues as they arise will smooth the implementation.

Early after implementation, such as 1 month in, it is advisable to schedule another meeting to address concerns and improve the patient flow. Team leads should be prepared to address complications that occur shortly after implementation that are frequently blamed on the new ERP even if they are unrelated. After incorporating these changes, regular feedback sessions reporting the progress and celebrating the "wins" (such as on regional bulletin boards, at staff meetings, and with newsletters) enhances sustainability. A regular process of communicating audit data on compliance and outcomes back to the teams provides opportunities to keep lines of communication open for suggestions on further education or improvement, and to continue to implement changes at designated time intervals.

Integration of team members and conflict management

All members of the perioperative team are critical to the successful implementation and sustainability of an ERP. The surgeon, the anesthesiologist, the nurses, other team members, and the patient all have key roles in the implementation and follow-through. Uniquely, ERPs have provided an opportunity for value realization in multiple roles. For example, the anesthesiologist is no longer "an anonymous technician" [29] but is being recognized as an important part of the perioperative team.

Another identified key element of implementation is the building of a "community of practice" among the champions within their disciplines, and across participating centers for networking and sharing best practices [26]. Successful Champions devote a significant amount of time to understanding current practices on the ground, raising awareness about the ERP protocols, and reviewing the evidence with colleagues when needed.

"Buy-in" from the providers participating in the ERP protocols is vital to success. Champions will typically find that some of their colleagues are easily accepting of the program, but they will also meet with individual-level resistance [26]. For example, elimination of preoperative bowel preparation and early postoperative feeding are common sticking points. Additional reasons for the lack of buy-in from the surgeons may be fear that if patients are discharged earlier readmission rates will rise, or concern over patient satisfaction due to shorter hospital stays.

One of the most common sources of conflict relates to perioperative analgesia blocks. Primarily, providers are concerned that the addition of blocks to the care plan will increase the individual operating room time, which can cascade to delays for subsequent cases during the remainder of the day. These time considerations are not unimportant, but they can be remediated by anticipating the need to present data that balance the slight increase in operative time with substantial benefits in regard to patient satisfaction with pain control, reducing in opioid requirements, and shortened length of stay. Another potential issue with blocks is the disparity in reimbursement: if the block is performed by the anesthesia team, the service may be billable; however, if the surgeon performs the block (which often is faster as the surgeon is already scrubbed at the bedside), the service may not be billable.

An additional and important barrier to the implementation and sustainability of ERPs is the frequent lack of support for the programs by hospital administration. It is unclear why these programs, which have been shown to be both cost-effective and beneficial to the patient experience, are not more consistently supported by hospital administration. The earlier in ERP implementation that ERP Champions partner with finance to understand and become able to form business plans that quantify these benefits, the more likely they are to garner meaningful institutional support for their programs.

Managing surgeons who do not support the program

One of the most common and well-recognized challenges to the implementation and sustainability of new clinical programs is lack of support from (typically more senior) staff and surgeons. For example, both active and passive resistance from senior clinicians was identified as a major implementation barrier during the global implementation of the WHO Surgical Safety Checklist [30]. This behavior frequently leads to a conclusion that buy-in "is probably going to require a retirement or two to change" [26]. Despite the evident impact of this particular challenge on the establishment of clinical programs, there are a paucity of published solutions.

The first strategy to counter this inertia is to gather a diverse group of leaders from throughout the organization to spearhead the project. Support can be bolstered by providing compelling evidence for success of the program at other institutions or in other industries, and by visiting established programs. Further, sharing LOS and patient outcomes data comparing compliant and non-compliant providers may motivate adoption. Engaging leadership to promote a bottom-up approach has been demonstrated to increase buy-in and to avoid a sense of coercion [26]. Equally important to convincing reticent surgeons is for administration to demonstrate commitment to the effort by funding positions for ERP coordinators and abstractors [14]. Several additional strategies that have been proposed to garner the support of resistant surgeons include establishing them as champions, facilitating open discussions, and collecting and sharing data [31].

Successful, evidence-based clinical programs often include elements that present a cultural shift that is difficult for some surgeons to integrate into their practice and workflows [30]. Frequently, resistance is overcome by data-driven processes that demonstrate improvement in patient and economic outcomes [14]. This requires continual collection of relevant data, open review, auditing of compliance, adjustment of program components, and dissemination of clinician-specific outcomes.

IT integration and compliance measurement

At some point in the maturation of all ERPs, there comes a point where further progress cannot be made without the availability of actionable data on element compliance. Many ERP directors/champions have discussed difficulty with obtaining compliance data, especially when it requires chart reviews and manual abstracting. Ideally, compliance data would automatically emanate from the Electronic Health Record (EHR), but this requires forethought on documentation workflows, templates, and structured data entry. When these design elements are present, the EHR can be converted from an obstacle to not only a functional tool, but to a huge asset in both reporting on and improving compliance [32]. For example, Grant and colleagues have demonstrated that when the use of a preoperative carbohydrate drink was documented as a free-text item at the bottom of a nursing note, the compliance rate was low [32]. But when the new EHR transition was completed and senior level executive support facilitated the addition of that "question as a structured [data] field in the checklist…compliance improved dramatically." Of course, EHR design must be coupled with provider training. As Grant notes, "Additionally, formal instruction was provided to anesthesia providers on how to locate and use the function" [32].

