



Healthcare Issues Change we can live with

Building the data capabilities and analytics to make critical improvements in patient safety and wellness.

By
**Brent James and
Douglas A. Samuelson**

The most important story right now about the changing healthcare system in the United States probably isn't about health insurance exchanges, different reimbursement schemes, mandated coverage or other policy provisions of the Affordable Care Act (ACA) that took effect this month. ACA also mandated a much greater emphasis on outcomes. This in turn will drive a change from the traditional focus on ailments and treatments to a focus on full courses of care and maintaining wellness of a population. Numerous major changes in medical practice and funding will almost certainly follow. The provisions encouraging and funding study of this change are already in effect. They are producing activities that should be of interest to all OR/MS analysts and other systems thinkers interested in healthcare.

At least one major recent development reflects the coming profound system change. On Sept. 27, just before press time for this issue, Intermountain Healthcare, one of the nation's leaders in health outcomes analysis as well as a major medical care provider, and Cerner, one of the nation's leading health data and information technology companies, announced a new strategic partnership. Drawing on Intermountain's pioneering leadership in quality improvement and data analytics and Cerner's expertise in information technologies, the multi-year partnership will implement the Cerner electronic medical record and revenue cycle solutions across all of Intermountain's hospitals and clinics. This means that one of the best analytic teams in a provider organization will be matched with the most comprehensive and high-quality health outcomes data resources in the country. It also means that they will generate care data that will make it much easier to link all the events in a course of treatment(s) that affected a given patient.

Intermountain's management explains, "Intermountain, based on careful analysis, believes that healthcare delivery is in the midst of a major shift from top-line revenue driven financial strategies to one of bottom-line cost control financial strategies. This is the direct consequence of a growing shift toward provider-at-financial-risk payment mechanisms (to wit: Intermountain is consciously moving toward full capitation [compensation for maintaining the wellness of a defined beneficiary population rather than fees for services as people get sick] under our Shared Accountability strategic initiative, which maximizes our well-established ability to reduce costs through higher quality, that is, through clinical quality improvement)." In other words, they plan to reorganize their data to facilitate analyses that drive quality improvement and reduce ineffective and potentially harmful treatments.

They elaborated, "We think this [the new direction in healthcare] has profound implications for health IT. We want to 'skate to where the puck is going to be' in five or 10 years. Some major players in the health IT marketplace are not well-positioned to make this transition, in terms of current infrastructure or vision, but Cerner shared the same vision and sense of urgency for change. This is the same strategy that Intermountain has been pursuing for the past decade or so, but now we have a stronger partner in making it happen."

The Problem: Quality Issues Resulting from Fragmented Care

This initiative and others encouraged by the Affordable Care Act are intended to address a problem that



Emphasizing the totality of events that affect patients in the system is the key element of the Intermountain-Cerner collaboration.

is large and growing: medical injuries caused mostly by system failures. The extent of this problem came to public attention 13 years ago, when the Institute of Medicine (IOM), one of the National Academies of Science, published a startling report (Committee on Quality of Healthcare, 2000) on preventable deaths in the healthcare system, estimating that 100,000 such deaths occur in the U.S. each year. The study committee concluded that most of these deaths resulted from system errors such as flawed information handling, rather than from mistakes by specific providers. Among the most significant instances of such system errors were critical medical information lost in transition among providers, dangerous medical tests that were repeated because the medical decision-maker had not received the results, and adverse drug events because patients' known sensitivities were not in the decision-maker's records.

Recent analyses, in particular Classen et al. (2011), indicate that the Institute of Medicine most likely understated the case. Preventable deaths within the medical system may be twice what IOM estimated, and the total number of adverse events – fatal and non-fatal – appears to have been underestimated by as much as an order of magnitude. This trouble stems not from carelessness or deliberate cover-ups but from insensitivity of the indicators IOM relied on, meaning that they miss many of the events of interest.

