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7 Integrating Patient Safety and Quality Improvement with Postgraduate Medical Education

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Executive Summary

This paper focuses on the resident as learner and the emergence of patient safety (PS) and quality improvement (QI) curricula for postgraduate trainees. We first present a framework that classifies a variety of potential exposures to QI or PS in training. We then summarize the types of curricula that currently exist, and the evidence supporting their effectiveness in achieving specific learning outcomes. We drew from the available evidence from 40 published curricula to arrive at recommendations and summarized the following three key themes and trends that are shaping the present and may define the future of PS and QI in postgraduate medical education.

1. The rapid emergence and evolution of PS and QI training in postgraduate medical education is creating a need for innovative educational interventions. The past decade has seen an explosion of literature that describes and evaluates educational interventions that aim to teach postgraduate trainees the tenets of PS and QI. Half of the 40 published PS and QI curricula have been created in the past three years. Many PS and QI curricula combine didactic and experiential learning to achieve significant improvements in learner knowledge and improvements in clinical processes. Among experiential learning techniques used, resident involvement in leading QI projects is extremely common. Other notable trends include modifying traditional teaching forums such as revamping traditional morbidity and mortality conferences to focus on systems issues and processes of care as opposed to individual performance to highlight PS and QI concepts, incorporating web-based modules and using reflective practice. Taken together, these educational interventions are well-accepted by learners, result in measurable improvements in learner knowledge about PS and QI concepts, and can lead to improvements in clinical processes of care.

2. Implementation challenges and feasibility issues limit the broader adoption of PS and QI training in postgraduate medical education. Despite the sudden increase of published curricula, broad adoption of PS and QI training remains limited in many postgraduate training programs. Implementing a PS or QI curriculum can be challenging. Learner factors (e.g., the degree of learner engagement and the need to balance competing educational and clinical demands) and faculty factors (e.g., the availability of faculty PS and QI experts to deliver curricula or supervise QI projects) warrant consideration to ensure successful implementation of a PS and QI curriculum. Other feasibility issues, such as scheduling an experiential PS or QI curriculum in a busy residency training program and identifying resources to support experiential learning (especially in the form of QI projects) are equally important.

3. There is value in partnering PS and QI educational efforts with other emerging themes in postgraduate medical education. With an ever-expanding list of competencies expected of future physicians, there is limited time to devote to dedicated PS or QI training in postgraduate medical education. One potential strategy to expand PS or QI content in training programs with limited curricular time is through collaboration with other emerging themes in postgraduate medical education. PS and QI topics lend themselves very nicely to being taught in a variety of contexts, and could partner with efforts in the following domains: simulation, intra and interprofessional education, issues of social accountability and professionalism). Rather than moving forward in separate educational silos, educational leaders in safety and quality should identify local champions in these overlapping domains, and create opportunities for trainees to learn synergistically about these concepts through unified educational activities.

Introduction Background

Since the release of the two seminal Institute of Medicine (IOM) reports *To Err is Human* (1) and *Crossing the Quality Chasm* (2), quality of care and patient safety issues have emerged as important topics discussed by policy makers, healthcare practitioners and patients alike. A decade later, the IOM published an equally influential report *Resident Duty Hours: Enhancing Sleep, Supervision and Safety* (3) that highlights important patient safety and quality of care issues that affect trainees including resident duty-hour restrictions (4-6), physician wellness and fatigue (7), effective patient handovers (8, 9), and adequacy of trainee supervision (10, 11).

There is increasing recognition that efforts aimed at improving healthcare quality requires direct engagement of all healthcare professionals, including physicians. The Royal College of Physicians and Surgeons of Canada (RCPSC) and the College of Family Physicians of Canada (CFPC), as part of the CanMEDS competency framework (12), and the Accreditation Council for Graduate Medical Education (ACGME) in the United States (U.S.), as part of its Outcomes Project (13), outline specific physician competencies that directly relate to patient safety (PS) and quality improvement (QI). As a result, many postgraduate training programs are beginning to recognize the importance of teaching future physicians PS and QI principles. Some are starting to include explicit curricula as a mandatory component of the training program (14).

The intersection between patient safety, quality of care, and postgraduate medical education is broad and encompasses important issues such as duty-hour restrictions, professionalism and adequacy of trainee supervision. This paper focuses on the resident as learner and the emergence of PS and QI curricula for postgraduate trainees. We first present a framework that classifies a variety of potential exposures to QI or PS in training. We then summarize the types of curricula that currently exist, and the evidence supporting their effectiveness in achieving specific learning outcomes. We draw from available evidence to arrive at recommendations and summarize key themes and trends that are shaping the present and may define the future of PS and QI in postgraduate medical education.

This paper is one of 24 papers commissioned for the Future of Medical Education in Canada Postgraduate (FMEC PG) Project. Other commissioned papers in this series address these issues in detail as well – see commissioned papers 11: Accreditation of Postgraduate Medical Education in Canada and commissioned paper 20: Teaching, Learning and Assessing professionalism at the Post Graduate Level.

Resident exposure to quality improvement and patient safety

Postgraduate trainee exposure to PS and QI occurs in a variety of teaching settings and learning environments. The various types of PS and QI exposure are found in Table 1.

Table 1: Types of Resident Exposure to Quality Improvement (QI) or Patient Safety (PS) in Postgraduate Training

Exposure	Description
Traditional medical education teaching activities	These include teaching methods commonly used in all domains of medical education. Examples include didactic lectures, small-group seminars, case-based discussions, or role-play with standardized patients. These may occur in isolation, or coordinated as part of a larger curriculum.
Morbidity and mortality conference with a specific quality or safety focus	A specific type of case-based rounds where cases are selected specifically to highlight an adverse outcome that, through group discussion, leads to improvement in future care. Traditionally these have focused primarily on individual performance improvement, but have more recently been expanded to focus more on clinical process issues and systems problems.
Self-directed learning activities	Activities whereby learners work independently to acquire knowledge about QI or PS. Examples include web-based modules or maintaining a patient safety portfolio to promote reflective practice.
Experiential learning exercises	Examples include chart audits to describe a quality gap relating to the care of their patients to identify opportunities for quality improvement. The range of possible applications of using a chart audit to teach QI or PS includes having trainees reflect on the results of the practice audit, to resident-led improvement efforts to address gaps in care. Other examples include exercises to engage residents in the use of common QI or PS tools, such as process mapping and root-cause analysis.
Resident-led quality improvement projects	Resident-led QI projects (either individual or team-based) where residents learn and apply specific QI skills such as rapid-cycle change methods, process mapping, or change management, to improve quality or patient safety. Often combined with a single or series of didactic lectures that provide foundational knowledge to support project work.
Faculty mentorship	Faculty mentorship experiences range from direct faculty supervision of residents carrying out QI projects, to exposing trainees to operational quality improvement practices by pairing trainees with local patient safety officer or risk managers.
Skills-based training	Curricula or training programs that focus on imparting specific skills that allow residents to provide safer care (without explicit discussion of the safety or quality principles or concepts that relate to these skills). Examples include communication training to improve error disclosure skills, teamwork training, or improving handoffs between residents.
Involvement in institutional quality or safety initiatives (without a formal curriculum)	Passive exposure of trainees to, and possible involvement of trainees in QI initiatives, without a formal curriculum to teach actual QI or PS principles. Examples include implementation of medication reconciliation on clinical services that include residents as members of the health care team, or soliciting resident feedback during the implementation of safe surgical checklists in the operating room.

