Building Self-Empowered Teams for Improving Safety in Postoperative Pain Management

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Abstract

Objective: The objective of this project was to test, in a residency training context, a novel methodology based on failure modes and effects analysis (FMEA) to improve postoperative pain management in older adults. The methodology forms adaptive self-empowered learning teams that prioritize and address the threats to quality they face in their own unique setting. **Methods:** On a postoperative floor at a teaching hospital, an Error Reduction Intervention Cycle was implemented, including an FMEA-based survey that elicits perceptions of frequency and severity of various types/causes of pain management errors, followed by meetings to reach consensus regarding priorities and feasible solutions. **Results:** The floor team developed a common set of priorities for improvement. Team members jointly developed solutions that are currently being implemented, including both system changes and educational interventions. **Conclusion:** This proactive methodology actively engaged surgical residents in quality improvement as part of an interdisciplinary team and has the potential to foster a culture of safety.

Introduction

Pain management in general, and postoperative pain management in particular, remains unsatisfactory despite: (1) the worldwide promotion of pain as the "fifth vital sign" (where pain is added to the traditional four vital signs to encourage its routine assessment), (2) technologic advances in medicine, and (3) enhanced guidelines.[1, 2, 3] The situation is worse in the case of older patients.[3, 4, 5, 6, 7, 8, 9, 10, 11] Deficient pain management may result in psychological and physiological changes resulting in morbidity and mortality and a decrease in patients' quality of life; increased financial burden on the patients and the health care system due to extended lengths of stay and readmissions; and patient dissatisfaction.[12, 13, 14]

The gap between what is delivered and what can be delivered in health care has been termed the "quality chasm" by the Institute of Medicine (IOM).[15] Deficiencies in postoperative pain management can be seen as part of this "chasm." Areas that require attention in order to close this gap include pain assessment and monitoring; familiarity and availability of a variety of pain management strategies (including nonpharmacologic and pharmacologic); teamwork/coordination; patient/family involvement; respect for the integrity and dignity of patients; and systematic continuing quality improvement.

In response to this need, the Accreditation Council for Graduate Medical Education[16] has called for residents to be trained in practice-based learning and improvement and system-based practice. The Academy of Medical Royal Colleges[17] and the World Health Organization[18] have called for placing patient safety at the heart of medical education and practice.

In any setting, one of the most important barriers to reducing errors and improving quality of care is the lack of awareness of the type, incidence, and consequences of these errors. The most commonly used method for estimating vulnerabilities in health care is to retrospectively collect and count errors through voluntary reporting systems (often referred to as incident reports). These are fraught with difficulty due to underreporting (according to the IOM's 1999 report, only 5 percent of known errors are typically reported, and then there are unknown errors) and abuse (e.g., reports filed and counterfiled as a means of retaliation against colleagues).[19] Error reporting often does not promote understanding of the organizational structure and processes of care. Instead, it tends to be associated with blame and shame and frequently results in antagonism among team members, undermining mutual respect, trust, and cooperation. Bates and colleagues have described the difficulties involved in defining and quantifying errors. They reported that even direct observational studies, which are highly labor intensive, often miss errors.[20]

An alternative approach that is prospective, rather than retrospective, and permits involvement of all team members in identifying and prioritizing safety and quality problems is failure modes and effects analysis (FMEA). This has been widely used in other high-risk industries and has been advocated by the IOM as a means of analyzing a system to identify its weaknesses (failure modes) and possible consequences of failure (effects) and to prioritize areas for improvement.[19] We have adapted this methodology and shown it to be effective in a variety of complex ambulatory settings.[21, 22, 23, 24, 25]

The proposed methodology, invoking the paradigm of complex adaptive systems, is designed to aid formation of central "attractors" in the form of self-empowered effective learning teams with a common vision to help their complex microsystems adapt and thrive.[26, 27, 28, 29, 30] Thriving systems are endowed with simple rules, shared vision, and opportunities for team members to innovate.