Last fall, in a joint keynote address to the annual national meetings of INFORMS and the Society for Medical Decision-Making, the first

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author of this article presented and explained some of these findings:

- Any injury potentially caused by any aspect of the medical system should be counted, not just those attributable to evident medical errors. The event of interest is *any undesired medical incident caused by a care delivery action, that results in durable impairments in patient functional capacity, additional medical monitoring or interventions, or significant patient symptoms (as defined by the patient.)*
- Such injuries occur to 3 percent to 4 percent of hospitalized patients.
- About one in 10 such injuries results in death.
- At least half of these injuries are preventable.

Even using the IOM's conservative estimate of 98,000 preventable deaths per year, hospital-based preventable medical injuries account for more deaths than motor vehicle accidents or breast cancer, and result in direct healthcare costs of \$9 billion to \$15 billion per year.

The high-frequency types of such injuries are:

1. Adverse drug events (ADEs) and adverse drug reactions (ADRs)

2. Iatrogenic (provider-caused) infections, especially post-operative deep wound infections, urinary tract infections (UTI,) lower respiratory infections (pneumonia or bronchitis,) bacteremias and septicemias
3. Pressure injuries
4. Mechanical device failures
5. Complications of central and peripheral venous lines
6. Deep venous thrombosis (DVT)/pulmonary embolism (PE)
7. Strength, agility and cognition (injuries and restraints)
8. Blood product transfusion
9. Patient transitions

Improving reporting, the basis of all subsequent analyses, is critical to finding the patterns of problems. Getting the reporting right, to support improvement, is also why it is preferable to think in terms of medical injuries rather than errors. Studies in LDS Hospital, a constituent institution of Intermountain Healthcare, several years ago indicated that current voluntary reporting systems show only one in 100 to 150 medical injuries, and that clinical teams are likely (70 percent of the time, for ADEs) not to associate the patient

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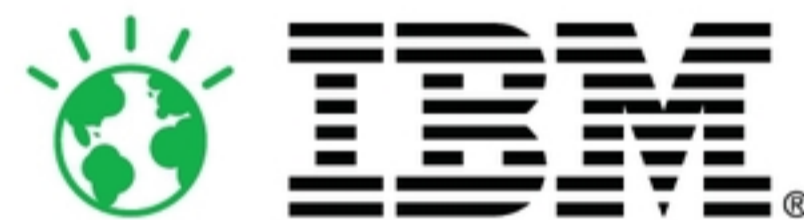
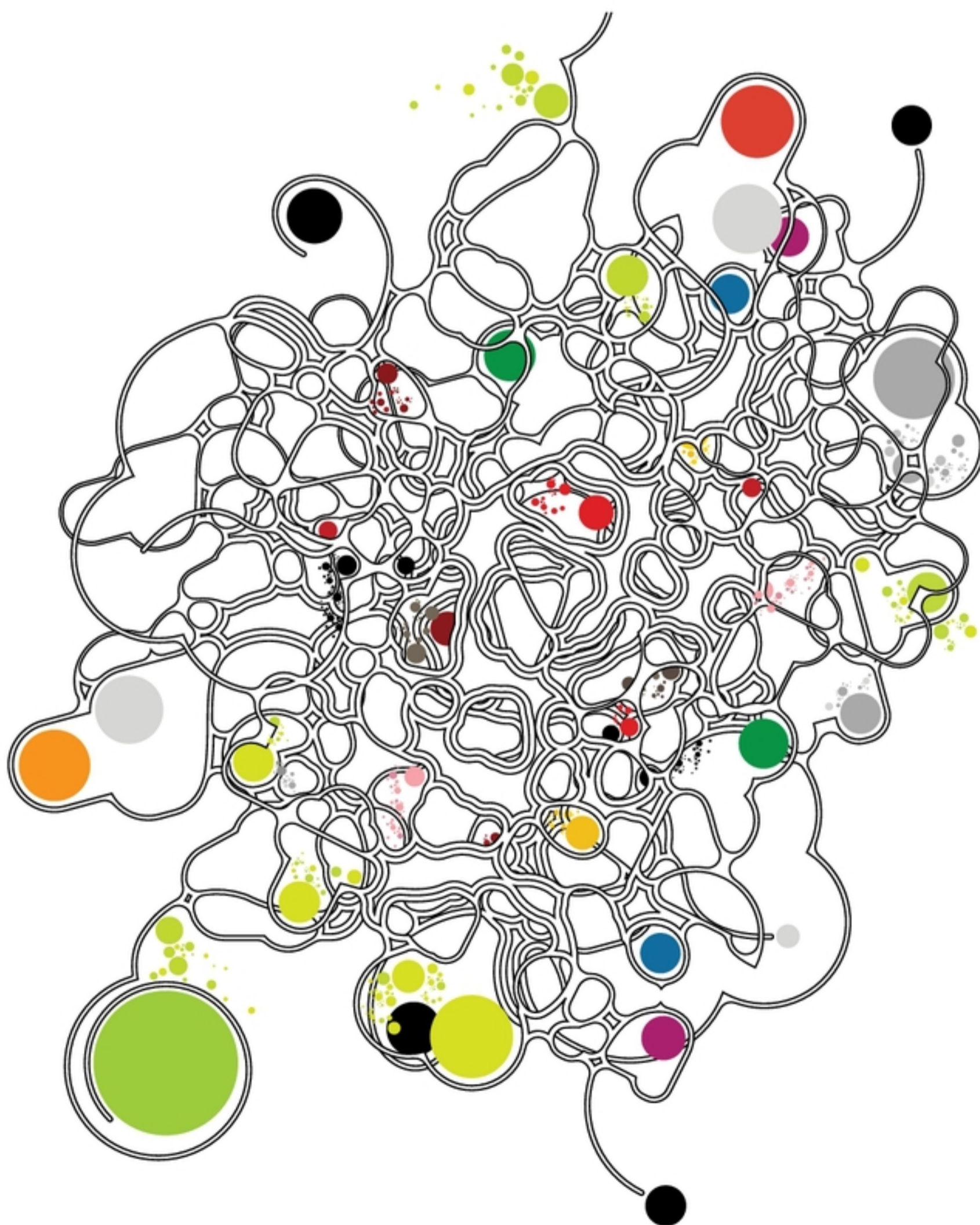
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symptoms with the medical treatment that caused them. A more accurate perception of sources of injury can hugely change intervention strategies. These failures of perception, not fear of consequences of reporting, account for the preponderance of the under-reporting.