QI = quality improvement; PS = patient safety

Training programs may impart residents with PS and QI concepts through the use of traditional teaching methods in medical education. Examples include didactic lectures, small group interactive discussions, case-based rounds, or role-play. These methods are extremely effective in delivering foundational PS and QI content to a large number of trainees, may be less challenging to develop and implement than more complex experiential approaches such as QI projects and can effectively lead to PS and QI knowledge acquisition (15). However, they are limited by their passive nature and reliance on expert faculty to lead these educational activities.

A specific type of case-based rounds, namely morbidity and mortality conference (M&MC), is another educational activity used to teach PS and QI to trainees (16-19). Traditionally, M&MCs used errors that led to surgical or anesthetic mortalities as a springboard for learning and improving practice, although the attention focused primarily on individual clinician performance improvement. Over the past decade, some M&MCs have evolved to focus more on systems and clinical process problems (20), which is why they are seen as a potentially useful tool to teach trainees about PS and QI.

Residents may independently complete web-based training modules or maintain a portfolio that captures reflections on patient safety problems as a way to expand their knowledge of PS and QI. Web-based training modules are particularly appealing due to the potential to train a large number of residents without relying on having local faculty members with QI or PS expertise. Some of these web-based resources are made available free-of-charge to trainees. Examples include the Institute for Healthcare Improvement (IHI) Open School (www.ihi.org/IHI/Programs/IHIOpenSchool) and the Agency for Healthcare Research and Quality (AHRQ) web M&M (www.webmm.ahrq.gov) websites. Web-based modules have also been shown to improve knowledge of PS and QI (21). Portfolios that capture reflections on quality or safety problems are also emerging, and may offer a feasible mechanism for trainees to take a more active approach to learning PS and QI principles (22).

Other types of exposure rely on experiential learning activities. Resident-led quality improvement projects and chart audits to improve quality of care actively engage residents in applying knowledge and skills to improve quality or address a safety problem. Other examples include learning exercises such as mapping a healthcare process or conducting a root cause analysis, whereby trainees apply these tools to real-world quality or safety problems.

There are also examples of emerging curricula that are closely linked to PS and QI because they impart residents with specific skills that allow them to practice more safely, but often do not focus on explicitly teaching the underlying principles that relate to these skills. For example, some postgraduate training programs provide communication training, often focused on issues of medical error disclosure (23, 24). These often include video vignettes, peer-role play and the use of standardized patients to teach empathic and transparent communication of a medical error. Other training programs explicitly teach residents effective sign-out skills, using a variety of interactive teaching techniques that include direct observation of sign-out skills with provision of formative feedback (25)

Finally, some training programs offer faculty mentorship opportunities for trainees to interact directly with individuals at the hospital operations level who have as their primary function a role in improving quality. Residents might also encounter PS and QI during their day-to-day clinical training as members of a healthcare organization where improvement initiatives take place. Examples include resident engagement in hospital-based initiatives to improve coordination of care through the implementation of multidisciplinary care rounds (26), participation in quality improvement activities in the intensive care unit to reduce sepsis mortality and iatrogenic

pneumothorax rates following thoracentesis (27), and involvement in ambulatory care chronic disease management programs (28).

A recent systematic review identified 28 published articles that explicitly list residents as active participants in institutional QI activities, suggesting that this type of exposure remains limited in most academic jurisdictions (29). However, other forms of passive exposure surely exist. For example, residents training at pioneering institutions for the adoption of computerized physician order entry (an information technology tool that can reduce medication ordering errors in hospitals) such as the Brigham & Women's Hospital in Boston, the Veterans Affairs Hospitals in the U.S., or the Indiana University School of Medicine (Regenstrief Institute) will have been exposed to, even in an indirect way, the role of systems-level solutions in preventing medical errors, and the process by which these solutions are designed, tested, revised and implemented.

Methods

We recently published a systematic review in September 2010 of published PS and QI curricula targeting both postgraduate trainees and medical students (14) and have subsequently updated this review focusing specifically on postgraduate training programs. The published systematic review summarizes the detailed review methodology and an abbreviated search strategy (our comprehensive search strategy is also available upon request). For this paper, we applied the identical search strategy from the systematic review to electronic literature databases (Medline, HealthSTAR, and Embase) to identify postgraduate PS and QI curricula published since the release of the IOM report *To Err is Human* (1), the report largely responsible for generating widespread interest in healthcare quality and patient safety.

For inclusion in this review, we narrowly define a QI or PS curriculum as one whose primary intent is to explicitly teach postgraduate trainees (as opposed to practicing physicians and medical students) core QI or PS topics and/or how to apply these principles in practice. We did not include studies that describe the involvement of trainees in broader institutional QI initiatives without an explicit curriculum (a recent systematic review summarizes this literature (29)). We also excluded curricula that narrowly focused on improving specific skills that promote safer care, such as teamwork training, improving handoffs, or communication training (e.g., medical error disclosure).

Using the curricular descriptions of published studies, we generated a framework to organize the different types of PS and QI curricula that currently exist in postgraduate training programs. We also summarize curricular features such as educational setting, teaching methods and curricular content, as well as learning outcomes reported by studies with curricular evaluation. We classified learning outcomes using the Kirkpatrick's framework for evaluating training, which includes impact on learner satisfaction (level 1), learner attitudes (level 2A) and knowledge acquisition (level 2B), changes in learner behaviour (level 3), and impact on clinical processes (level 4A) and patient outcomes (level 4B) (30).

