

Information Systems Solutions to Medical Errors

DOUGLAS IVAN THOMPSON, President, Ivan Thompson & Co., Mesa, Arizona
 JAMES OAKES, President, Criterion Health Strategies, Fairfax, Virginia

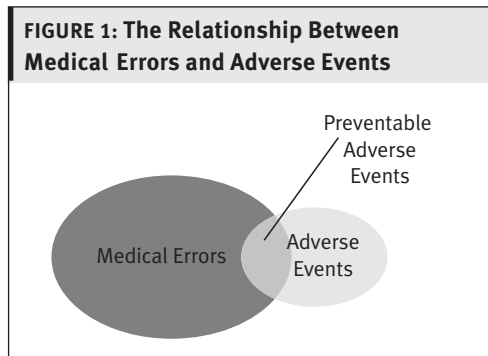
THE INSTITUTE OF MEDICINE released a report in late 1999 titled *To Err is Human: Building a Safer Health System*. This report puts the number of preventable deaths in America from medical errors at 44,000 to 98,000 a year, and estimates the cost of preventable errors at \$17-29 billion. While the research behind this report is not new, these figures shocked the nation, and have already led to a number of proposed regulatory changes. In addition this report has touched a nerve in boardrooms and living rooms across the country, and is likely to eventually result in other, more fundamental changes in the way consumers and purchasers evaluate and select healthcare providers.

This paper:

- Summarizes what the IOM report says about the nature, frequency, and causes of medical errors;
- Links the report's recommendations and their information systems implications;
- Proposes an integrated approach to help providers design information systems solutions that can reduce the rate of medical errors.

NATURE, FREQUENCY AND CAUSES OF MEDICAL ERRORS

To Err is Human defines adverse events as “injuries caused by medical management rather than the underlying condition of the patient.” Preventable adverse events are those attributable to medical error. As shown in Figure 1 most medical errors do not cause adverse events, and not all adverse events are preventable.



Numbers of Errors

Due to the lack of a standardized national reporting system or methodology *To Err is*

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Human does not contain comprehensive information about the prevalence of medical errors and adverse events. Instead the report draws its conclusions from the available literature, which:

- focuses primarily on inpatient hospital admissions and medication errors
- is dominated by a few large studies from specific geographic regions
- does not use consistent research methodologies, definitions and terminology

The report's widely-publicized estimates of 44,000 to 98,000 preventable deaths due to medical error come from two large studies of hospital inpatient admissions, one from Utah and Colorado, and one from New York State.^{1,2} Figure 2 illustrates the numbers of preventable events and deaths found in these studies.

These studies likely underestimate the actual incidence of medical errors because they “(1) considered only those patients whose injuries resulted in a specified level of harm; (2) imposed a high threshold to determine whether an adverse event was preventable or negligent...and (3) included only errors that are documented in patient records.”³

Other studies reported significantly higher rates of adverse events in hospitals. A 1981 study conducted on the general medical service of a university hospital found that nine percent of all admissions had an iatrogenic illness that threatened life or produced disability, and in another two percent of admissions contributed to death.⁴ Figure 3 extrapolates these rates to the U.S. inpatient population,

assuming that 50 percent of iatrogenic events were preventable.

Two other studies estimated that the number of preventable deaths due to medication errors alone could be over 100,000^{5,6} annually. What is the true rate of death and disability related to medical error? The answer is, we really don't know. The numbers reported in the IOM study are only general indicators of a problem that is certainly very large, and may be substantially larger than what is reported in the evening news.

Types and Causes of Errors

According to the studies cited in the Report the adverse events which occur most frequently include:

- Medication errors
- Surgical injuries
- Hospital-acquired infections
- Accidents
- Pressure wounds
- Restraint-related injuries

Adverse events occur most frequently in emergency departments, operating rooms, and intensive care units where high risk patients are

