The Environmental Context of Patient Safety and Medical Errors

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EXECUTIVE SUMMARY

Interest in the issue of patient safety and medical errors has accelerated over the last decade, most recently culminating in widespread media attention and policy consideration by state and national levels of government, accrediting bodies, health care organizations, and employer groups. The purpose of this paper is to explore the environmental context of patient safety and medical errors with specific interest in rural settings. We review the patient safety/medical error literature, point out unique features of rural health care organizations and their environment that relate to the patient safety issue and medical errors, summarize relevant organizational theory, and conclude by discussing strategies for medical error reduction and prevention in rural health care settings.

There is little evidence to evaluate how the level of patient safety and quality of care differs between rural and urban settings. This is true for both patient safety and patient outcomes. We model the rural hospital as complex systems that adapt to face a distinct environmental context. Organizational research shows that organizations, as complex systems, adapt to fit their context. Complexity is a function of organizational size, technological complexity, and environmental complexity. These differences in organizational environments result in variation in processes, information flows, the culture of safety, and organizational learning to improve safety between rural and urban hospitals.

We discuss rural-urban differences in hospital processes, information flows, the culture of safety, and organizational learning and develop the following hypotheses about these differences:

- Rural hospitals will have a greater proportion of adverse events associated with the elderly than urban hospitals.

- Rural hospitals will have a lower proportion of adverse events associated with over-learning than urban hospitals but a greater proportion of adverse events associated with medical training that emphasizes work in a more specialized environment.

- Rural hospitals will have a lower proportion of adverse events associated with information flows between the patient and the hospital than urban hospitals due to enhanced social embeddedness.

- Rural hospitals will have a greater proportion of adverse events associated with informal communication processes within the hospital than urban hospitals.

- Rural hospitals will have a greater proportion of adverse events associated with triage-and-transfer decisions and a greater proportion of adverse events associated with transporting patients than urban hospitals.

- Rural hospitals will find it easier than urban hospitals to build a culture of safety based on a feeling of being in a community, but will find it more difficult to build tools such as anonymous reporting systems.

We conclude by discussing how learning processes can be developed in rural hospitals to help health services researchers to work effectively as partners with rural hospitals. Two questions need to be examined to understand how organizational learning to improve patient safety can be facilitated in rural hospitals:

- When and how should rural hospitals explore new technologies (i.e. global technologies) and processes by adopting them?
- When and how should rural hospitals exploit their existing technology and processes by refining them?

These are fundamentally different strategies to reduce errors. Because organizations have budget and personnel constraints, they often cannot pursue both simultaneously. But doing either one exclusively can lead to sub-optimal performance.

Two strategies are identified for helping rural hospitals to manage the learning process about errors:

- Decrease system ambiguity, formalize technologies to decrease uncertainty, and identify countable events that can be monitored.
- Develop common measures across rural hospitals that allow them to determine if they are falling into a competency trap.

We argue that rural hospitals differ in systematic ways from larger urban hospitals and measures specifically designed for rural hospitals (e.g. timeliness and safety of the patient transfer process) are likely to be required if they are to be useful in helping rural hospitals to balance exploitation and exploration optimally.

We currently know little about patient safety and medical errors in the rural context. The time to learn about patient safety, medical errors and successful interventions in rural hospitals and environments is now. The reduced scale and complexity of rural institutions provide an excellent laboratory for examining patient safety and medical errors issues. An important next step is financial and technical support for the systematic collection of data from rural hospitals and other entities that will lead to relevant patient safety practices for rural America.

INTRODUCTION

The subject of occasional scientific and organizational inquiry for nearly 100 years, interest in the issue of patient safety and medical errors has accelerated over the last decade (Sharpe and Faden, 1998), most recently culminating in widespread media attention and policy consideration by state and national levels of government, accrediting bodies, health care organizations, and employer groups. Although several publications on the topic have been published within the last decade (Bogner, 1994; Sharpe and Faden, 1998; Spath, 2000), statistics and recommendations for action published in The Institute of Medicine's (IOM) *To Err Is Human* report (Kohn, Corrigan and Donaldson, 1999) are widely acknowledged to be the catalyst for recent national attention to and proposed action on this issue. Subsequent publication of "*Doing What Counts for Patient Safety: Federal Actions to Reduce Medical Errors and Their Impact* " by the Quality Interagency Coordinating Task Force (Quality Interagency Coordination Task Force (QuIC), 2000) and IOM's *Crossing the Quality Chasm* (Institute of Medicine, 2001) further expanded the issue. Health professionals also have considered the ramifications of *To Err Is Human* for their profession and everyday practice (Kohn, Corrigan and Donaldson, 1999; Gunn, 2000; Sirota, 2000).

The recommendations published in *To Err Is Human* are aimed at reducing medical errors through regulatory and market-based initiatives intended to encourage health care organizations and professionals to make patient safety a priority. These recommendations include:

- a nationwide, two-pronged, state-based medical error reporting system featuring a mandatory component subject to public disclosure and a voluntary, confidential component;
- incorporation of meaningful patient safety programs with defined executive responsibility into regulatory and/or accreditation standards; and,

- commitment by health care organizations to improve patient safety by developing a "culture of safety" supported and encouraged by non-punitive systems for error reporting and analysis, and adopting professionally based, safe medication practices.

The QuIC Report (QuIC, 2000) echoed these recommendations and proposed action through at least two significant Health Care Financing Administration (now the Centers for Medicare and Medicaid Services) requirements for all hospitals participating in the Medicare program, namely: 1) participation in a national mandatory reporting system of medical errors intended to report publicly on medical errors that result in significant harm to patients and are preventable, given the current state of knowledge; and, 2) an effective internal reporting system and an effective evidence-based error reduction program for all patients as necessary components for certification and accreditation. Examples of error reduction programs provided by QuIC include: automated pharmacy order entry systems, automatic safeguards against harmful drug interactions and adverse side effects built into the treatment process, decision-support systems, and integrated data systems.

We believe that the applicability, meaning, and implementation of the IOM and QuIC recommendations on medical errors will be different in rural health care settings in comparison to larger urban settings. To our knowledge, however, only one publication has explored the implications of the IOM reports for rural health systems (Wakefield, 2002).

The purpose of this paper is to explore the environmental context of patient safety and medical errors with specific interest in rural settings. We review the patient safety/medical error literature, point out unique features of rural health care organizations and their environment that relate to the patient safety issue and medical errors, summarize relevant organizational theory, and conclude by discussing strategies for medical error reduction and prevention in rural health care settings.

PATIENT SAFETY AND THE SYSTEMS APPROACH

The second IOM report, *Crossing the Quality Chasm*, succinctly summarizes the safety "ideal" which lies at the center of the *To Err Is Human* recommendations and places patient safety within a broader health care quality context. Three themes that run throughout both IOM reports are:

- a systems framework for the patient safety/medical error issue
- the interdependence of people, technology, and organizations within that framework, and;
- the central role in error reduction of effective, accessible, and "remembered" communication about each individual patient.

The report also sets one standard for safety across all organizations, through all processes, all the time.

The systems approach to medical error causation and reduction considers interactions between various system components that make a system more or less prone to error and more or less able to detect and correct error depending on how those interactions are designed (Leape et al., 1995; Leape, 1997; Reason, 2000). A system may be defined as "an interdependent group of items, people, or processes with a common purpose" (Leape et al., 1995). Systems analysis considers the roles of, and interactions between, system components and processes, including: physical ergonomics, hardware, human behavior, organizational and management behavior and, extending beyond the walls of the hospital, legal and regulatory rules and societal and cultural pressures (Moray, 1994).