Results

Literature review

Since the release of the IOM report in 2000, we identified 40 studies (15-19, 21, 22, 27, 31-62) of published QI or PS curricula; 30 (70%) studies included a curricular evaluation (15, 16, 19, 21, 27, 31-36, 38-40, 43, 45-49, 52-60, 62). Most PS and QI curricula are based out of U.S. training programs (35 studies; 88%), with four (10%) reports arising from Canadian

postgraduate training programs (three internal medicine (17, 37, 61) and one psychiatry program (52)). Postgraduate training programs with published QI or PS curricula include: internal medicine (18 studies; 45%), mixed training programs (11 studies, 28%), family medicine (four studies; 10%), surgery (three studies, 8%), pediatrics (two studies; 5%), psychiatry (one study, 3%) and radiology (one study, 3%).

Most curricula take place in the ambulatory (17 studies, 43%), inpatient hospital (12 studies, 30%), or mixed clinical (eight studies, 20%) settings. A variety of PS and QI topics are taught, the most common of which include continuous quality improvement (25 studies, 63%), systems thinking (18 studies, 45%), and root-cause analysis (16 studies, 40%).

PS and QI curricula employ a variety of teaching methods, including didactic lectures (31 studies, 78%), small group discussions (20 studies, 50%), case discussions (17 studies, 43%), self-reflection (seven studies, 18%), improvement projects (23 studies, 58%), chart audit exercises (five studies, 13%), faculty mentorship (14 studies, 35%), presentations (21 studies, 53%), and web-based modules (six studies, 15%). Most curricula are designed using a combination of the aforementioned teaching methods. The following section presents a framework that outlines the various types of PS and QI curriculum design.

Design of quality improvement and patient safety curricula

Although there was significant heterogeneity in the design and delivery of published PS and QI curricula, we are able to define five distinct curriculum designs that describe the majority of these curricula (Table 2). These include curricula with the following characteristics: 1) a primarily didactic curriculum; 2) a curriculum combining didactic lectures with a QI project; 3) a curriculum that is didactic with experiential learning other than involvement with a QI project; 4) web-based curricula; and 5) morbidity and mortality conference revamped with a quality or safety focus.

Table 2: Types of Quality Improvement and Patient Safety Curriculum in Postgraduate Medical Education

Type of Curriculum	Curriculum Subtype	Example(s)
Primarily Didactic	One-day curriculum with a series of lectures / workshops (n=1) (15)	A one 4-hour session that covers broad quality and safety concepts. The same program was repeated 4 times to accommodate 138 PGY1 residents from 15 different medical and surgical specialties attended the session. The content was taught through didactic lectures, large-group facilitated discussions and small group sessions (Reznek, 2010)
	Multiple lectures / workshops delivered over several days in a single block rotation	No programs at the postgraduate level.
	Multiple lectures / workshops delivered longitudinally throughout one or more years during the training program	No programs at the postgraduate level.
Didactic with Quality Improvement (QI) Project	Independent QI project with or without direct faculty mentorship / supervision (n=4) (42, 46, 47, 60)	A QI elective offered during an ambulatory block (20 hours per week for 3 weeks) within a single U.S. residency program. In the 3-week program, residents attended 3 hour-long didactic seminars, participated on QI hospital committees (depending on scheduling and time), completed a root cause analysis of a recently reported incident, and then selected and worked on a quality improvement project with the guidance of a faculty mentor. The short duration of the program was found to be challenging to residents for choosing a meaningful QI project topic and completing it within this timeframe. (Weingart, 2004)
	Team-based QI project with resident physician team members (n=10) (32, 39, 41, 43, 44, 48, 50, 55, 56, 61)	A six-week elective curriculum for PGY3 surgical residents during their research year, offered in a single U.S. residency program (Department of Surgery). The 3-part curriculum included didactic hour-long lectures in the first 2 weeks on the PDSA cycle within the Model for Improvement. Residents formed teams and implemented the QI project within the research year. Teams presented their project findings to the entire residency program. (Canal, 2007) A program delivered to PGY2 internal residents during their 2 mandatory 1-month ambulatory rotations at one U.S. teaching hospital. The curriculum included seminars during each ambulatory block that taught foundational QI topics. Residents used the American Board of Internal Medicine's (ABIM) Clinical Preventative Services Practice Improvement Module (CPS PIM) to audit their practice during the first ambulatory block, and then used this data for a group QI project. Residents also performed chart audits after the QI interventions to evaluate their effectiveness. (Oyler, 2008)

Type of Curriculum	Curriculum Subtype	Example(s)
	Team-based QI project with interprofessional team members (n=5) (27, 33, 38, 52, 57)	A mandatory program offered to family medicine residents in a single U.S. residency program. Interprofessional teams of residents, faculty and staff from ambulatory care sites worked on a QI project 6 months. One-hour monthly didactic sessions taught foundational QI topics during weekly residency didactic core conference series over a period of 7 months. Teams used additional team meetings for project planning, execution and evaluation. (Coleman, 2003) A 4-week elective interprofessional quality improvement curriculum at a single U.S. academic medical center. Seven learners participated as an interdisciplinary team (including fellows, a resident and nursing Masters' students). Instruction was provided on QI topics as well as interprofessional collaboration topics. The QI project focused on medication reconciliation in an outpatient preventive and occupational medicine clinic. (Varkey 2006)
	Sequential participation in a team-based QI project (n=2) (45, 53)	A sequential, longitudinal QI curriculum located at four community-based practice locations affiliated with 1 U.S. academic hospital. An initial didactic lecture taught residents QI and the model for improvement. As a group, residents then identify gaps in their practice that they plan to improve over the course of the academic year. Residents direct the change process in groups with faculty mentorship and then hand-off their project to the next resident who is doing their rotation. The projects are completed over the course of 1 academic year. (Neuspiel 2009)
	QI project design without implementation (n=3) (31, 36, 58)	A mandatory QI curriculum for internal medicine and pediatrics residents in a single U.S. residency program during their one-month ambulatory block rotations. Three one-hour sessions were devoted to QI theory and its applications. Residents designed a QI project although the actual project was not implemented. Following the curriculum, some residents began to meet with faculty towards project implementation. (Djuricich, 2004)
Didactic with Experiential Learning Activities (other than QI project)	Chart audits to identify quality gaps (n=2) (40, 59)	A curriculum was delivered to internal medicine residents during a new 4-week quality of care rotation. The curriculum consisted of 3 components: 1) independent reading of an assigned syllabus; 2) an audit of 10 medical records from the residents' own diabetic patients and those of their peers from the residency outpatient clinic; and 3) weekly meetings with a faculty member to discuss the self-reflection on the chart audit. Residents were encouraged to find solutions to identified deficiencies and problems. (Holmboe, 2005)
	Experiential exercises that engage learners in the use of QI or PS tools (e.g., root cause analysis, process mapping) (n=2) (34, 54)	A 6-month program delivered to all family medicine residents from a single U.S. residency program. Residents attended a 1-hour introductory didactic lecture on medical error, followed by 6 mandatory 1-hour monthly conferences on patient safety and near misses. The program used a process called "modelling", which is a process like root cause analysis, to have participants analyze events for the case conferences. The topics for conferences were case discussions and its analysis through small group discussion, the use of structured worksheets, large group discussion and a case summary by the faculty moderators. (Coyle, 2005)
	Use of reflective practice to enhance didactic learning about PS and QI (n=2) (22, 37)	Internal Medicine residents completed electronic structured improvement logs bi-annually by internal medicine residents as part of a larger QI curriculum. The logs have the purpose to spark residents' active reflection and identification of QI opportunities in relation to their clinical practice. The logs have questions and contain a structured format for residents to follow. (Wittich, 2010)