The paradigm of complex adaptive systems suggests that each health care setting can be viewed as a complex adaptive microsystem. To survive and thrive, hospital floors have to be adaptive. That is to say, they must: (1) generate information about the vulnerabilities of their microsystem and promote dissemination of this information to aid learning about these vulnerabilities (the hallmarks of safety culture, as pointed out by the National Health Care Safety Council of the United States National Patient Safety Foundation); (2) pool diverse resources to generate options for responding to unpredictable external and internal stimuli/pressures; and (3) create good teams to perform tasks 1 and 2 successfully and keep the prevailing anxieties in check.[30]

The objective of the work presented here was to test our FMEA-based safety improvement methodology in a teaching hospital setting for improving postoperative pain management, focusing on older adults, with surgical residents as integral members of the team. The methodology was intended to form adaptive, self-empowered learning teams motivated to

prioritize safety problems and to devise feasible interventions, thereby fostering a sustainable culture of safety.

Methods

Adaptation of Failure Modes and Effects Analysis

Traditional FMEA is a labor-intensive process that comes in several varieties but essentially involves the following parts:

a. Choose a specific process to study.
b. Assemble a team to conduct the analysis.
c. Identify the steps in the process.
d. Identify all the possible failure modes at each step.
e. Estimate the consequences (effects) of each failure mode.
f. Prioritize areas for improvement.
g. Design interventions and/or system changes to address the highest priority areas.
h. Implement and measure the effects of these interventions.

FMEA is time-consuming, costly, and requires considerable expertise and experience. In most settings, the scarcity of necessary resources and expertise is particularly problematic. Even in hospital settings, trained quality improvement personnel are not always available (especially at the individual floor level), despite the fact that leadership is mandated (in the United States) by the Joint Commission (formerly known as JCAHO) to provide the necessary resources for this type of activity.

A further problem with the traditional FMEA approach is that it focuses on a very specific process (e.g., the medication prescribing process) and, therefore, has potential only to improve a small part of the system. Individual floors/settings cannot afford to limit their quality improvement efforts to such a narrow area at the exclusion of other potentially fruitful ones.

In an attempt to overcome some of these practical barriers and while maintaining the essential thrust of FMEA, our process is designed to give a broad overview of the problem at hand. We include almost all of the entities and their interfaces/interactions in the setting under study.[31] This avoids the problem of having to choose a very specific process to study (part “a” of the traditional FMEA). Instead, one can take a broader view and study a problem that is wider in scope. Postoperative pain management, for example, is a complex problem that involves many different processes and personnel and would be beyond the scope of traditional FMEA.

In our process, steps “g” and “h” of the traditional FMEA are unchanged, but steps “b” through “f” are achieved via a single step that consists of an anonymous survey of all staff. This survey, known as a “Safety Enhancement and Measurement Instrument – Patient Centered” (SEMI-P), serves as a proactive risk assessment tool.[21, 22, 23, 24] It is designed to generate a hazard profile (“snapshot”) of the setting at any given time. Considerations leading to its development are described below.

Design of SEMI-P: Macrosystem and Microsystem Level Considerations

The SEMI-P is broadly structured on a visual model[31] of the whole continuum of health care (Figure 1). The model is a systematic, patient-centered representation (based on safety engineering principles) of health care settings. The concentric circles represent the various domains of care in which a patient can transition, including the home/community (at the center), the primary care office, the emergency department, long-term care, and the inpatient setting.