Depending on such factors as organizational size, design, available technology, and complexity of tasks undertaken by the organization, these components may be more or less tightly coupled (i.e., interdependently linked), with consequent effects on the error-proneness and detection/correction ability of the system. The patient, of course, is another part of the system, accompanied by individual complexity, uncertainty, and labile physiological status. Systems thinking also requires consideration of linkages beyond one's own building or organization to include sites of care or ancillary services separated by geography, management and culture. These external linkages, typically managed via diffuse, decentralized control, and coordinated via informal networking, custom, and regulation, introduce "more opportunities for error and more unpredictable outcomes than in a single, hierarchical system" (Van Cott, 1994).

Health care within organizations can be viewed as a socio-technical network of interacting processes that rely on effective decision-making and execution to assure a high probability of positive patient outcomes. Some familiar examples of such processes are patient flow, the patient care process, the medication use process and the laboratory process. Each individual process can be seen as a series of sequential transitions or handoffs, occurring simultaneously with several other processes that interact in competitive, complementary, or synergistic fashion. Handoffs within and between processes are critical points in system design, for "it is in inadequate handoffs that safety often fails first" (Institute of Medicine, 2001). Reduction of the number of handoffs in a process is a staple of error reduction (Nolan, 2000), as is double-checking on critical vulnerable parts of a system (Kohn, Corrigan and Donaldson, 1999).

Handoffs are associated with potential gaps in health care – often appearing as "losses of information or momentum or interruptions in delivery of care" (Cook, Render and Woods, 2000). Examples of handoffs and potential gaps include shift changes, patient transfers within or between facilities, division of attention within a single practitioner caring for two or more patients (Cook, Render and Woods, 2000) or physician cross-coverage (Petersen et al., 1994).

Factors associated with the failure of processes include variability (uncertainty) in the input, complexity, inconsistency (lack of standardization), tight coupling between actions within a process or between processes, human intervention (e.g., reliance on memory), tight (or very loose) time constraints, and hierarchy (as an inhibitor of communication among participants in a complex process) (Croteau and Schyve, 2000). Although these factors may be most easily seen in acknowledged high risk areas of a hospital - the emergency room, surgical suites, and intensive care units - they are in play within every process that makes up an organized system of care.

In the systems view, "errors are seen as consequences rather than causes, having their origins not so much in the perversity of human nature as in "upstream" systemic factors" (Reason, 2000). While mistakes in human cognition are considered to be one aspect of error causation in systems thinking, the emphasis is on identifying and correcting systemic flaws in design, construction, maintenance, allocation of resources, training, and development of operational procedures (Leape, 1994). Systems analysis shifts responsibility for error causation, reduction, and prevention from the individual "at the sharp end" (Reason, 2000) into the realm of process management and improvement by health care professionals as well as administrators.

Ideally, through iterations of design, implementation, feedback, and redesign, the systems approach leads to prevention of errors. This is reflected in IOM recommendations to "adopt a proactive approach: examine processes of care for threats to safety and redesign them before accidents occur" and, recognizing that prevention is never perfect, to "design for recovery."

INFORMATION FLOW

Running throughout – and connecting – the many processes that constitute health care delivery is a multi-pronged flow of information that, if functioning properly, unites the patient, providers and delivery system in a seamless fashion. At least four flows of information can be identified within health care:

- between the patient and the system;
- between the current evidentiary knowledge base (including evidence-based medicine, best practices, and organizational policy) and health care practitioners;
- between the various components within the health care organization (departments, services, care units, processes, shifts, cross-coverages); and
- between organizations (referral hospitals, inpatient/outpatient settings).

In most current health care delivery systems, information flows seem particularly prone to error (Kohn, Corrigan and Donaldson, 1999; QuIC, 2000; Institute of Medicine, 2001).

In a landmark systems study of adverse drug events within two tertiary care hospitals, Leape et al. (1995) found that the seven most frequent systems failures (defects in drug knowledge dissemination, dose and identity checking, availability of patient information, order transcription, the allergy defense system, medication order tracking, and interservice communication), accounting for 78 percent of all errors, all featured impaired access to information during decision-making or execution phases of the medication use process. Other authors have documented the occurrence of missing, lost, or inaccessible information in the medication use process (Beers, Munekata and Storrie, 1990; Omori, Potyk and Kroenke, 1991) and discharge process (Macaulay et al., 1996). It is not surprising that improvements in access to accurate, timely information, through both low and high-tech means, form the core of most proposed mechanisms of medical error reduction and improved health care quality (Kohn, Corrigan and Donaldson, 1999; Bates et al., 2001; Institute of Medicine, 2001).

HUMAN ERROR

As defined in *To Err is Human*, error is the failure of a planned action to be completed as intended (i.e., error of execution) or the use of a wrong plan to achieve an aim (i.e., error of planning). At either level, errors can be classified as errors of commission (failure of the person/system in the performance of a decision or action) or errors of omission (failure of the person/system to perform an act or to take all information into account in planning or executing the plan). For the human component of systems, Reason (1990) classifies errors of *execution* as "slips" (actions performed not as intended) or as "lapses" (failures of memory). He defines errors of *planning* as "mistakes", i.e., "deficiencies or failures in the judgmental and/or inferential processes involved in the selection of an objective or in the specification of the means to achieve it…"

Expertise – possession of a "large stock of appropriate routines to deal with a wide variety of contingencies" (Reason, 1990) has implications for the genesis and management of human error. At any performance level, the ability to employ problem-solving skills that go beyond the surface level of the problem – *a depth of expertise* - is seen as beneficial. Ideally, depth of expertise within each facet of organizational function is complemented by *breadth* of expertise, spread across professions, departments, shifts, and processes, rather than being concentrated in any one facet. As evidenced by the relationship between surgical volume and hospital volume on quality of care (Hughes, Hunt and Luft, 1987), expertise, either at the individual or organizational levels, is more commonly a function of the frequency of direct, lived, experience as opposed to application of infrequently used knowledge to a rarely encountered problem. Development of expertise in an organization, then, may result from the breadth (i.e., variety) and depth (i.e., complexity and frequency) of experiences addressed by the organization over time or through recruitment into the organization of expertise developed elsewhere.

Communication, development of expertise through experience, and the importance of personal/power relationships in organizations are addressed in *To Err Is Human* as important aspects of organizations that can affect safety. An organization's culture of safety (Guldenmund, 2000), the values and norms among co-workers about appropriate behavior related to safety (such as what constitutes an error and the importance of reporting) can be powerful influences on patterns of behavior among health care workers (Bosk, 1979; Osborne, Blais and Hayes, 1999; Wakefield, 2002).

Human error and systems thinking explicitly intersect in *To Err is Human* as a recommendation to respect human limits in process design. To accomplish this, organizations are urged to design jobs for safety (consider the effect of workloads, staffing ratios, sources of distraction, and inversion in assigned shifts), avoid reliance on memory (through checklists and protocols), use constraints and forcing functions (especially in setting device defaults and in diagnostic and therapeutic ordering), avoid reliance on vigilance (through automation and electronic monitoring), simplify key processes and standardize work processes.