FIGURE 2: Medical Errors Studies Extrapolated to U.S. Inpatient Population

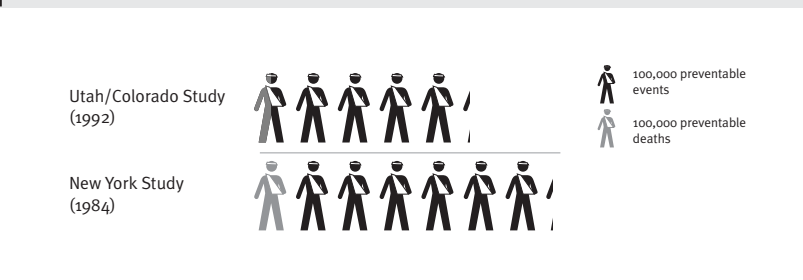
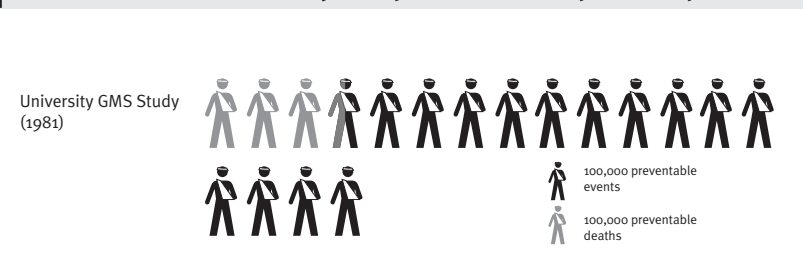


FIGURE 3: Medical Errors Study Extrapolated to U.S. Inpatient Population



found and rapid, precise actions are required. Adverse events are caused by the following types of errors:⁷

Diagnostic

- Error or delay in diagnosis
- Failure to employ indicated tests
- Use of outmoded tests or therapy
- Failure to act on results of monitoring or testing

Treatment

- Error in the performance of an operation, procedure or test
- Error in administering the treatment
- Error in the dose or method of using a drug
- Avoidable delay in treatment or in responding to an abnormal test
- Inappropriate care

Preventative

- Failure to provide prophylactic treatment
- Inadequate monitoring or follow-up of treatment

Other

- Failure of communication
- Equipment failure
- Other system failure

The processing and flow of information plays an important role in how errors occur. Examples include:

- Information to make a correct decision was never obtained
- Information was obtained but was not available when the decision was made
- Information was obtained and available but was not used in making the decision
- Information got lost or garbled in transfer
- Patient was not properly identified so key information was unavailable or incorrect
- Not enough time was available to use information in complex calculations or check for errors
- Too much data was available for the provider to see information patterns required for decision-making
- Complex processes were not overseen or integrated (no one has the big picture)
- Repetitive, routine calculations diminished

attention and led to errors

- Past errors were not recognized, recorded, analyzed, and used to improve
- Processes, including information flows, were not standardized

INFORMATION SYSTEMS IMPLICATIONS

The IOM report’s recommendations and their information systems implications are summarized below:

Recommendation 4.1

Congress should create a **Center for Patient Safety** within the Agency for Health Care Policy and Research.⁸

General IT Consequence:

- Research into methods for identifying and preventing errors will result in recommendations for various “best practices.”
- The specific consequences of this recommendation are years away, but ultimately the work of a Center for Patient Safety will help reduce some of the wide variation in how current information systems products work in the real world. Software developers will probably be the hardest hit with new standards and criteria for compliance.
- Human factors and engineering principles from other industries will influence the look and feel of next generation applications.
- Introduction/implementation of new technologies will be accompanied by protocols to monitor rates of medical error—software may get simpler, but its implementation will be more complex.

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Recommendation 5.1

A nationwide **mandatory reporting system should be established** that provides for the collection of standardized information by state governments about adverse events that result in death or serious harm.⁹

General IT Consequence:

- At least one third of the states currently have some sort of mandatory adverse event tracking system; however, each state tracks different events and most under-report based upon the literature. Few state systems use databases, instead collating and interpreting submissions.

Specific Issues:

- Even though the study recommends a narrowly defined focus for the data, not all the relevant data exists in one system (or even in a system). Additional sources of adverse events data will need to be identified; data will need to be extracted and formatted for submission to the appropriate agencies.
- The study recommends a standardized reporting format. Vendor systems do not view healthcare delivery processes exactly the same way, and vary in how they represent and store data. As a consequence, ambiguities and local nuances in the data will need to be mapped authoritatively.

Recommendation 5.2

The **development of voluntary reporting efforts** should be encouraged.¹⁰

General IT Consequence:

- While the IOM study provides a clear, but broad definition of an adverse event, different coordinating bodies define these events more narrowly.