There are substantial additional benefits to transitioning from an audit process of ERP compliance completely separated from the EHR to an audit process embedded in the EHR. Creating documentation workflows that serve the multiple purposes of medical documentation, billing, coding, and ERP compliance, not only minimizes overall documentation burdens, they also give local frontline providers "personal accountability for relevant pathway elements and prompt further conversations about system-level barriers" [32]. Hence, the EHR can move ERP compliance into a timely, interactive, accountable process owned by frontline providers, rather than a retrospective analysis that only engages a few abstractors who are too distant from care to materially improve the outcomes.

The effectiveness of the EHR in enhancing ERP implementation is so significant that obstacles in doing so become major impediments. The properly configured EHR allows sharing of real-time outcomes data which "facilitates the spread of best practices [and] improves collaboration between teams" [33]. These interactions help to justify resources and sustain interest from leaders and hospital administration. As demonstration of positive impacts cannot be done without high-quality baseline data to compare with post-implementation data, it is optimal to address the EHR build and to integrate health IT professionals on the ERP team early in the process [32].

With the power of the EHR to improve compliance with ERP programs already demonstrated, the next level of health IT support includes digital media "apps" for patients on their Smart Phones or portable digital tablets [34]. In particular, these apps facilitate feedback on patient-reported symptom intensity and functional recovery, including pain scores, mobility levels, wound photos, reminders to follow ERP protocols, and access to education libraries [34].

In addition to a general lack of ERP elements within EHR platforms, there is an additional barrier of data standardization across hospitals and countries. Stone et al. indicate that among a list of obstacles to ERP implementation there is absolutely a need for surgical societies and other key stakeholders to

declare which standardized measures in data fields are needed across all EHRs to measure ERP program compliance, and improve outcomes and quality [35]. Defining these data fields in the context of measuring quality (and likely development of an economic enticement), may eventually lead EHR vendors to hard-wire these metrics (e.g., in a format like a Quality Clinical Data Registry (QCDR) or 'HL7' format in tech-speak) into their architectures. Making them universally available for comparison would facilitate not only ERP program compliance but also large-scale analyses by multi-institutional Quality Collaborative such as that demonstrated by the Michigan Surgical Quality Collaborative and the South Carolina Surgical Quality Collaborative.

Compliance measurement

During the evolution of every ERP, there comes a time when compliance reports are needed for internal quality improvement. The measurement of compliance can, however, be challenging and requires personnel and IT resources. One example of a program that has successfully reported compliance data is the ERAS Society model [14, 28].

Following publication of evidence-based guidelines in 2005 focusing on colon surgery [36, 37], a formal audit-based implementation program (the ERAS Implementation Program, EIP) and analytic database (ERAS Interactive Audit System, EIAS) were developed. The EIAS provides specific modules for each surgical specialty, calibrated to best practices and measured by compliance with the guidelines. The EIP is a four-part hands-on coaching program that assigns a team of experts (surgeon, anesthesiologist, nurse, and data coordinator) to the institution initiating the program. The curriculum unfolds over 8–9 months with four coaching sessions, and access to the coaching team [38].

This structured approach has shown two important findings: (1) the greater the degree of compliance with guidelines the better the patient outcomes; and (2) audit and feedback are vital to maintain compliance. In one study, < 50% compliance with ERAS protocol elements resulted in a mean length of stay of 9.5 days and a readmission rate of 11%, while compliance > 90% showed an improved length of stay of 6 days and readmission rate of only 2% [37]. In general, patient-facing success is realized when 70% element compliance is regularly achieved. The transparent and timely data feedback exemplified by the ERAS Society approach certainly appears to be critical to full and sustained ERP implementation.

Conclusion

ERP implementation is a fascinating process with numerous challenges, but also enormous opportunities. Successful implementation requires equal parts of human-touch and science. This article aimed to arm ERP implementation teams with guidance on team/culture building and specific proven strategies. Key inclusion criteria for a successful implementation are goal congruence, leadership buy-in, administration support, engagement from a cohort of multidisciplinary team members, EHR integration, and compliance measurement. Given the value of ERP to patients, providers, hospitals, and society, it is well worth the effort to learn and incorporate these new skills. The additional positive residue from these efforts is the formation of stronger and more satisfied perioperative teams.

Author contributions Authors are listed alphabetically and all equally participated in the Design, Writing, Editing, and Final Approval of this manuscript.

Compliance with ethical standards

Disclosures Drs. Aloia, Keller, Kowalski, Lin, Luciano, Myers, Sinha, Spaniolas, and Young-Fadok have no conflicts of interest or financial ties to disclose.

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