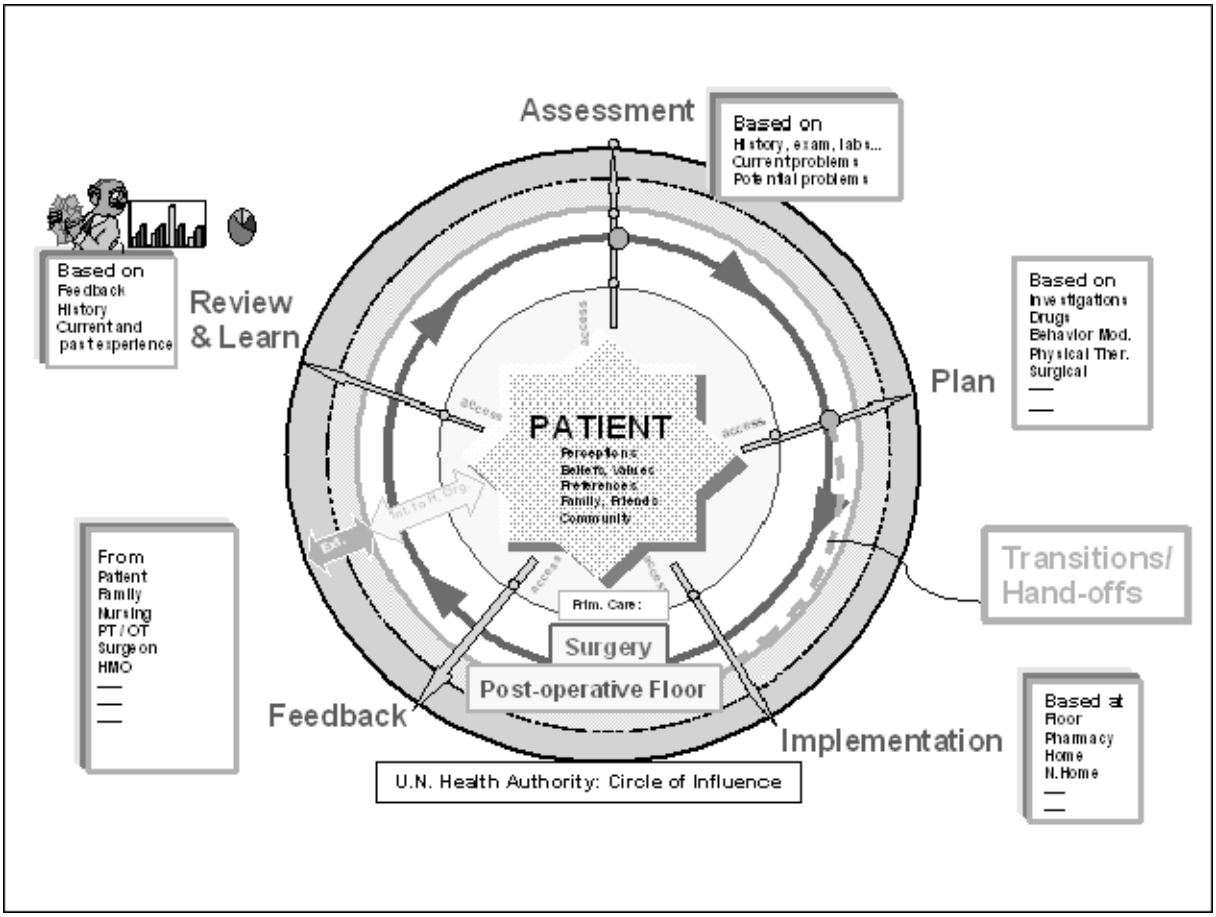


Figure 1. Model of the whole health care system. Adapted from Singh R, Singh A, Fox C, et al., Inform Prim Care 2005; 13: 135-144.

A cycle of care takes place in each circle, consisting of the following processes:

1. **Assessment**. Accurate collection, review, and documentation of history, physical exam, laboratory results, medications, and current and potential problems.
2. **Plan.** Accurate prescription of appropriate medications, dosage, timing, and combinations (avoidance of unnecessary polypharmacy) and ordering of appropriate, timely, and sufficient monitoring and other appropriate interventions.
3. **Implementation.** Accurate completion of orders, including transcription, dispensing, and administration of medications, laboratory testing, and other interventions.
4. **Feedback.** Accurate feedback from the patient, family, doctor/nurse/pharmacist/staff, lab, and medical record.

5. **Review and learn.** Systemic learning from process evaluation (without assigning blame).

Each point of intersection between a circle and a process represents a specific set of processes of care. For the purposes of the present work, the circle shown in bold in Figure 1 represents pain management on the postoperative floor. Therefore, the five points around the circle represent the steps in postoperative pain management. These steps need to be examined closely in the SEMI-P. This is achieved by creating a microsystem view, as will now be discussed.

Figure 2 represents a detailed (microsystem) view of inpatient postoperative pain management. It includes all the entities and interactions that together achieve the cycle of care (e.g., assessment, planning, implementation). The microsystem view provides a natural structure for identifying failure modes. The SEMI-P is structured around this micromodel. It dedicates a separate page to each of 18 entities/interactions within the system. Each page includes a list of failure modes that can occur in that specific part of the system. The micromodel and the lists of failure modes were developed by review of the literature and consultation with the setting/floor leaders. The questionnaire contains 153 failure modes. When responding to the survey, participants are encouraged to add to the lists of failure modes as they see fit. Figure 3 shows an example page.