MEDICAL ERROR AND PREVENTABLE ADVERSE EVENTS

Historically referred to as iatrogenic injury or illness, medical errors have come to be nearly synonymous with the term "adverse event" (AE) in the medical and patient safety literature. An adverse event is defined as "an injury caused by medical management rather than by the underlying disease or condition of the patient" (Kohn, Corrigan and Donaldson, 1999). Adverse events vary in their predictability and hence avoidability. A preventable adverse event (PAE) is an adverse event attributable to error (Kohn, Corrigan and Donaldson, 1999), preventability implying that “methods for averting a given injury are known and that an AE results from failure to apply that knowledge” (Leape et al., 1993). Errors stemming from negligent practice constitute a subset of PAEs. By definition, preventable adverse events may be managed, reduced, and prevented through practitioner and organizational action.

No comprehensive list of all potential medical errors has yet been compiled, perhaps due to the historical variation in definitions of medical error. While medication-related error has been extensively studied, it is important to remember that error can occur at any phase of the patient care process. One oft-cited error categorization proposed by Leape et al. (1993) is based on which phase of the patient care process (diagnostic, treatment, preventive) errors occur in. These three phases may be looked at as organizational reasons for being and – rather than assigning responsibility for each of them to a given profession or service – recognizes, that laboratory, radiological, or medication errors, for instance, cut across all parts of the patient care process.

Estimates of the incidence of adverse events among hospitalized patients based on large-sample review of medical records have ranged from 3.7 percent of all admissions in New York State in 1984 (Brennan et al., 1991) to 2.9 percent in Colorado and Utah in 1992 (Thomas et al., 1999). In these studies, 70 percent (Leape et al., 1993) and 58 percent (Thomas et al., 1999) of AEs were judged to be preventable with 6.9 percent of PAEs leading to death in one study (Thomas et al., 1999). While these estimates have been criticized on methodological grounds (McDonald, Weiner and Hui, 2000a, 2000b; Sox and Woloshin, 2000; Hayward and Hofer, 2001), there is little argument about the need for improvement in the safety of health care.

RURAL HOSPITALS, PATIENT SAFETY AND MEDICAL ERRORS

There is little evidence to evaluate how the level of patient safety and quality of care differs between rural and urban settings. This is true for both patient safety and patient outcomes. Both are important because the way hospitals organize should cause reliable, safer, and lower error patient care and better patient outcomes (Campbell, Roland and Buetow, 2000; Wholey et al., 2002). To our knowledge, the only estimate of incidence or errors in patient outcomes in rural areas is an "adverse event" rate (percentage of patients discharged who had experienced an AE due to hospitalization) of one percent in rural hospitals in New York State in 1984 (Brennan et al., 1991). This rate was significantly lower than for metropolitan-based institutions; however, the rate of AEs due to negligence did not vary between metropolitan and rural hospital locations. Similarly, little is known about differences in hospital safety organization between urban and rural settings. This section discusses where differences would be expected in both the types and rates of errors and in hospital safety organization.

The types of challenges rural hospitals face in providing safe and high quality care include (Coombs, 2001): 1) inadequate numbers and types of providers and staff; 2) incomplete services across the full continuum of care; 3) inadequate financial resources (partly due to different rural/urban reimbursement from government programs); 4) lower patient volume which may make trending and learning from errors more difficult; 5) bypass of rural providers by rural patients; 6) the lack of a cooperative system for sharing of resources to address quality issues or benchmark outcomes; 7) distance and geographic barriers; 8) constraints on quality improvement and assurance due to the limited size of medical staffs; 9) limited automated management information support for both clinical support and measurement/tracking of quality; and 10) perceived inappropriateness of accreditation standards for rural hospitals. While urban hospitals also encounter many of these challenges, the challenge is usually of a larger relative magnitude in rural hospitals.

These challenges can be categorized by how they may be resolved. Constraints are those challenges resolved by policy changes and often have a long-term time frame. Managerial problems are those that can be resolved by hospital managers and staff in the short-run. Examples of constraints such as nurse supply, which affects errors through its effect on nurse staffing ratios (Needleman et al., 2002), and resource availability, which affects errors through its effect on ability to install tools such as electronic medical records and to hire more staff, have to be dealt with in the larger policy environment. Nurse training programs and rural hospital payment policies, for example, address these two issues. Solving managerial problems means organizing the hospital given the constraints. The distribution of the types of managerial problems differs systematically between urban and rural hospitals. Because of this systematic difference, rural and urban hospital managers must focus their attention differently to create safer organizations. In this section, we develop hypotheses about these differences.

In developing our hypotheses, we model the rural hospital as complex systems that adapt to face a distinct environmental context. Systems are "a set of interdependent elements interacting to achieve a common aim. The elements may be both human and non-human (e.g. equipment, technologies)" (Reason, 1990). A hospital is a complex organization, consisting of a variety of subsystems such as pharmacy, surgery, medical care, janitorial, admissions, billing, laboratory, and medical records. Organizational research shows that organizations, as complex systems, adapt to fit their context. Complexity is a function of organizational size, technological complexity, and environmental complexity. These differences in organizational environments result in variation in processes, information flows, the culture of safety, and organizational learning to improve safety between rural and urban hospitals.

To help organize our discussion of rural/urban differences, we characterize hospital systems as a network of information flows linking processes which perform a distinct function. Earlier, we broadly characterized the information flows as those between the patient and the system, the current evidentiary knowledge base and health care practitioners, the components within the health care organization, and organization and other organizations. The processes are what is done in a hospital – a patient being admitted, a RN administering drugs, a surgeon performing an operation, and a patient's condition being monitored. These processes are supported by an information system that can store and retrieve information, such as maintaining a record of the medications a patient is taking that can be accessed to check for drug interactions when a new drug is prescribed. We first discuss rural-urban differences in hospital processes, followed by differences in information flows, the culture of safety, and organizational learning.

Hospital Processes: The Distribution of Patients and Errors

The first major contextual difference is in patient mix. Rural areas are more likely to have a preponderance of elderly, which is associated with rural hospitals being more likely to have swing-beds and closely affiliated nursing homes. This implies that rural hospitals will be disproportionately faced with medical injuries and adverse drug events associated with these populations (Gurwitz et al., 2000; Rothschild, Bates and Leape, 2000). Because of the elderly population, rural hospitals are disproportionately at risk for problems such as hospital-acquired complications and falls (Shojania et al., 2001b).

Hypothesis 1: Rural hospitals will have a greater proportion of adverse events associated with the elderly than urban hospitals.[1]