Training programs may deliver their PS and QI curriculum as a series of didactic lectures or workshops that engage residents in various activities depending on the program. The encounters might occur at one time (e.g., a one-day stand-alone curriculum), several encounters during a block rotation (e.g., a series of lectures taking place during an ambulatory rotation), or a series of encounters delivered longitudinally (e.g., multiple lectures and sessions delivered throughout one or more years of a training program). Among published studies in postgraduate training programs, only one utilizes the last approach.

We identified 21 studies that feature curricula with didactic lectures and experiential involvement in a QI project (32, 33, 35, 38, 39, 41-48, 50, 52, 53, 55-57, 60, 61). Three additional studies involved trainees in the design of a QI project without actual implementation (31, 36, 58). Residents often worked in groups or teams (16 of 21 studies, 76%) to carry out projects with direct supervision from a faculty mentor. Only 5 of these curricula mandated the involvement of interprofessional teams (33, 35, 44, 52, 57). Approximately half of the QI projects were carried out longitudinally (10 studies, 48%), whereas the other half of the QI projects were completed during a block rotation (11 studies, 52%). Two curricula (45, 53) had resident teams carry out projects sequentially by taking over projects from previous groups, completing one part of a larger QI project, and then handing the project off to the next incoming group of residents.

Other curricula used other forms of experiential learning aside from direct involvement in a QI project in combination with didactic lectures. For example, several curricula have residents conduct chart audits of a clinical practice to identify quality gaps and targets for improvement (40, 59). Some link the chart audit exercise to resident participation in actual improvement activities to address quality gaps identified (40), whereas others simply ask that residents actively reflect on the findings of their chart reviews (59). Other curricula actively engage residents in learning exercises by applying specific QI or PS tools to a specific quality or safety problem (34, 54). Examples include teaching residents how to conduct a root-cause analysis or map a clinical process. More recently, several training programs make use of active reflection to encourage residents to learn experientially by reflecting on healthcare processes, quality gaps or medical errors in order to gain a greater appreciation of the underlying QI or PS principles or concepts (22).

A few programs are starting to take advantage of existing web-based curricula as a means to deliver their QI or PS curriculum (21, 49). Most of these programs involve resident participation in web-based modules that are interactive, and sometimes involve residents applying clinical information or data from their local clinical environment to contextualize the learning (48).

Effectiveness in achieving learning outcomes

Postgraduate trainees rated PS and QI curricula highly, the majority of which were rated at least four on a five-point Likert scale. Of the 15 studies reporting learner satisfaction data, two (13%) reported lower satisfaction levels (60-70 out of 100 and three out of five respectively) (33, 52). Both attributed this lower satisfaction rating to difficulties integrating the experiential project work with other competing educational and clinical demands. PS and QI curricula had a minimal impact on learner attitudes, mostly because learner attitudes towards healthcare quality and patient safety were already quite positive at baseline.

The main learning impact of PS and QI curricula relates to knowledge acquisition. Twenty-one studies (70%) reported knowledge acquisition outcomes. Eight of the studies that assessed learner knowledge acquisition used a test of knowledge, such as the Quality Improvement Knowledge Assessment Tool (63), to measure knowledge gains; three of these studies

compared knowledge acquisition to that of a contemporaneous control group. The remaining studies asked learners to self-assess their QI or PS knowledge gained as a result of participating in the curriculum. Learner knowledge, both self assessed and tested, consistently increased as a result of the educational interventions. In the eight studies that quantitatively measured knowledge gains, all demonstrated statistically significant improvements in knowledge (15, 21, 36, 45, 47, 49, 56, 57).

Two studies assessed changes in learner behaviour and demonstrated that acquisition of knowledge failed to translate to changes in learner behaviour. The first study (60) showed that 56% of learners who participated in a QI elective reported that their behaviour as a physician with respect to QI had changed. The second study (34) found that at six-month follow up, there was no significant change in error reporting behaviours after completing a medical event reporting curriculum.

Eighteen of the 21 studies that engaged residents in QI projects assessed the impact on clinical processes. Nine (43%) of these studies report measurable improvements in clinical processes, including increased screening for body mass index (48), increased completeness of dictated medication lists (57), increased monofilament testing and ordering of baseline EKG (40), decreased inappropriate use of telemetry (60), increased screening for microalbuminuria and medication data sheet completion (33), increased childhood immunization rates (43), increased perioperative betablocker use (38), improved accuracy and completeness of medication documentation (35), and implementation of a *C. Difficile* notification system (19). Only one study (3%) assessed potential impact on patient outcomes, reporting a decrease in HbA1c levels of 0.4% compared to an increase of 0.7% in the control group (40).

Discussion

Our synthesis of the published literature suggests that trainees are most satisfied when PS and QI curricula employ a combination of didactic, small group and experiential learning activities. These approaches effectively enable knowledge acquisition and improvements to processes of care. Other teaching methods, such as the use of modified M&MCs with a focus on safety and quality, reflective practice and web-based teaching modules and faculty mentorship represent emerging strategies that should also be explored and expanded.

While the demand for robust training in quality improvement and patient safety is increasing, the true prevalence of PS and QI curricula in postgraduate training programs remains unknown. At the undergraduate level, recent surveys of Canadian and U.S. medical schools estimate that 10-25% of schools have a formal, explicit patient safety curriculum (64, 65). If PS and QI training at the postgraduate level mirrors that at the undergraduate level, there is clearly a need for contemporary postgraduate training programs to work with medical schools to expand their PS and QI training across the continuum.

A number of educators in PS and QI identify implementation challenges that may account for this gap. A recent review summarizes these factors into four broad categories (Table 3) (14).