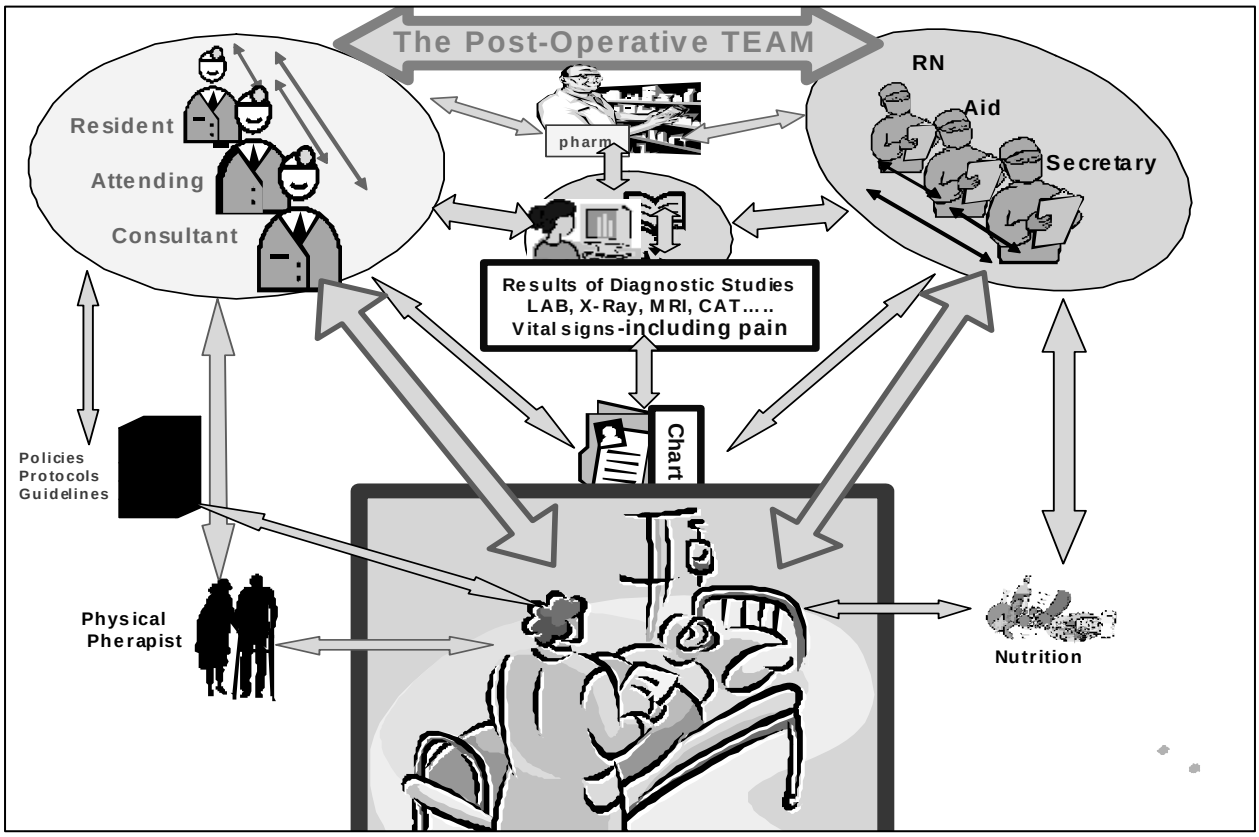


Figure 2. Visual micromodel of the entities and interfaces/interactions for postoperative pain management.