Hospital Processes: Volume, Uncertainty, and Under- and Over-Learning

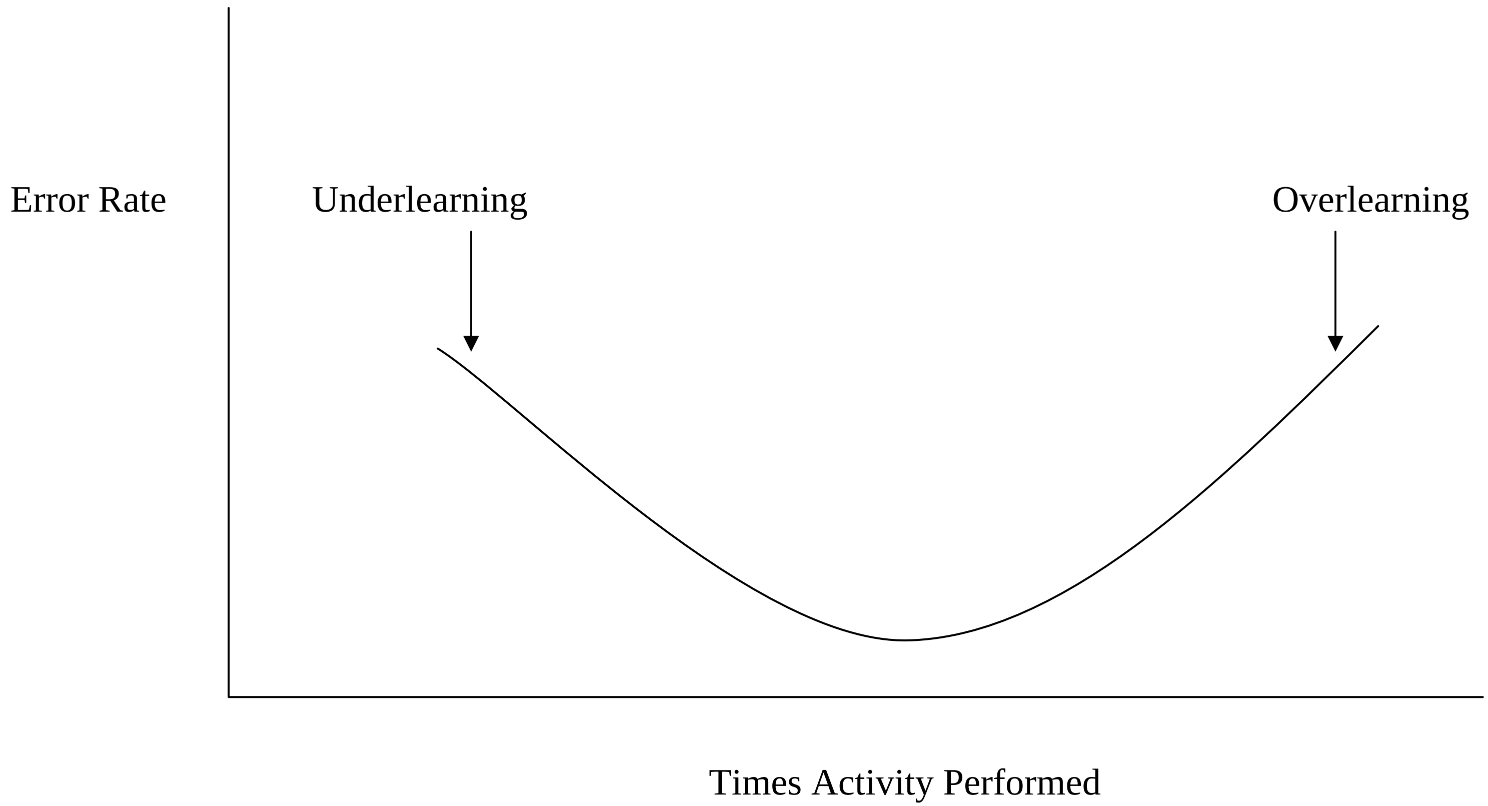
Rural and urban hospitals differ in types of adverse events associated with learning (Figure 1). In an urban hospital with a refined division of labor, a provider could end up performing a specific activity repeatedly. While this can lead to greater expertise, it can also lead to complacency and routinization. In a rural hospital, a procedure may be performed so infrequently that providers worry if they are doing it correctly. One example would be mixing intravenous solutions. In an urban hospital, mixing the IV may be so routine for the pharmacy technician that deviation from the usual (such as different units of measure because one is dealing with a small child) is missed and an error is made. A rural hospital, in contrast, may not have personnel in the pharmacy (e.g., at night and on weekends) and registered nurses may need to mix the intravenous solutions. These different types of adverse events need to be addressed with different managerial strategies. Under-learning and inexperience is addressed with training (Shojania et al., 2001b), while over-learning and repetition are addressed with mechanisms to force attention.

A related issue is that physicians in rural hospitals are more likely to be generalists. For many rural areas there will not be a sufficient volume of patients to allow a physician to specialize. Nonetheless, the rural physician may face the dilemma of whether or not to treat a low volume condition (e.g. operate on an abdominal aortic aneurysm) or risk patient death during transportation to an urban hospital.

[1]These adverse events may be addressable with implementation of bed restraints and development of geriatric consultation services (Shojania et al., 2001b)

Figure 1

Frequency of Performing Activity and Learning



Medical training occurs mainly in urban hospitals. Errors can be created not because of the complexity of the rural hospital but because physicians are less familiar with the problems encountered there. The usual problems treated by a surgeon in a rural setting, for example, may differ significantly from those he/she commonly took care of in his/her training in an urban trauma center. The problems are not more or less difficult, they may just be less familiar and, therefore, more prone to error.

Hypothesis 2: Rural hospitals will have a lower proportion of adverse events associated with over-learning than urban hospitals but a greater proportion of adverse events associated with medical training that emphasizes work in a more specialized environment.[2]

Information Flows: Patient to Hospital

In interviews with rural hospital administrators and staff, one common observation about rural/urban differences was the relationship of hospital staff to community members. As well as staff knowing patients as patients, many of the staff knew patients as members of the community. They lived in the same neighborhood, or attended the same church, or shopped at the same stores. Not only were there professional relationships between staff and patient, there were social relationships. This phenomenon, which sociologists call social embeddedness, affects information flow between patients and hospital. In a rural hospital, the physician who treats a local resident for an emergency condition on Friday night can follow up on the patient the next week at the local store. A physician treating a patient for a chronic condition knows the individuals in a patient's social support network.

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[2]These errors may be addressable with training programs to practice infrequent events; training programs by specialists for non-specialists (e.g. non-radiologists reading radiographs); reporting systems that identify dangerous situations by encouraging staff to discuss their concerns and worries about performing a procedure; and by monitoring the frequency with which procedures are done to identify low frequency procedures (e.g. mixing intravenous drugs); automated dispensing equipment; and formalized pharmacist consultation procedures (Shojania et al., 2001b).

This embeddedness has its pluses and minuses. The staff's history with the patient may result in them noticing an anomalous result, such as a lab technician noting an untoward change in a lab reading and calling it to a physician's attention. The extensive shared information may support a richer base of information for diagnosis and treatment, avoiding some errors. While the rural environment may be beneficial for gathering information that can be used to avoid errors, it also has its downside. The informality may lead to complacency, such as armbands may not be checked when hospital staff know the patient. Staff members may not communicate information because they assume that other staff members know about the individual. Patient specific information may be discounted, particularly if it does not fit stereotypical beliefs about the patient. While urban hospitals face managerial problems of not gathering enough information, rural hospitals may face problems associated with a culture of complacency and assumed knowledge. This has the risk of causing staff to overlook or discount near-misses, which may need to be countered by developing a culture of safety that pays attention to divergent information and near misses and seeks to minimize over-confidence by focusing on the fallibility of systems (Weick and Sutcliffe, 2001).