Table 3: Factors that Influence Successful Implementation of Quality Improvement and Patient Safety Curricula in Postgraduate Medical Education

Factor	Curriculum Subtype
Learner Factors	Level of learner enthusiasm or buy-in towards curriculum
	Competing educational demands of medical students and residents
Teacher Factors	Adequate number of faculty with expertise in teaching quality and safety
	Involvement of faculty role models committed to patient safety
	Faculty recognition and support
	Level of faculty enthusiasm or buy-in towards curriculum
Curricular Factors	Curriculum should combine didactic and experiential teaching methods
	Providing adequate time to carry out curriculum (especially those involving QI projects)
	Scheduling of curriculum to optimize likelihood of completing QI projects
	Integration into existing curriculum longitudinally and stand-alone experiences have both been found to be effective
Learning Environment Factors	Institutional culture regarding QI to support educational efforts
	Linking curriculum to hospital leadership or operational activities
	Financial support to fund educational efforts and promote changes from QI projects
	Information systems that can provide easy access to health data

Using the implementation of a curriculum involving a QI project as an example, there are (1) learner-related factors such as learner enthusiasm for the project topic and competing educational and service demands limiting the amount of time available to commit to project work; (2) faculty-related factors such as the availability of a sufficient cadre of faculty experts who can help to mentor and supervise trainees to support the QI projects; (3) curriculum-related factors, such as the importance of scheduling the QI project during “lighter” rotations and early enough in the training program to increase the likelihood of projects being completed; and (4) learning environment-related factors, such as the availability of clinical data and personnel to retrieve this data to support QI projects. Postgraduate training programs need to address these factors in order to successfully implement a QI or PS curriculum in their local context.

Many of these PS and QI themes will overlap with other emerging topics in postgraduate medical education, such as the use of simulation (commissioned paper 18: Simulation in Postgraduate Medical Education), intra and interprofessional education (commissioned paper 17: Inter and Intra-Professional Collaborative Patient-Centered Care in Postgraduate Medical Education), issues of social accountability (commissioned paper 1: Health Disparities, Social Accountability and Postgraduate Medical Education) and professionalism (commissioned paper 20: Teaching, Learning and Assessing Professionalism at the Post Graduate Level). Rather

than moving forward in separate educational silos, educational leaders should identify local champions in each of these domains, and create opportunities for trainees to learn synergistically about these concepts through unified educational activities. This approach has the added benefit of addressing issues of competing educational demands associated with the ever-expanding list of expected competencies of future physicians.

Synergy with other emerging themes in postgraduate medical education can already be seen in a number of PS and QI curricula. Recent curricula that feature a QI project are starting to mandate that project teams include members from a variety of non-medical health professions. Linking quality and safety to interprofessional education (IPE) seems like a natural fit, particular given that IPE is increasingly called upon to improve healthcare systems and promote patient safety. Much of the skills-based training aimed at developing skills that promote safer, higher quality care (e.g., teamwork training, sign over training) takes advantage of simulation as a teaching strategy. In these instances, educators should expand on these activities by explicitly teaching the key safety principles that underpin the importance of teamwork training or improving handoffs. The future of PS and QI education will rely on these overlapping fields moving forward and evolving together.

Medical educators can also partner with institutional initiatives that target local healthcare quality and safety problems. These activities often already involve trainees, since residents are usually the front-line physicians that are directly affected by changes in healthcare practices aimed at improving quality. In fact, institutional quality and safety practices are evolving to make more explicit the involvement of resident trainees as active members of improvement teams, with the thought that quality and safety goals are more successfully met (29). This creates an opportunity for training programs to take advantage of existing institutional resources and foster learning about PS and QI.

The CanMEDS framework explicitly includes competencies of PS and QI as part of the Physician as Manager role. Since PS and QI are seen as core competencies for postgraduate medical education, it seems reasonable to devote energy to developing and implementing large-scale multi-modal curricula that engage trainees in experiential learning, whether it is through direct involvement in a QI project, or through participation in other quality or safety activities such as process mapping or root-cause analysis. However, it remains unclear whether more involved programs are the optimal approach, particularly since a number of curricula are able to effectively teach trainees PS and QI concepts without such a large investment in time and resources. Taken together with the recognized implementation challenges, educators promoting PS and QI training in postgraduate medical education will need to balance the desire to provide comprehensive training and the feasibility of doing so in an era filled with competing educational demands and limited educational resources.

Summary

Postgraduate training programs recognize the need to integrate PS and QI training in their programs. Broadly, three overarching themes summarize the issues that relate to the integration of PS and QI into postgraduate medical education:

1. The rapid emergence and evolution of PS and QI training in postgraduate medical education.

2. Implementation challenges and feasibility issues that limit the broader adoption of PS and QI training in postgraduate medical education.

3. The value of partnering PS and QI educational efforts with other emerging themes in postgraduate medical education.

Theme 1: The Emergence and Evolution of PS and QI Training is creating a need for innovative educational interventions

The past decade has seen an explosion of literature that describes and evaluates educational interventions that aim to teach postgraduate trainees the tenets of PS and QI. Half of the 40 published PS and QI curricula occurred in the past three years. Peer-reviewed articles describing PS and QI curricula appear in high-impact clinical, quality and safety, and medical education journals, suggesting that this topic has relevance for a broad healthcare audience. Although initially delivered primarily in general training programs such as internal medicine, family medicine, published reports of PS and QI curricula are emerging in more highly specialized postgraduate training programs such as psychiatry, radiology and surgical programs.

Many PS and QI curricula combine didactic and experiential learning to achieve significant improvements in learner knowledge and improvements in clinical processes. Among experiential learning techniques used, resident involvement in leading QI projects is extremely common. With respect to the QI project experience, there has been a notable shift towards team-based projects, with some curricula starting to involve inter-professional team members. This is consistent with the prevailing consensus that effective QI relies on healthcare team members collaborating to achieve improvements in care.

Other notable trends include the modification of traditional teaching forums to highlight PS and QI concepts. For example, some training programs have revamped their traditional M&MC to focus on systems issues and processes of care (as opposed to individual performance) and consider these rounds to be the main element of their PS and QI curriculum. Although the discussions that take place during M&MCs are by their very nature reflective, some programs formalize the reflective practice by asking trainees to document their reflections in a journal or portfolio. Reflective practice is just one of many teaching methods that have started to emerge as PS and QI curricula evolve over time. Other examples include the increased use of web-based modules, faculty mentorship and exposure to local QI activities.

The existing evidence does not clearly favour one approach over the next. While this finding can be slightly unsettling as one tries to select the best design for the most effective curriculum, it is somewhat reassuring that all of the emerging approaches to teaching PS and QI have achieved improvements in learner knowledge. Therefore, how one decides to design and deliver a PS and QI curriculum may depend on other factors, such as available of faculty experts and resources, feasibility issues, and availability of curricular time for PS and QI training.