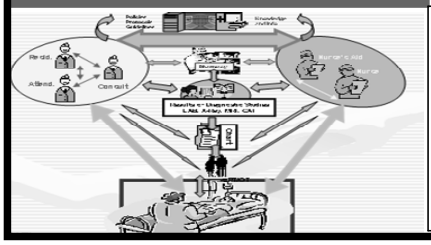
Type/cause of Error : Patient	How often does this happen?				What is the usual consequence?			
	Frequent	Occasional	Uncommon	Remote	Severe	Moderate	Mild	Minimal
Patient does not complain (stoic)								
Unable to explain pain due to cognitive impairment								
Unable to explain pain due to sedation								
Unable to explain pain due to language barrier								
Does not provide accurate information about:								
medical problems								
prior medications								
allergies								
substance use / abuse history								
Does not seek clarification when needed from Dr/Nurse								
Does not provide/participate in self-assessment of pain								
Patient unfamiliar with pain management strategies								
OTHER								
.								
	One or more times in a day	One or more times in a week	One or more times in a month	Less than once a month	Severe or irreversible complications (eg deleriu m, disabilit y)	Mild or moderate reversible complicati ons unrelated to the natural course of the illness	Increas ed length or severit y of illness	No increas e in length or severity of illness

Figure 3. Survey example page.

Participants anonymously and confidentially expressed their perceptions of the frequencies and severities (as defined on each page) of the various failure modes in the setting where they work. These answers were transposed onto numerical scales and then converted to relative hazard scores by taking the product of frequency and severity for each failure mode (see Table 1).

Instead of asking staff about their own personal error experiences, which likely would have been uncomfortable for some respondents, the SEMI-P asked them about their perceptions of the floor as a whole.

This approach took advantage of local experiential knowledge and, like the highly acclaimed Aviation Safety Reporting System (ARS), had three important attributes; safety (immunity from blame and punishment), simplicity and convenience, and worthiness and value (provided

Table 1. Relative hazard matrix used for transposing qualitative frequency and severity into numerical values

	Probability of occurrence			
Severity(s)	**Remote**	**Uncommon**	**Occasional**	**Frequent**
Minimal	0.01	0.02	0.24	1
Mild	0.03	0.10	1.20	5
Moderate	0.10	0.40	4.80	20
Severe	0.50	2.00	24.00	100

feedback and served as a tool for development of improvement strategies and enhancement of staff self-esteem).

Intervention Design

The intervention design applied an Error Reduction Intervention Cycle (ERIC), as illustrated in Figure 4. The process was carried out on two postoperative surgical floors at an urban teaching hospital. The two units were run by the same nursing manager and were viewed as one unit for this study. All staff—including nursing, administrative and support staff, surgical attendings, and surgical residents—were invited to participate. The hospital quality improvement committee approved the protocol. The steps in the intervention (Figure 4) are described below.