Hypothesis 3: Rural hospitals will have a lower proportion of adverse events associated with information flows between the patient and the hospital than urban hospitals due to enhanced social embeddedness.[3]

Information Flows Within Organizations: Formalization and Communication

Communication flows within rural hospitals are likely to be less complex and formalized than communication flows within urban hospitals. Rural hospitals tend to be smaller and treat a more limited range of conditions than urban hospitals. Since rural hospitals are less complex than urban hospitals, there are fewer information flows within the hospital. Organizational

[3]These adverse events are addressable with formalized patient admission and discharge mechanisms and tools such as bar-codes to identify patients within the hospital (Shojania et al., 2001b).

theory predicts that size, complexity, and formalization are positively related (Scott, 1986). An urban hospital with a highly refined division of labor, including many different types of specialist physicians, nurses, and technicians, is likely to have bureaucratic structures. The volume of information flow will be processed efficiently by limiting it to the necessary information. This may result in adverse events associated with not understanding the context of an action. For example, a lab technician may know only that he is being asked to perform a test and not be aware of contexts for the tests, the physician or the patient, and merely report the test result. In contrast, in a rural hospital the lab technicians may know the context, may know the physicians and patients. This knowledge may result in the lab technician noticing an anomalous lab result when a test panel is ordered and calling it to the physician's attention. The risk in the rural hospital is that the relationship between the technician and physician may lead to informal communication that is not always completed accurately.

Hypothesis 4: Rural hospitals will have a greater proportion of adverse events associated with informal communication processes within the hospital than urban hospitals.[4]

Information Flows Between Organizations: Triage and Transfer

Rural hospitals are generally capable of treating a more limited variety of conditions than are larger, urban hospitals. While a smaller urban hospital may be similar to rural hospitals in their capability to treat a limited range of conditions, their situation differs from a rural hospital. In an urban setting, patients are more readily routed to the appropriate hospital during initial transportation and if a patient needs to be transferred between facilities, the distance between facilities is often not as great as it is for rural hospitals. This greater distance for rural hospitals may increase the chances of adverse events during transport, which can be addressed with

[4]These adverse events are addressable with tools specifying routines for notification of test results that require a positive indication of reception (Shojania et al., 2001b).

specialized transport teams (Shojania et al. 2001b). But the distance to referral sites makes the decision to immediately triage and transfer a patient, stabilize and transfer a patient, or treat the patient different in a rural setting than in an urban setting. The following example (provided by Dr. A. Clinton MacKinney), which describes emergency care treatment of acute myocardial infarction, illustrates the different types of challenges physicians face depending on the availability of human and infrastructure resources.

For the urban physician treating an acute myocardial infarction, the resources of an urban medical center allow straightforward clinical decision-making. Standard protocols for chest pain (monitoring, ECG, labs, oxygen, nitroglycerin, morphine) are provided by an ER team shortly after patient arrival and without physician input. The urban physician's clinical decision-making includes:

1. Confirm a pertinent history
2. Perform a pertinent exam
3. Confirm patient stability
4. Review the ECG computer-generated diagnosis of acute myocardial infarction
5. Ensure proper interventions have been provided
6. Ask staff to notify the on-call cardiologist stat

At this point, the urban physician's clinical decision making is complete.

In contrast, for a rural physician treating an acute myocardial infarction, supporting human and infrastructure resources are comparatively limited. The rural physician's clinical decision-making includes:

1. Assess the nursing history telephoned in the middle of the night
2. Recall from memory medication dosages and specific interventions for chest pain patients
3. Obtain a pertinent history
4. Perform a pertinent exam
5. Review the ECG and diagnose acute myocardial infarction
6. Recall that ST segment elevation in lead V1-4 is more likely to be complicated by congestive heart failure

7. Assess the patient for "clot-busting" medication appropriateness (there is no pharmacy protocol developed)
8. Read the package insert for the new "clot-busting" medication (the physician has never used this product before)
9. After reading the insert, obtain further history and testing to ensure that the patient does not develop life-threatening complications from the medication
10. Assess nursing capability to properly mix and infuse the medication
11. Recall that other interventions are now needed such as aspirin and beta blockers (there is no hospital protocol for these interventions and medication doses must be looked up)
12. Observe reperfusion arrhythmias and wonder if treatment is needed
13. Discuss transfer with patient and family
14. Assess weather conditions for helicopter transfer
15. Personally telephone urban ER and discuss transfer with ER physician and cardiologist
16. Recall and hand-write paper work necessary for patient transfer to avoid EMTALA violations
17. Provide a clinical update via radio to the helicopter crew
18. Reassess patient and note clinical deterioration with shortness of breath
19. Note that a chest x-ray was never completed
20. Order and review a chest x-ray with limited experience to note subtle pulmonary edema
21. Nonetheless, diagnose congestive heart failure and recall latest treatment protocol
22. Hope the patient does not arrest before the helicopter arrives because Advanced Cardiac Life Support training was years ago and no one is trained in intubation
23. Respond to a precipitous delivery in OB during this ER cardiac case.

Making the triage and transfer decision more difficult is the mixed evidence for patient outcomes, some of which shows that stabilization before transfer does not increase mortality (Veenema and Rodewald, 1995; Rogers et al., 1999) and some of which shows that direct transport of trauma patients reduces mortality (Sampalis et al., 1997). At least one study shows that guidelines can be developed that can assist in the triage-and-transfer decision (Reilly et al., 2002), but this study was completed at a large urban hospital so the guideline may not be applicable to a rural setting. The decision-making problem also varies across geographic areas as a function of whether the hospital has available a statewide (Mann et al., 1997) or other geographically-based (Narad, Becker and Frecceri, 1996) triage-and-transfer system. Development of these geographically-based systems may support the creation of specialized teams to transfer patients and standardized communication channels between organizations, both of which could reduce the risks and difficulties associated with triage-and-transfer decisions (Shojania et al., 2001b).

Hypothesis 5: Rural hospitals will have a greater proportion of adverse events associated with triage-and-transfer decisions and a greater proportion of adverse events associated with transporting patients than urban hospitals.[5]

Developing a Culture of Safety

The IOM calls on health care organizations to "develop a culture of safety such that an organization's care processes and workforce are focused on improving the reliability and safety of care for patients" (Kohn, Corrigan and Donaldson, 1999). Because of the different environments faced by rural and urban hospitals, developing a culture of safety is likely to differ significantly between rural and urban hospitals.

In order to leave a unique role for the culture of safety, we do not view a culture of safety as being equivalent to organizational design (e.g. using medication practices demonstrated to be safe, clear role definitions, the design of incentives, and the design of non-punitive reporting mechanisms), or human factors and team design (e.g. avoiding reliance on memory, using constraints and forcing functions, and task simplification) (Kohn, Corrigan and Donaldson, 1999). While these are all important determinants of safety that support and encourage a culture of safety, they are not the same as a culture of safety because they only refer to the design of organizational roles and processes.

Culture is a set of shared beliefs among organizational members that define behavior as moral, where moral refers to appropriate (Durkheim, 1947; Guldenmund, 2000). A culture of

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[5]The adverse events can be addressed with clinical guidelines for triage, specialized transport teams, and geographically-based trauma transport systems (Narad, Becker and Frecceri, 1996; Mann et al., 1997; Shojania et al., 2001b).

safety refers to those cultural elements that relate to safety. Organizations that focus on safety and quality are organizations with a "preoccupation with failure, reluctance to simplify interpretations, sensitivity to operations, commitment to resilience, and deference to expertise" (Weick and Sutcliffe, 2001).

A culture of safety is an organizational culture where employees believe that the behaviors to support reliability and safety are appropriate. There are four broad types of these beliefs (Reason, 1998; Weick and Sutcliffe, 2001): reporting, justness, flexibility, and learning. In a culture of safety, employees believe it is appropriate to report errors, believe they will be treated fairly, are flexible in work roles so that they can manage unexpected errors, and should learn from experience. Organizational systems, such as blame-free reporting, can encourage these beliefs (Weeks and Bagian, 2000; Wald and Shojania, 2001a).