Theme 2: Implementation Challenges and Feasibility Issues

Despite the sudden increase of published curricula, broad adoption of PS and QI training remains limited in many postgraduate training programs. Even those programs that publish their curricula cite a number of challenges that potentially threaten the successful implementation of a formal PS and QI curriculum (14). We have summarized a number of these issues in our paper, and some suggestions and potential solutions to overcome these challenges follow.

Some implementation challenges relate to the learners themselves. One issue is the degree of engagement and interest that trainees show towards PS and QI, and the perceived relevance (or lack thereof) to future practice. One way to enhance learner engagement and increase enthusiasm for PS and QI is to make the learning contextually and clinically relevant by allowing learners to identify safety or quality problems that resonate with them as the focus for their experiential learning. The other main barrier relates to integrating project work into busy work schedules and other educational activities of postgraduate trainees. Programs might overcome this barrier by providing adequate protected time from clinical duties to facilitate project work and allow trainees to complete projects.

An equally challenging issue relates to faculty engagement and expertise. Availability of faculty with expertise in PS and QI to lead and deliver various aspects of these curricula, ranging from presenting didactic lectures, to facilitating small group discussions, to mentoring QI project teams, is critical. Coordinated continuing education efforts will play a key role in building faculty capacity in this regard. A number of university-based certificate courses, training programs offered through national healthcare improvement organizations (such as the Canadian Patient Safety Institute or the IHI), and train-the-trainer initiatives have emerged over the past decade to address this gap. These programs coincide with the increased recognition that patient safety and QI pursuits merit consideration for academic promotion and advancement (66). This shift may enable faculty to focus their scholarly activities on expanding their expertise in PS and QI to expand the pool of available experts to champion ongoing PS and QI curricular efforts.

Designing an experiential curriculum that is feasible can also be difficult. While there are identifiable benefits associated with a longitudinal QI project, not the least of which includes the potential to implement changes that improve care, involving residents in QI projects is inherently time consuming and difficult to integrate with existing educational and clinical activities. Some programs overcome this by condensing the QI project experience into a block rotation and scheduling the project during light clinical rotations or during training years that are traditionally less demanding. However, some groups point out that the time-limited nature of a block rotation limits the likelihood that projects actually get completed. This observation has led to an emerging strategy to have sequential teams of residents participating in a longitudinal project (45, 53). Residents carry out project work during a lighter block rotation, and then hand off the project to an incoming group of trainees. This approach is particularly appealing since resident involvement is more feasible, but increases the chances that resident teams complete QI projects.

Finally, institutional resources (e.g., financial resources, clinical data available for projects) and culture can be important enablers or barriers to PS or QI curricular implementation. One way to capitalize on existing institutional resources is to align the PS and QI curriculum with institutional priorities (29). This strategy has the dual advantage of facilitating the experiential aspect of the curriculum and improving the chances that ongoing institutional QI initiatives achieve their intended goals.

It is important to note that the implementation and feasibility issues for which we have proposed solutions are taken primarily from published PS and QI curricula that did not have as their primary objective the reporting of implementation or feasibility issues relating to their curriculum. Therefore, to better characterize these issues, we interviewed the lead authors of some of the published studies to determine whether the themes listed are the most important ones, and whether there are other challenges and strategies to address them, that we have not identified. The early results confirm many of the challenges identified, particularly those relating to faculty capacity, protected time and timing training during a “light” clinical rotation.

Theme 3: Partnering with Other Emerging Themes in Postgraduate Medical Education

Given the ever-expanding list of competencies expected of future physicians, a natural question arises: How can we partner PS and QI educational efforts with other ongoing educational efforts and collaborate together to achieve common educational aims? Fortunately, PS and QI topics lend themselves very nicely to being taught in a variety of contexts.

For example, effective QI requires strong team skills and a collaborative effort among individuals from multiple health professions. Furthermore, effective team functioning and heightened situational awareness can enhance safety. Given this, several potential partnerships immediately jump to mind. One might consider working with interprofessional educators to develop an interprofessional curriculum in PS or QI. Alternatively, one might partner with simulation experts to develop a team-training curriculum that explicitly teaches both team skills and the underlying safety principles and epidemiology that form the rationale for improving team skills.

Another example might be professionalism. Recently, there has been an increased awareness that trainees with professionalism concerns identified during training are at higher risk for future regulatory disciplinary action (67, 68). Teaching the tenets of medical professionalism in the context of promoting safer care in the future would be one way to incorporate PS and QI in existing professionalism curricula.

One could also consider modifying existing curricula that focus on teaching specific skills, such as effective patient handoffs or disclosure of medical error, and explicitly incorporate foundational PS or QI concepts as part of the training. Skills-based training is emerging as extremely important (for example, the most recent ACGME duty-hours regulations explicitly mention improving patient handoffs), but can conceivably be taught without specifically highlighting patient safety or healthcare quality concepts. Therefore, these educational activities should be seen as clear opportunities to disseminate safety and quality concepts.

Such collaborative efforts should not be undertaken lightly. There are both known and unknown challenges to fostering these partnerships. While the overall benefits of shared educational initiatives likely equal more than the sum of the individual components, the combined barriers associated with each educational theme can be challenging to overcome and may limit the success or feasibility of these joint ventures. However, we believe that, with careful planning and early recognition and anticipation of these barriers, one can potentially capitalize on these synergies and create rich opportunities that achieve multiple educational goals.

Conclusion

Postgraduate training programs recognize the need to integrate PS and QI training in their programs. The growing body of literature documenting outcomes for existing programs suggests that educational interventions that combine didactic and experiential learning can improve learner knowledge and, in some cases, improve clinical processes of care. Questions remain regarding the educational delivery method that best balances effectiveness and feasibility. Training programs hoping to expand PS and QI teaching in their local contexts need to be cognizant of implementation barriers and identify opportunities to integrate PS and QI

Table 4: Educational impact on Kirkpatrick learning outcomes of quality improvement and patient safety curricula (N=30 studies)