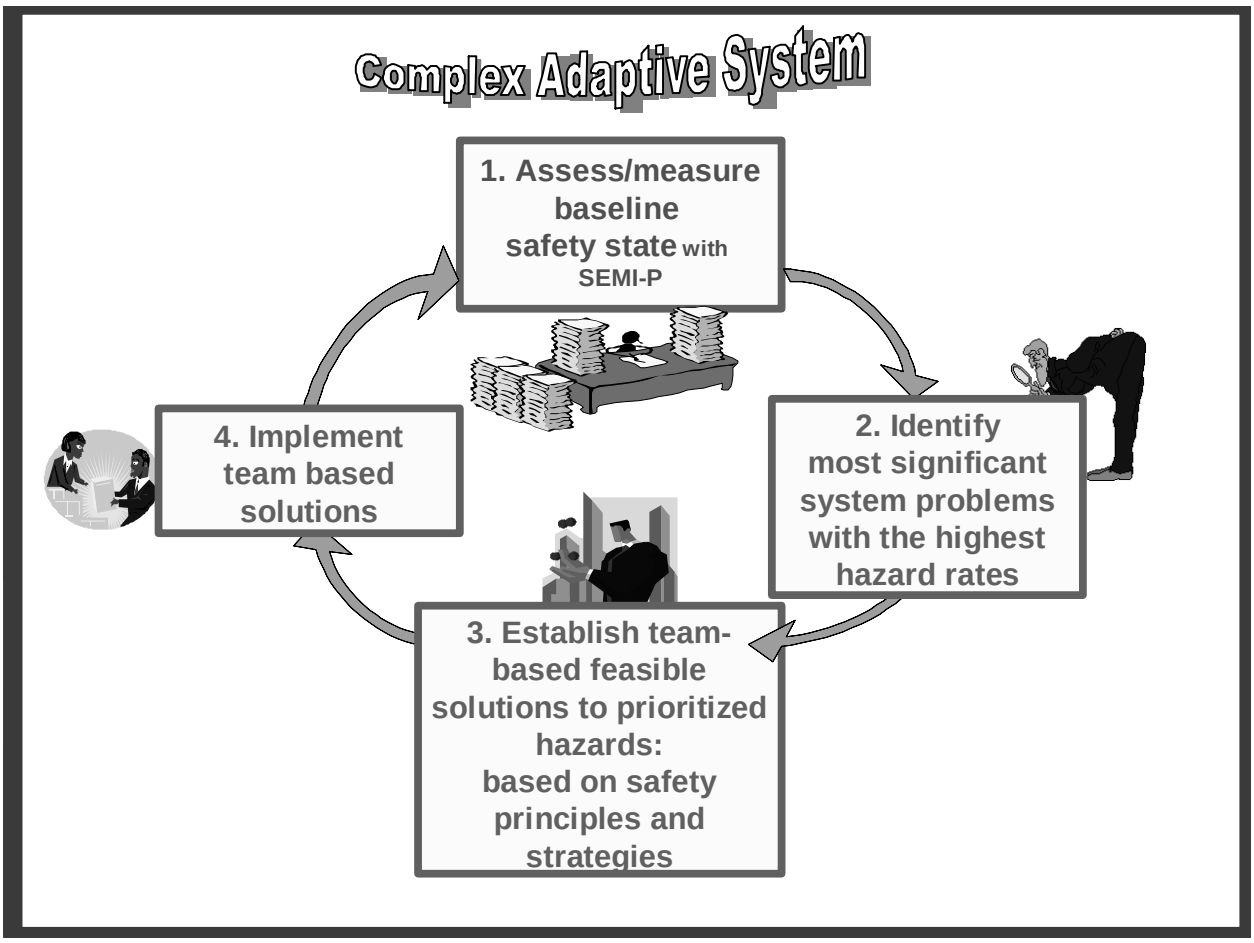


Figure 4. Error Reduction Intervention Cycle (ERIC) using Safety Enhancement and Measuring that is Patient-Centered (SEMI-P).

Step 1: Assess the Baseline Safety State

Prior to administration of the questionnaire, participants attended a 20-minute orientation session that explained the rationale behind the approach, the visual model, the intended cyclic process of improvement, and the format of the survey. Specifically, the following aspects were reviewed with the aid of slide show and flip charts:[23]

- The importance of reducing errors for improvement of quality.
- Avoidance of individual blame when errors occur – *To Err Is Human*.
- The importance of focusing on team learning from errors.
- The superiority of a safety culture over a culture of blame and other possible strategies.
- The important contributors to this culture were described and explained in detail.

For floor staff, this orientation was done in small groups at lunchtime meetings (with lunch provided). Surgeons (residents and staff) were oriented during existing scheduled meetings. Immediately after orientation, each group received the SEMI-P survey together with an envelope to facilitate anonymous return of the survey. Meetings were scheduled to include sufficient time to complete the survey. Following the methodology outlined earlier, hazard scores were calculated for each failure mode. Failure modes were then ranked according to their means.

Step 2: Identify the Most Significant System Problems

Ideally, all floor staff and surgeons would have met together to establish priorities based on the survey results. However, this was not feasible. Therefore, two separate meetings were arranged, one with floor staff and one with surgical residents. Each meeting was conducted using the following structure:

- Brief review of the orientation material.
- Presentation of SEMI-P results in detail, including comparison of hazard scores assigned by surgeons vs. floor staff.
- Prioritization discussion, using the SEMI-P results to encourage a common vision and as a starting point for discussion.
- Creation of a mutually agreed upon list of top priorities for improvement in postoperative pain management.
- Where time permitted, preliminary discussion of solutions to the identified priorities (i.e., the beginning of Step 3).

Step 3: Establish Feasible Team-Based Solutions

A joint meeting was convened with representation from surgeons, floor staff, and hospital administration to review the priorities identified in Step 2 and reach consensus regarding appropriate solutions. In keeping with the philosophy of using internal expertise and promoting group ownership of problems and their solutions, the group was encouraged and helped to develop their own solutions based on their intimate knowledge of their own unique microsystem. To aid and guide the design of safety interventions, the staff was shown a brief slide presentation covering basic strategies and principles of system redesign based on IOM recommendations.