Flexibility and learning require beliefs that encourage avoiding simplification, sensitivity to operations, a willingness to believe existing processes are fallible, to plan for recovery from error, and deferring to those expert in solving the problem, even if the expert is at a subordinate level in the hierarchy (Weick and Sutcliffe, 2001). A culture of safety is a set of commonly held beliefs about reliability and safety that is shared among organizational members. Because it is a culture, it is created through processes such as recruiting, training, socialization, and interaction and it is supported through organizational incentives, structures, and processes that are consistent with it.

The sources of a culture of safety, and thus the ways of managing a culture of safety, are likely to differ between rural and urban hospitals. Culture has two basic sources – interaction based in a common situation (mechanical solidarity) and interaction based in a division of labor (organic solidarity) (Durkheim, 1947; Collins and Markowsky, 1998). Mechanical solidarity results from people in similar situations developing shared beliefs because of their regular interactions in a common context. This occurs in rural hospitals through shared social ties to individuals in the community and among the personnel in the hospital. This is in part due to the relatively small size of rural hospitals and in part due to living in a community small enough to get to know the people in the community. Employees in rural hospitals often point to this "family" type atmosphere as a key point differentiating them from urban hospitals.

In urban hospitals, the larger size, greater specialization within professional roles, and more diverse patient base makes interaction on the basis of similarity more difficult. In a large urban hospital, the division of labor may result in distinct sub-cultures based in mechanical solidarity within organization units such as laboratories and pharmacy because of the interaction of individuals within the unit. In these more complex organizations, culture is primarily based in organic solidarity, which has the shared beliefs that emerge from the interaction resulting from people of different occupations working together. While the culture of both rural and urban hospitals is based in both mechanical and organic solidarity, the relative contribution of each source differs. Mechanical solidarity is likely to play a larger role in rural hospitals than in urban hospitals.

These differences in the source of culture have implications for the culture of safety within rural hospitals. In a rural environment, the managerial problem is encouraging a culture based on mechanical solidarity to not take the system for granted, to not discount unexpected events, and to question the fallibility of the system. Because the existing hospital system and culture is based in mechanical solidarity, employees may be reluctant to question the system because of their common "ownership," the system's fallibilities may be overlooked, and unexpected errors may be discounted because they do not fit into the stereotype (there may be many idiosyncratic reasons to discount an error with a well known patient). Because of the mechanical solidarity, in which everyone knows everyone else, it may be difficult to guarantee anonymous reporting, which is critical to safety management (Wald and Shojania, 2001a). In an urban hospital, with the culture based in organic solidarity, the managerial problem will need to focus on integrating the sub-cultures of different professions and units. The greater complexity in an urban hospital may lend itself to tailoring an anonymous reporting system.

Hypothesis 6: Rural hospitals will find it easier than urban hospitals to build a culture of safety based on a feeling of being in a community, but will find it more difficult to build tools such as anonymous reporting systems.

LEARNING TO IMPROVE SAFETY IN RURAL HOSPITALS

Organizations improve safety through learning – the implementation of tools that provide safer health care, where tools refers to organizational rules, structures, processes, and technologies. In a rural hospital, the tools available to manage safety can be placed along a local-global continuum. Local tools are those tools that are unique to a particular rural hospital. An example is a home-grown information system or training program. Global tools are those tools that look the same in every hospital. An example is standardized operating room environments for anesthesiology (Kohn, Corrigan and Donaldson, 1999). Another example is the adoption of a statewide trauma transfer system in Oregon (Mann et al., 1997).

Electronic medical record systems (EMR) are a good example of a tool in the middle of the local-global continuum. While the hardware and software is global, every organization customizes the system to its own environment by using its own business rules. Computerized physician order entry systems and electronic medical records, for example, are implemented by fitting triggers and screens to the preferences of a local hospital and even to a specific physician. Technologies tend to migrate from local to global. This can be due to professional forces, such as anesthesiologists standardizing anesthesiological practice (Kohn, Corrigan and Donaldson, 1999), and technological forces, such as information technology and the Internet. Information technology has developed computerized order entry systems, electronic medical records, and technologies for managing medical records, such as bar-code scanning to track the location of records.

A significant managerial problem is making the decision when to invest in improving safety by exploiting a hospital's own capabilities or by exploring new capabilities by acquiring new technologies and processes. Given limited budgets and resources, rural hospital administrators infrequently have the luxury of aggressively pursuing both strategies. Implementing global technologies is costly. While some argue that computerized physician order entry for drug prescriptions should be widespread, the feasibility of its implementation is difficult because "Physician order entry is a major process change; its implementation can be difficult and expensive. An organization wishing to realize its benefits must not only choose a well-designed system, but must also consider pre-implementation management and education and post-implementation technical and functional support" (Teich et al., 2000). The exploitation or exploration decision is a significant, and tough, managerial decision.

Some argue that the solution is that all organizations should adopt global systems because medicine is common – there are acknowledged standard guidelines, drugs, treatments, and procedures that represent best practice and should be used at all times and in all places. But this is not a feasible solution. Each hospital has a different mix of patients, providers, labor pool, physical capacities, and culture, which makes all organizational solutions unique (Berg, 1997). The truth probably lies in the middle – while there are local and global technologies, each organization must learn to how to best take advantage of these technologies.

While it would be tempting to ask researchers to define what is best practice, learning is an evolutionary process requiring the continued collaboration of health services researchers and hospital administrators. The patient safety frontier is a moving target. Not only do professions and industries improve organizing methods and technologies, each hospital's ability to absorb new technologies (Cohen and Levinthal, 1990) changes as a function of its history of innovating and building a culture of safety. Health services researchers and rural hospital staff will have to collaborate in this evolution because they possess complementary expertise and skills. Rural hospital personnel know the specifics of their organization and the feasibility of implementing new technologies and organizational structures and processes. Health services researchers can assist in learning about, evaluating, and diffusing best practices from diverse organizations. The next section discusses how learning processes can be developed in rural hospitals so that health services researchers can work effectively as partners with rural hospitals.

AN ORGANIZATIONAL PATIENT SAFETY LEARNING MODEL

How can organizational learning to improve patient safety be facilitated in rural hospitals? This broadly separates into two questions (March, 1991):

- When and how should rural hospitals explore new technologies (i.e. global technologies) and processes by adopting them?
- When and how should rural hospitals exploit their existing technology and processes by refining them?

These are fundamentally different strategies to reduce errors. Because organizations have budget and personnel constraints, they often cannot pursue both simultaneously. But doing either one exclusively can lead to sub-optimal performance.

Exploration and exploitation involve significant tradeoffs. Exploration is difficult and risky, especially with new technologies because it may require large investments in equipment and in training with uncertain prospects about the magnitude of the benefit. While exploitation can proceed on a more incremental basis, it has its own risks. It can result in the organization falling into a competency trap, which occurs "when favorable performance with an inferior procedure leads an organization to accumulate more experience with it, thus keeping experience with a superior product inadequate to make it rewarding to use" (Levitt and March, 1988). Because organizations have limited resources, they tradeoff these two learning strategies. The tradeoff must be made with care, because "adaptive systems that engage in exploration to the exclusion of exploitation are likely to find that they suffer the costs of experimentation without gaining many of its benefits" and "conversely, systems that engage in exploitation to the exclusion of exploration are likely to find themselves trapped in a sub-optimal stable equilibria" (March, 1991) where they do not take advantage of the benefits of newer technology.