Learning Outcome	Studies Evaluating Each Learning Outcome, n (%)	Main Findings	Evaluation Methods
Learner Satisfaction	15 (50)	Most curricula well-accepted; several had less favourable ratings, citing concerns regarding time available to carry out project work	Both quantitative (end-of-curriculum surveys using Likert-rating scales) and qualitative (open-ended comments, focus group interviews) methods
Learner Attitudes	21 (70)	Minimal impact on learner attitudes since attitudes already favourable towards PS and QI at baseline	Self-reported measure of change in attitudes. Some studies compared attitudes before-and-after the curriculum.
Knowledge Acquisition	21 (70)	The majority of curricula improved both self-reported as well as tested changes in learner knowledge.	Studies used both learner self-assessment as well as tests of knowledge. The most commonly used test was the QIKAT (Quality Improvement Knowledge Assessment Tool) (63). Several studies demonstrated that knowledge gains compared before and after the curriculum were greater in learners undergoing the curriculum as compared to a contemporaneous control group.
Behaviour Change	2 (7)	The impact on behavior change, when assessed, was minimal. One study described improvements in self-reported behaviors relating to QI, whereas a second demonstrated no change in error reporting behavior.	Both studies asked learners to self-report changes in behavior relating to QI activities or error reporting.
Clinical Process Change	18 (60)	Many curricula, particularly those that engaged trainees in a QI project, led to measurable improvements in clinical processes. Examples include improvements in diabetes care,	Most assess the impact on clinical processes by auditing practices before and after the intervention. Most used traditional statistical methods to demonstrate an improvement, as opposed to QI data methods such as run charts or statistical process control.
Benefits to Patients	1 (3)	One study reported an improvement in HbA1c levels in diabetes patients receiving care from learners in the intervention group as compared to patients receiving care from learners in a control group.	Clinical data gathered using a patient chart audit was measured before and after the intervention. The improvement in HbA1c level was compared to a contemporaneous control group.

Columns: 1) Learning outcome 2) Effectiveness of curricula in achieving this outcome 3) Examples of outcomes achieved

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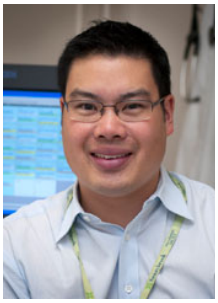
Appendix 1: About the Authors



Dr. Brian Wong (MD) received his MD and subsequent specialty training in General Internal Medicine at the University of Toronto. He is an assistant professor in the Department of Medicine and the Deputy Site Program Director for the Core Internal Medicine Training Program at Sunnybrook Health Sciences Centre training site. His academic focus lies at the intersection between patient safety, quality of care and medical education, having completed advanced training in both patient safety and medical education as part of a Canadian Health Services Research Foundation research fellowship in patient safety. His current research focuses on identifying the best evidence to guide the design and implementation of patient safety and quality improvement training for trainees, and is largely responsible for designing and implementing a patient safety curriculum for core trainees in his local training program. Other patient safety related research interests include enhancing clinical communication in hospitals and improving care provided to elderly institutionalized patients. Dr. Wong is the lead for this paper with Dr. Shojania.

Elisa Hollenberg (BA, BFA, BSW, MSW) is a research associate with the Department of Medicine at Sunnybrook Health Sciences Centre, The Wilson Centre, and Bridgepoint Health. Elisa has been working for over 10 years as a health research associate on projects across a range of health areas including primary care, mental health, cancer, and health professional education research. Most recently, she has been providing research assistance and coordination for interprofessional education and health professional education pilot programs and research. Elisa is a contributor in this paper and was responsible for assisting with the initial review of articles, synthesis of articles, and editing for this paper.

Dr. Edward Etchells (MD, MSc) received his MD and subsequent specialty training in General Internal Medicine at the University of Toronto. He joined the faculty of the Department of Medicine after completing an MSc in Clinical Epidemiology. Dr. Etchells conducted some of the original research that established medication reconciliation globally as a best practice in patient safety and he was a co-investigator on the Canadian Adverse Events Study. He co-founded the Patient Safety Service at Sunnybrook Health Sciences Centre (SHSC), the first hospital-based academic safety service in Canada, and helped to establish the U of T Certificate Program in Quality and Patient Safety in 2008. He is the Associate Director and Site Director of the Centre for Patient Safety at SHSC and the Medical Director of Information Services at SHSC. His research interests include medication reconciliation, computerized medication order entry, and real time alerting and decision support for critical laboratory values. Dr. Etchells is a contributor in this paper.

Dr. Ayelet Kuper (MD, D.Phil.) is an assistant professor in the Department of Medicine at the University of Toronto in 2007 as an Internist based at Sunnybrook Health Sciences Centre, where she attends on the General Medicine wards three months per year. She has been teaching both undergraduates and postgraduates since she was a resident and prior to joining the faculty had already received awards for her teaching and for her contributions to medical education at the University of Toronto. Dr. Kuper is a Clinician-Scientist in the Department of Medicine and a Wilson Centre Scientist in 2010. Dr. Kuper's current research program addresses the origins and history of the field of medical education research and the effects of that history (e.g., sociohistorical factors and the struggle for legitimacy between disciplines and methods) on the definition of legitimate knowledge production within this field. She also has specific experience applying qualitative research methods to study patient safety educational phenomena, such as the teaching and learning that occurs during morbidity and mortality case conferences. Dr. Kuper is a contributor in this paper.

Dr. Wendy Levinson (MD) has served as the Sir John and Lady Eaton Professor and chair of the Department of Medicine since 2004. In this role, Levinson oversees 600 full-time faculty members distributed across seven teaching hospitals and 17 divisions, along with over 500 postgraduate trainees and fellows. Her leadership in medicine extends beyond the university and hospital boundaries, however. She was recently the past chair of the American Board of Internal Medicine – the first Canadian to ever hold the position – and was also past president of the 3,000-member Society of General Internal Medicine. Dr. Levinson is one of the world's foremost researchers on physician-patient communication, and has contributed to large-scale training programs to enhance the skills of primary care physicians and surgeons in communicating effectively with their patient. Dr. Levinson is a contributor in this paper.

Dr. Kaveh Shojania (MD) is appointed in the Department of Medicine at the University of Toronto. He is also a General Internist at Sunnybrook Health Sciences Centre where he holds a Canada Research Chair in Patient Safety and Quality Improvement and is the Director of the Centre for Patient Safety. Dr. Shojania's research focuses on identifying evidence-based patient safety interventions and effective strategies for translating evidence into practice. His work has appeared in leading journals, including the New England Journal of Medicine, the Journal of the American Medical Association, the British Medical Journal, and the Canadian Medical Association Journal. A book on patient safety for a general audience that he co-authored with Dr. Robert Wachter (at the University of California San Francisco) received excellent reviews in the New York Times and Journal of the American Medical Association and has sold approximately 50,000 copies. Most recently, Dr. Shojania was named the Editor-in Chief of BMJ Quality and Safety, the leading journal in the field. Prior to his recent recruitment to the University of Toronto and Sunnybrook Health Sciences Centre, Dr. Shojania held faculty positions at the University of Ottawa and the University of California San Francisco. Dr. Shojania is the co- lead for this paper with Dr. Wong.