Specific Issues:

- Most healthcare providers have no mechanisms in place to collect comprehensive information on less serious errors and adverse events, and no systems/databases to store and report this information.
- Tension will grow between needs for process data to support investigation of the causes of error on one hand, and security/litigation risks on the other.

Recommendation 6.1

Congress should **pass legislation to extend peer review protections to data** related to patient safety and quality improvement that are collected and analyzed by health care organizations for internal use or shared with others solely for purposes of improving safety and quality.¹¹

General IT Consequence:

- Data involved in these peer review processes will need to be authoritative and secure.

Specific Issues:

- Handling sensitive data related to medical errors will require a carefully standardized system of checks, protocols, and security policies to insure that it is used appropriately.
- The role of information system security will become more critical in all areas of the operation.

Recommendations 7.1 and 7.2

Performance standards and expectations for health care organizations and health professionals should **focus greater attention on patient safety**.¹²

General IT Consequence:

- Increased need for a strategic outcomes approach that clarifies which data is gathered from which system and for what purpose.

Specific Issues:

- “Information about the patient, medications, and other therapies should be available at the point of patient care, whether they are routinely or rarely used.”¹³
- “Clearly, any discussion of the availability of accurate, timely information for patient care

must stress the need for electronic databases and interfaces to allow them to be fully integrated, and the committee underscores the need for data standards and the development of integrated computer-based databases and knowledge servers.”¹⁴

- “The committee also believes that organizations, individually and in collaboration, must commit to using information technology to manage their knowledge bases and process of care. Doing so will require the integration of systems that are patient specific, allow population-based analyses, and systems that manage the case process through reminder, decision support, and guidance grounded in evidence-based knowledge.”¹⁵

Recommendation 7.3

The Food and Drug Administration (FDA) should **increase attention to the safe use of drugs** in both pre- and post-marketing processes.¹⁶

General IT Consequence:

- Greater focus on pharmacy automation and its relationship to ordering procedures.

Specific Issues:

- The most significant specific impact will be increased pressure for physician order entry. The consequences for automation, especially in terms of point of care devices could be great. Historically, many physicians have been resistant to this citing time spent interacting with a computer would reduce their availability to their patients. Evidence from the IOM report indicates that physician order entry may have significant benefit for patients.

Recommendation 8.1

Health care organizations and the professionals affiliated with them should make continually improved patient safety a declared and serious aim by **establishing patient safety programs** with defined executive responsibility.¹⁷

General IT Consequence:

- Focus on reducing the normalization of

deviance¹⁸— small changes in behavior become the norm and expand boundaries so that additional deviations become acceptable.

Specific Issues:

- Improvements in training for the use of installed applications. “Most care delivered today is done by teams of people, yet training often remains unfocused on individual responsibilities leaving practitioners inadequately prepared to enter complex settings.”¹⁹
- Selection criteria for healthcare applications should reflect the standards and requirements of internal safety programs. “Organizations should incorporate well-known design principles into their work environment. For example, standardization and simplification are two fundamental human factors principles that are widely used in safe industries and widely ignored in health care.”²⁰

Recommendation 8.2

Health care organizations should **implement proven medication safety practices**.²¹

General IT Consequence:

- The amount of data involved in the automated ordering and the administration of medications will increase.

Specific Issues:

- Interfacing from orders management to pharmacy systems will become more complex as more detailed patient and order data is required.
- Back-end and informal processes will be simplified and more integrated with the overall safety goals of medication ordering.

AN INFORMATION SYSTEMS APPROACH TO REDUCING MEDICAL ERRORS

Each organization must determine the level of energy it needs to expend in measuring medical errors, uncovering their causes, and taking corrective action. This represents a broad improvement program that will progress over many years. Some specific actions can be taken

in the short term, however, that will help achieve measurable results sooner. Quickly mapping these to your local information system environment will yield immediate benefits. The following recommendations will help an organization keep an information technology strategy in synch with the changing and increasing demands for action regarding medical errors.

Assess Your Risk from Medical Error

Find out how large a problem you have by estimating the number, type and costs of medical errors and adverse events at your facility. The size of your problem will determine the amount of resources you're willing to devote to reducing medical errors. Outcomes consultants such as Ivan Thompson & Co. have developed structured methodologies for describing and quantifying provider risk of medical errors.