Step 4: Implement Team-Based Solutions

Team members collaborated as needed, with input and approval as necessary from within the administrative hierarchy of the hospital, to implement the solutions identified in Step 3, modifying them as needed to overcome the barriers they faced.

Results

Results of each step in the ERIC process are described below.

Step 1: Assess the Baseline Safety State

During a 2-month period, 36 floor staff and 53 surgical staff (including residents and attending surgeons) completed the SEMI-P. Those respondents who completed the survey during the assigned meetings were observed to take between 20 and 30 minutes.

Step 2: Identify the Most Significant System Problems

Approximately 2 months later, two prioritization meetings took place independently, one for floor staff and one for surgeons. The meeting for surgeons was attended by 45 surgical residents and one surgical attending (the residency program director) and was limited to 20 minutes due to scheduling constraints. The SEMI-P results were presented and discussed. The meeting took place in a lecture hall, a setting not conducive to open discussion. Therefore, to allow for maximal participation in the prioritization decisions, 14 items (including those with the highest hazard scores and others raised in discussion) were presented to the group for a vote, based on a show of hands. The four items with the highest number of votes became the surgeons' priority list, as follows:

- Misunderstanding of written pain management orders due to poor handwriting.
- Inadequate information from patients regarding prior medications.
- Poor access to the current medication list.
- Limited knowledge among surgical residents regarding appropriate medication dosages for older adults.

Prioritization by floor staff took place at a 2½-hour dinner meeting with a roundtable format that was conducive to discussion and debate. The nursing manager, nine floor nurses, three nurse's aides, one physical therapist, and one secretary participated. As with the surgeons' meeting, the data were presented, and a discussion was facilitated by one of the authors. The problems the staff identified as having the highest priority were:

- Misunderstanding of written pain management orders due to poor handwriting.
- Shortage of time for nurses to adequately assess and manage pain.
- Use of intravenous bolus dosing of opiates for pain (felt to be inappropriate in most cases by nursing staff).
- Poor communication of pain symptoms by patients to physicians.
- Junior residents sometimes uncomfortable changing the pain medication prescribed by their attending, even if it was not effective.
- Difficulty in reaching the appropriate resident covering a patient.

The time available permitted extensive discussion of the prioritized issues including details of perceived reasons for problems, discussion of previous attempts to address them, and preliminary discussion of new solutions. This discussion format, although more labor-intensive, was more helpful overall than the "voting" method employed with the surgical residents because of the rich

exchange of ideas that occurred. In addition, the detailed records of the discussion served as a useful reference document during Step 3.

Step 3: Establish Feasible Team-Based Solutions

At a l-hour breakfast meeting held 1 month later, seven surgical residents, the surgical residency program director, five floor nurses, the unit nurse manager, three nursing administrators, and the hospital's chief of geriatrics met to review the priorities identified by the two groups in Step 2, to reach consensus regarding these priorities, and to plan interventions to address them. As a result of this meeting, a summary document was produced, listing the planned interventions and assigned responsibilities. The following is an excerpt from that document [names edited out]:

Planned interventions to improve postoperative pain management:

1. **Create a standardized postoperative progress note form** that contains prompts reminding residents to check for pain, functional status, and other relevant parameters. A group of surgical residents/attendings could work together to develop this form under the supervision of the surgery residency program director. Examples of such forms used in other facilities may be readily available and could serve as a starting point.

2. **Work with surgery residency program director to identify training opportunities** for surgical residents and attendings regarding:
    a. Management of acute pain in the elderly, including:
        i. Appropriate medications and dosages.
        ii. Alternative routes of administration.
        iii. Management of patients who also have underlying chronic pain.
    b. Medication reconciliation; this is already implemented but not all physicians are aware of how it works.
    c. Preoperative discussion of postoperative pain management options (for elective surgeries). Residents might have limited access to preop patients, so this may be more of an attending issue.

3. **Consider increased availability of patient-controlled analgesia (PCA) pumps** as an option for postoperative pain management. [Nursing administrator] will explore whether there are any administrative barriers. Unfamiliarity with ordering PCA pumps (due to prior history of this being done only by anesthesiology at this hospital) is another barrier that might need to be addressed with residents and attendings as part of item 2 above. Similarly, nursing staff will require in-service training.