Appendix 2: Annotated Bibliography

Readers can also refer to Table 2 to see short "annotations" of what we felt were representative studies outlining different curriculum designs.

Canadian PS and QI programs: The following four entries are the four Canadian programs identified through the systematic review. They are categorized in Table2 as representing a certain type of curriculum but were not previously annotated as we wished to present them here, as a group:

Farquhar D, Myers K, Benjamin D. Education in quality of care in an internal medicine residency program. Acad Med. 2001;76:562.

The curriculum was offered as part of a single Canadian residency (internal medicine). A mandatory ½ day introductory seminar was followed by monthly peer-led noon hour case discussions to highlight process of care, QI theory, how to improve quality and systems thinking.

Kuper A, Nedden NZ, Etchells E, Shadowitz S, Reeves S. Teaching and learning in morbidity and mortality rounds: an ethnographic study. Med Educ. 2010;44:559-569.

This curriculum involved hospitalist fellows, senior medical residents and interns from a single Canadian residency program (internal medicine). Participants attended a weekly 1-hour Morbidity and Mortality conference (M&MC) with a systematic case discussion of every death on the Internal Medicine service with a focus on process issues affecting care. Any subsequent changes in processes of care were reported in one of the following conferences. While faculty believed that the M&MC was an ideal forum for teaching and learning about systems and processes of care, many trainees felt that the key learning still related to medical content knowledge. Authors conclude that additional strategies to make learning about systems and processes of care need to be more explicit to highlight these aspects of the rounds for learners.

Sockalingam S, Stergiopoulos V, Maggi J, Zaretsky A. Quality education: a pilot quality improvement curriculum for psychiatry residents. Med Teach. 2010;32:e221-6.

This QI program was part of a broader physician-manager curriculum in a single Canadian residency program (psychiatry). A mandatory ½ day QI workshop was attended during the PGY2 year. PGY3 residents then participated in teams on longitudinal quality improvement projects (QIP). The projects were supervised by faculty, used the PDSA cycle, were on a topic of their choice on any area of psychiatry, involved multi-disciplinary non-medical staff to increase support and were ultimately presented at research day/psychiatry rounds. Some teams achieved improvements in clinical processes. Focus group interviews revealed that learners appreciated the contextual nature of the curriculum, but raised concerns regarding the amount of time available to complete the project.

Wong RY, Hollohan K, Roberts M, Hatala R, Ma IW, Kassen BO. A descriptive report of an innovative curriculum to teach quality improvement competencies to internal medicine residents. Can J Gen Int Med. 2008;3:26-29.

This longitudinal QI curriculum was delivered in a single Canadian residency program for 31 PGY1 residents (internal medicine). Two half-day didactic lectures were delivered 4 weeks apart, followed by a 10-month longitudinal team-based QI project on a topic of their choice. The training program provided protected time for project work, (1 hr/week) and groups met 5 times over the course of the project for 1 hour tutorials and feedback with faculty supervisors. Teams presented their project results at the annual Resident day on QI. Study investigators, as a next step, plan to evaluate the impact of their curriculum.

Systematic Reviews: The following articles represent two systematic reviews of published undergraduate and graduate PS and QI programs.

Wong BM, Etchells EE, Kuper A, Levinson W, Shojania KG. Teaching quality improvement and patient safety to trainees: a systematic review. Acad Med. 2010;85:1425-1439.

This article was a systematic review of published quality improvement and patient safety curricula for medical students and/or residents. The review described the content and teaching methods of programs identified, presented and assessed their learning outcomes, and discussed implementation barriers and facilitators. 41 curricula met the inclusion criteria with 14 programs identified for medical students, 24 for residents and 3 for both. PS and QI curricula were well-accepted, increased learner knowledge, and improved clinical process outcomes. The review also identifies factors relating to the learner, faculty, training program and clinical training environment that influence the success of curricular implementation.

Patow CA, Karpovich K, Riesenberg LA, Jaeger J, Rosenfeld JC, Wittenbreer M, et al. Residents' engagement in quality improvement: a systematic review of the literature. Acad Med. 2009 Dec;84(12)1757-64

This article was a systematic review of published accounts (between 1987 and Oct. 2008) of clinical QI programs with resident participation. The intention of the search was to identify all initiatives and their impact upon patient care or other factors. The search produced 28 articles in which 5 used patient health as an outcome measure while 23 examined process changes in patient care or residents' education as outcomes. More research into the clinical or educational effectiveness of residents' participation in QI efforts is needed.

Institute of Medicine (IOM) Reports:

The Institute of Medicine (http://www.iom.edu) is a U.S. independent, nonprofit organization which draws upon professional expertise to identify and report on important health and health care policy questions. The IOM generates research and makes evidence-based recommendations for the public, the private sector, decision makers and the federal government. It mission is "advisor to the nation to improve health".

Kohn LT, Corrigan JM, Donaldson MS, eds. To err is human: building a safer health system. Washington, DC: National Academy Press, Institute of Medicine; 2000.

This report was issued in 1999 by the U.S. Institute of Medicine. Its goal was to raise awareness about the large numbers of people who die each year as the result of preventable medical errors and to generate a groundswell of interest to address the issues causing these deaths. The report outlined a strategy and challenged the system, health care providers, industry and consumers to draw upon existing knowledge and to reduce errors by 50% in the next five years.

Institute of Medicine Crossing the Quality Chasm: A New Health System for the 21st Century. Washington, DC: National Academy Press; 2001.

This report builds upon and furthers the argument in the "To Err is Human" report with recommendations to improve the level of quality in health care through changing health care system processes. Focused areas for policy and change were identified including: Safety, Effectiveness, Patient-Centeredness, Timeliness, Efficiency and Equity. Factors leading to error were identified and13 recommendations were made to effect change.

Resident duty hours: Enhancing sleep, supervision and safety. Washington, DC: National Academy Press; 2009.

This report was based on a scientific review of research evidence on sleep and performance. It re-examined the implementation and impact of the 2003 duty-hour regulation for medical residents. This regulation specified an average resident work week of 80 hours over four weeks and 30 hours as the longest consecutive work shift. Recommendations included reducing the length of shifts to a maximum of 16 hours and other suggestions to improve educational outcomes, sleep hygiene, increase safety and reduce fatigue-related medical errors.

AHRQ Patient Safety Network (PSNet) Website (http://www.psnet.ahrq.gov/index.aspx)

This national (U.S.) website is devoted to presenting a wide range of current resources and news on patient safety. Its resources include the latest patient safety meetings, literature, news and tools ("What's New"), and annotated links to research including the most recent and "classic" materials ("The Collection"). This website is a rich repository of both updated and archival knowledge and information conveniently located in one place for the patient safety community.