Balancing the tradeoff between exploration and exploitation varies as a function of the learning context for each managerial problem (Levitt and March, 1988). Learning contexts vary along three dimensions: ambiguity, technological uncertainty, and performance measurement. Each of these dimensions and the ways to resolve the problem it poses for developing safer systems is described below. Table 1 presents examples of types of interventions to reduce medical errors in each type of organizational learning context.

Ambiguity is the understanding of the causal processes driving the desired outcomes. In an unambiguous process, the technology is well understood. The effect of changing an aspect of the process on patient outcomes is well known. In ambiguous processes, the effect of changing an element of the process on outcomes is unclear. An example is drug interaction effects, where the effect of a drug is conditional on an individual's genetic structure. In general as system complexity and interdependence between processes increases, ambiguity increases and

Table 1

The Learning Context for Patient Safety by Type of Intervention to Reduce Medical Errors

		Type of Intervention	
Organizational Problem Type	**System Design Issue to be Addressed**	**Exploitation (Develop and Improve Internal Capabilities)**	**Exploration (Adopt Technologies External to Organization)**
Ambiguity	Understand types of error	Collect incident reports: conduct face-to-face confidential interviews with front-line practitioners; conduct "safety walk-throughs" of units/ departments.	Familiarity with scientific and other literature; direct and indirect forms of information sharing between organizations; participation in "collaboratives".
	Understand causes of performance and error	Apply Continuous Quality Improvement (CQI) and Plan-Do-Study-Act (PDSA) cycles to errors to better understand causes of performance Employ various forms of "anticipatory failure analysis"; have practitioners identify "uncomfortable actions" and "accidents waiting to happen" Perform root cause analysis (RCA)	Familiarity with scientific and other literature (e.g., "sentinel events"); direct and indirect forms of information sharing between organizations; participation in "collaboratives"
	Create a culture of safety	Encourage reporting of errors and hazardous conditions; ensure no reprisal for reporting; develop a working culture in which communication flows freely regardless of authority gradient; implement mechanisms of feedback and learning from error; focus on operations and resiliency.	
Technological Uncertainty	Avoid/reduce reliance on memory	Point-of-care reminders: clinical "best practice" guidelines; physician order sheets; pre- and post-op checklists; drug formulary; allergy wrist-bands; order-writing standards; brand-generic drug name charts; equipment "safe operation" guides	Computerized "corollary order" support; computerized physician order entry and clinical decision support systems

Table 1 (continued)

		Type of Intervention	
Organizational Problem Type	**System Design Issue to be Addressed**	**Exploitation (Develop and Improve Internal Capabilities)**	**Exploration (Adopt Technologies External to Organization)**
Technological Uncertainty	Avoid/reduce reliance on memory	Accessible, up-to-date printed drug information Eliminate use of abbreviations or "coined names" in orders	Computerized drug information databases (e.g., Micromedex or hand-held devices)
	Standardize processes	Create clear guidelines and standards for writing medication orders Standardize medication administration times to reduce the chance of omissions Standardize/limit the number of strengths of medication stocked by pharmacy Unit-dose medication systems Protocols: for use of "high hazard" or "high alert" medications (e.g., anticoagulants, insulin, chemotherapy) or procedures	Computerized physician order entry system
	Standardize (and check) equipment	Standard placement and identification of medications in units and in "drug carts" Standardize types of infusion pumps, ventilators, anesthesia equipment	Use of robotics and automation in medication dispensing
	Use "double checks" at critical stages in processes	Use "hear back" for oral orders and instructions Pharmacy software with up-to-date drug interaction capability	

Table 1 (continued)

Organizational Problem Type	System Design Issue to be Addressed	Type of Intervention: Exploitation (Develop and Improve Internal Capabilities)	Type of Intervention: Exploration (Adopt Technologies External to Organization)
Technological Uncertainty	Match “expertise” with task and/or patient demands	Clear organizational definitions, indicators and procedures for matching staff mix and numbers with task/patient demands Clear organizational definitions and indicators for “go/no go” decisions regarding procedures; “two challenge rule” from aviation Simulations of “treat/triage” decisions	
	Eliminate or reduce impact of “loss of expertise” due to gaps in coverage	Clear policies, protocols and training for “off hours” access to pharmacy Clear policies, protocols and training for preparation and dispensing of “high hazard” medications in absence of pharmacist Provisions for “timely” double checks of radiographic and medication-related activity by radiologist and pharmacist	Provide around-the-clock radiology, pharmacy, laboratory services or access to expertise via video-conferencing
	Improve interdisciplinary communication and teamwork	Involve broad range of health professionals on patient safety committee	Offer team training to those who are expected to work in teams (e.g., critical care areas) using crew resource management techniques from aviation
	Design for recovery	Keep antidotes for high-risk drugs up-to-date and easily accessible Standardize procedures for responding quickly to adverse events Use drills and simulation training	

Table 1 (continued)

Organizational Problem Type	System Design Issue to be Addressed	Type of Intervention	
		Exploitation (Develop and Improve Internal Capabilities)	**Exploration (Adopt Technologies External to Organization)**
Performance Measurement	Track error occurrence and types	Compile and analyze incident reports (or chart review or administrative data) within an organization and benchmark over time Develop written policies and procedures that include competency standards for each patient care area and a method for measuring individual performance against those standards	Use tracking system developed by external entity who will benchmark your data with similar institutions

determining the cause-effect relationships becomes more difficult. Transient errors also are more likely to occur. As ambiguity increases, learning is more difficult because it is harder to identify which element to change to improve performance. The solution to ambiguity is improving the understanding of the causal relationships in and among processes.

Technological uncertainty is determining whether the system actually is doing what it is designed to do. It comes from three sources. First, it may be caused by slips or lapses in the use of a technology. Incorrect values may be entered while doing a laboratory test, which results in an erroneous laboratory reading. An incorrect drug may be dispensed. System design affects these slips and lapses (Reason, 1990, 2000). Second, turbulence may cause uncertainty about what the system is supposed to do. This could be caused by new government regulations such as HIPAA, the advance of new technologies, such as personal computers and the Internet, or the development of new types of system vendors, such as application service providers who provide web-based physician order-entry systems. While the system does not change, the technological frontier for the system, and the expectations about its performance level, lead to uncertainty about the ability of the existing system. New types of slips and lapses may be identified because of changing expectations. Third, it may be caused by difficulties in implementing a new system. Adopting new technologies, a form of learning by exploration, often requires significant investments in new machinery, in skilled individuals who can operate the new machinery, in training of existing personnel, and in restructuring organizations. For example, the adoption of diagnostic imaging using CT and MRI resulted in significant changes within organizations, particularly in occupational arrangements (Barley, 1990, 1996; Reason, 2000). Slips and lapses are likely to increase during this learning process. In all cases, ambiguity may be low because the technology is well-understood. But there is uncertainty about operating the technology well.

Performance measurement is used to assess performance and guide learning. Performance measurement is often used to compare current performance to targets to guide future performance improvement. Error reduction depends on the measurement of errors and near misses to determine the frequency and source of errors (Wald and Shojania, 2001b). There are a variety of factors affecting measurement. Measurement accuracy varies as a function of the frequency with which an event occurs. Even relatively common events, such as caring for diabetic patients, encounter measurement reliability problems when done at the physician level (Hofer et al., 1999). Measurement problems are exacerbated in rural hospitals because of the low frequency of many events. Some rare events, such as overdoses that occurred with chemotherapy (Morrissey, 1995), only occur as single events. In these cases, organizations are often forced to learn from single events (March, Sproull and Tamuz, 1991). Another measurement difficulty occurs when measurement relies on interpretation of events by "experts." Using physician peer reviews to assess errors, for example, is not a reliable way to assess quality and avoidability (Hofer et al., 2000).