Audit Your Outcomes Information Systems

Measuring and monitoring medical errors should be done in the context of an overall outcomes measurement strategy. Find out what your organization is spending on outcomes data collection, processing and reporting and how this information is being used. Large providers often support redundant outcomes data collection, do not make full use of available outcomes data, and do not collect other data required to support their organizational strategy.

Prepare for Mandatory Reporting

Compare your available data on adverse events with the likely reporting regulations. Identify sources and collection methods for additional required data. Decide where and how the data will be stored. Investigate possible electronic reporting methods and become familiar with possible report formats.

Consider Use of Databases and Tools... for voluntary collection, analysis and reporting of errors. Mandatory reporting will likely include only the most serious adverse events, however, less severe events have costs too, and their

numbers are likely much greater. There may also be financial costs to errors that cause no injury. An ongoing monitoring system for medical errors can take advantage of available financial data to reduce the amount of clinical resources required to identify errors and events. Ideally a voluntary error/event reporting system would include information about the causes of error, so that this information can be used to address the root causes of errors.

Simplify Key Processes

The most commonly garbled process in any healthcare setting is ordering. Often several people are involved in a relay of information that sometimes can involve multiple databases. Consider implementation of physician order entry, which the IOM report identifies as a key strategy to reduce medication errors. This may involve the use of point of care technology.

Design Jobs for Safety

From the point of view of information technology, designing jobs for safety includes "addressing staff training needs and anticipating harm that may accompany downsizing, staff turnover, and the use of part-time workers and "floats" who may be unfamiliar with equipment and processes in a given patient care area."²²

Reduce Reliance on Memory

Favor the use of pharmacy applications that support drug interaction alerts and dosing.²³ Few systems currently do an adequate job of warning about patient allergies.

Use Constraints and Forcing Functions

The logical path through an application should be toward the safest result. For example, it should be harder to order more dangerous drugs or doses (a less common requirement as well) and easier to order more common items. Automated clinical pathways and other work flow technology can help standardize information flows and work processes without removing a provider's ability to change the recommended actions based upon clinical judgement.

JENNIFER ZELMER'S FAVOURITE WEBSITES



As Director, Health Reports and Analysis, Jennifer Zelmer and her team at the Canadian Institute for Health Information develop health indicators that provide the public, caregivers and health authorities alike with the real stuff. She leads CIHI's partnership with researchers, AND with the media including Maclean's Magazine and their annual Health Report. Jennifer is one of a long list of "Protti Proteges."

She offers these favorite websites:

www.ncbi.nlm.nih.gov/entrez/query.fcgi?db=PubMed

Because PubMed allows anyone to search (for free) an index to hundreds of thousands of health-related journal articles from around the world.

www.canada411.com

Because it eliminates the need for shelves filled with phone books from across the country.

www.specialedition.net

Because you can access current and past articles in dozens of newspapers from across the country in one place.

www.cihi.ca or www.icis.ca

Because it's the easiest way to access the latest range of CIHI's health information products and services. (Although I may be prejudiced!)

www.google.com

Because it's a gateway to the rest of the web, from the latest research on measuring outcomes of care to the best places to stay on holiday.

I tried to get a fair range that reflects the depth of information and different types of services available.

Standardize Work Processes

From the point of view of computer technology this can be as simple as standardizing on display size, desktop operating system, default applications, keyboard layout, and pointing devices. In multi-hospital scenarios it can also extend to consistent and uniform implementation of vendor applications. Consider buying an integrated system with a common user interface from one vendor rather than assembling one from diverse components. Update application selection criteria to place increased emphasis on standardization, integration and ease of use.

The HIMSS Book will be a regular feature and so this article is the first in a series from the Healthcare Information and Management Systems Society (HIMSS). It represents the journal's working arrangement with the Society to exchange information, best practices and new models in health information management. The Chair of HIMSS will join the Editorial Advisory Board; this year it is Greg Walton, Chief Information Officer for Carilion Health System in Virginia. In Canada HIMSS has a chapter headed up by Lina Milone, Director, Information & Communication Services at Sunnybrook & Women's College Health Sciences Centre (lina.milone@swchsc.on.ca).

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