4. **Create a preprinted postoperative order form that includes pain management** and other post-op orders. Experience with the postop order form used on the orthopedics floor could help inform the development of this. Surgeons and nurses will need to work collaboratively to develop this. [Unit manager] will create an initial draft as the basis for further discussion.

5. **Improve access to resident schedules.** Nurses do not find the current schedule user-friendly. They need a list of who is covering each team each day. Some nurses create their own list each day; this helps. This process could be institutionalized so that one list is made and

distributed. Alternatively, this information could be available online. [Unit manager] will explore these two possibilities.

6. **Put in place a system to encourage premedication (when appropriate) to reduce pain prior to physical and occupational therapy**. [Unit manager] will discuss with the relevant therapy departments the possibility of posting schedules so that nursing has enough advance notice so they can premedicate. The preprinted postop order set (item 4) could include the option of a standing order to "Premedicate with _____ prior to therapy."
7. **Make current medication lists more easily available to residents**. The [specific document in the hospital computer system] was felt to be the most useful document. This has to be requested from pharmacy. [Unit manager] will investigate the possibility of making this available in the chart for every patient on a daily basis.

Step 4: Implement Team-Based Solutions

All of the above action items are currently being implemented. Barriers encountered include resistance from practicing surgeons to change their prescribing habits, unfamiliarity with PCA pumps and how to order them, and competing demands.

Discussion

Each health care setting is a unique and complex microsystem and should be respected and treated as such. This means that off-the-shelf solutions seldom work. We have presented a novel approach, adapted from the method of FMEA intended to be used by each unique health care setting to identify its own set of priorities and to internally develop feasible solutions based on the team members' intimate knowledge of their microsystem. We have described our experience with using this approach to address postoperative pain management in a hospital setting. The diverse members of the postoperative team were able to work together to develop and implement solutions. However, it is not yet known whether the implemented solutions will lead to improved care and/or outcomes. This clearly requires further study. A variety of effectiveness measures will likely be needed, ranging from simple rates of use of the interventions (e.g., order forms, PCA pumps) to patient satisfaction with pain control, rates of pain-medication-related adverse events, and length of stay.

A further intended effect of the methodology presented here is the fostering of a culture of safety. The ERIC process aims to incorporate change management strategies through a motivated guiding coalition of all staff with a clear, shared vision and shared goals.[32] Empowerment, ownership, good team formation (that fosters mutual respect, trust, understanding, collaboration, cooperation, and work satisfaction) are sought to be the driving "strange attractors" of a learning, self-directed, adaptive, and evolving organization[26, 33, 34] leading to a culture of safety.

This philosophy contrasts with the prevalent approach, often referred to as "Taylorism," (described by Frederick Taylor in his influential 1911 book, *The Principles of Scientific Management*)[35] in which, in its extreme form, only management is empowered to make decisions while workers are expected to follow unquestioningly. The fact that team members worked constructively together in this study is one sign of staff empowerment and a developing safety culture, but further studies are needed. For example, safety climate/attitude surveys might

be used to attempt to measure changes in safety climate that might occur because of the team's participation in the ERIC process.

Although some items were the same between the two groups (surgeons vs. floor staff), most of the priorities initially identified by the two groups were different. This highlights the need to incorporate the perspectives of the whole range of workers in a system. Ideally, team meetings should have involved all staff to maximize the opportunities to discuss similarities and differences of opinion, build a common vision, and take advantage of as many people's experience and insights as possible. While this ideal will likely not be achievable in most settings (as was the case in this study), we suggest that management show their overt support for this kind of approach by facilitating group meetings and exchange of ideas as much as possible. Other methods of exchanging ideas, such as online discussion forums, offer possibilities that should be explored.

The residents' participation as key members of the quality improvement team was an important aspect of this study. Residents participated actively in discussions regarding priorities and contributed much to the development of the interventions. We have not formally evaluated the residents' experience with the process, but our observations are that the residents who participated most actively began to understand better the nursing staff's perspectives, developed a greater understanding of the need for teamwork in pain management, and gained an appreciation of the methods and challenges involved in system improvement. Furthermore, the SEMI-P instrument, in addition to its role in identifying opportunities for system improvement, served as a needs assessment for resident, attending, and staff training.

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