Perhaps the easiest learning context is where system ambiguity is low, the technology is certain, and there are enough countable events so that errors, slips, and lapses can be monitored. In this situation, rural hospitals can use standard quality improvement techniques (e.g. root cause analysis) to monitor error rates and reduce them. This suggests the first strategy for rural hospital learning about errors: ***decrease system ambiguity, formalize technologies to decrease uncertainty, and identify countable events that can be monitored***. Strategies that can be used to identify ambiguity include using standard systems analysis techniques such as working with employees to understand the organization of the systems used to perform specific tasks (Leape, 1997). The systems analysis will identify countable events, such as slips and lapses, that can be used for monitoring and reducing error rates. A difficulty in implementing this approach is that rural hospitals may not have the resources required to support the administrative staff specialized in system and task analysis. But the small scale and lower complexity of rural hospitals may make the analysis relatively easy to do. Programs to support training staff in these techniques or providing facilitators who can guide employees through these processes may be useful.

Not all system processes can be transformed into situations where ambiguity and uncertainty are low and measurement is straightforward. Rural hospitals may have an advantage of dealing with these rare events. Error reporting and counting requires the standardization and categorization of errors so that counts mean the same thing. It also requires a large enough scale so that statistics generated from counts are reliable. The cost of obtaining standard and reliable measures may be the loss of the specific local context of the error, which is the cause of the error in a specific rural hospital. The rich, specific description associated with an event may be cast-aside (Tamuz, 2000). The more that this rich contextual information is useful in understanding the cause of errors, the more difficult it will be to develop safer systems. Maintaining and analyzing rich contextual information in large-scale systems is burdensome and difficult. Even if it is maintained, analysis is difficult because analysts lack the contextual understanding of the system's nuances. The smaller size, lower complexity, and informal relationships among individuals in the rural hospital mean that maintaining and analyzing rich contextual information is less costly and more easily done. The risk of this approach, though, is exploiting existing systems so much that exploring new systems is missed.

Rural hospitals require a mechanism to evaluate a well-developed and exploited local system relative to a global system to avoid the situation of exploiting a sub-optimal system. A target model of performance improvement, used in organizational theory to describe organizations in general (March and Simon, 1958; Cyert and March, 1963), can be used to understand rural hospital behavior. In this model, rural hospitals set some target level of performance, their aspiration level, measure their performance relative to that aspiration, and take actions based on that comparison. In response to the comparison, organizations have the choice of modifying organizational processes to change their level of performance or modifying their aspiration level to make it consistent with the level of performance. Learning occurs when the performance level is below the aspiration level and organizations change their technologies or processes, either through exploration or exploitation, to improve their performance. However, organizations do not seek to learn if their aspiration levels are relatively low or if they adjust their aspiration level to fit their performance.

Aspiration levels (i.e. goals) are set in a comparative process. Organizations can either compare their performance to themselves over time or to other similar organizations at the same time (Thompson, 1967). Continuous quality improvement strategies rely on the former approach, analyzing the changes in a performance measure (e.g. physicians using reminders) over time with the objective being to improve the process (Balestracci and Barlow, 1996). Benchmarking strategies involve comparing performance to other organizations. Comparing performance within the organization over time can result in a competency trap, where an organization continually improves a sub-optimal process. Comparing performance to other organizations can result in the exploration problem of never making existing processes work well. Ideally, organizations would have measures available that are consistent across organizations and are available over time. In this case, the organization can balance the gains from exploitation and exploration, using it to guide its decision-making about learning.

A second strategy for helping rural hospitals to manage the error learning process is ***to develop common measures across rural hospitals that allow them to determine if they are falling into a competency trap.*** This could be done by using anonymous reporting tools that encourage house-staff and physicians to provide rich anecdotal information on near-misses and errors to a trusted third-party. Research shows that these types of reporting mechanisms capture a richer set of data at a lower cost than using procedures such as coding medical records (O'Neil et al., 1993; Welsh, Pedot and Anderson, 1996; Weingart, Ship and Aronson, 2000). The third-party could code measures that are comparative within and/or between hospitals (Weinberg, 2001) and could support regular physician and house-staff review meetings to better focus safety prevention efforts within each rural hospital (Weinberg and Stason, 1998). As we have argued, rural hospitals differ in systematic ways from larger urban hospitals and measures specifically designed for rural hospitals (e.g. timeliness and safety of the patient transfer process) are likely to be required if they are to be useful in helping rural hospitals to balance exploitation and exploration optimally.

CONCLUSION

The central organizational goal in adopting a specific patient safety practice is to achieve a "fit" between the problem and proposed solution – a "fit" which can only be ultimately realized within the unique context of each organization. Of course, in finding a "fit", an organization is well-advised to also look outside itself, especially to organizations operating in similar environments and offering a similar range of services, for one expects some degree of convergence in problems and solutions between such organizations. There is risk, however, in adopting a patient safety practice simply because "it works somewhere else". Doing so without first verifying the existence of a particular problem and identifying its real or potential causes within one's own organization is likely to breed a "solution" that exists on paper only or – even if successfully adopted and running smoothly – accomplishes little more than a false sense of security within the organization. In the words of Ioannidis and Lau (2001), "while it is easy to agree that preventing errors is desirable, specific interventions must be evaluated according to their own merits with respect to effectiveness and cost-effectiveness in specific health care settings."

The strength of evidence for various patient safety practices has only recently begun to be evaluated, for example, through the work of Shojania et al. (2001a) and Ioannidis and Lau (2001). Shojania et al. (2001a) use a structured "evidence-based" approach to rate 79 practices by strength of current evidence regarding impact, effectiveness, potential amount of vigilance required, and estimated implementation cost and complexity.

Despite its many strengths, the applicability of Shojania et als. (2001b) ratings for rural environments should be qualified in several ways. First, impact ratings are estimated by the potential number of patients positively affected by the practice in the aggregate United States population, which may not translate into relative impact among rural populations. Second, implementation cost and complexity ratings are based on initial start-up and annual expenditures for full implementation at a medium-sized hospital or health care organization, assuming a three-year lead-time. Cost-effectiveness considerations are appropriately left to local decision-makers, but, as outlined earlier, size, resource, and internal political factors may make implementation cost and complexity quite different for rural hospitals relative to their medium-sized counterparts. Third, the strength of evidence ratings for various practices may be context bound in that nearly all of the patient safety practice/intervention literature from which the ratings are drawn was produced in medium or large hospitals, particularly in large, urban, academic-affiliated tertiary care centers. Whether or not the strength of evidence is comparable across all settings cannot be answered at present. Finally, several interventions with long histories of success in non-health care fields (e.g., promoting a culture of safety, fixed shifts or forward shift rotations) were not rated due to the current lack of investigation in the health care realm. Thus, while helpful, these ratings should be read through the lens of local conditions.

We currently know little about patient safety and medical errors in the rural context. The time to learn about patient safety, medical errors and successful interventions in rural hospitals and environments is now. The reduced scale and complexity of rural institutions provide an excellent laboratory for examining patient safety and medical errors issues. An important next step is financial and technical support for the systematic collection of data from rural hospitals and other entities that will lead to relevant patient safety practices for rural America.

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