Example: What Causes Adverse Drug Events

Adverse drug events (ADEs) provide an especially striking case in point (see Figure 1). In a prospective surveillance study of 202,220 inpatients, Intermountain Healthcare found 4,155 medication errors: the physician ordered correctly, but the pharmacist then prepared the medication incorrectly or the nurse delivered it incorrectly. Specifically, then, these errors include: (1) wrong preparation, (2) wrong dose, (3) wrong route of delivery, (4) wrong rate of delivery, and/or (5) wrong patient.

This study also found 3,996 adverse drug events. The surprising finding, however, was that only 138 of the ADEs resulted from medical errors – that is, incidents in which one departure from recommended practice clearly led to the adverse result. That is, *most medical errors did not produce serious consequences, and most of the serious consequences did not result from identified medical errors.*

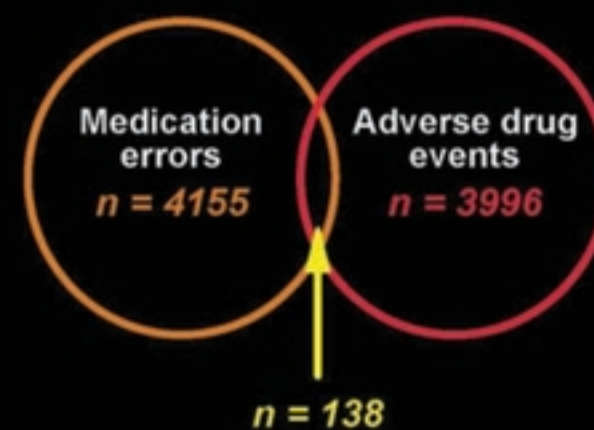
There are many possible explanations: under-reporting of adverse effects from medications, adverse reactions to combinations of medications that would be safe one at a time, misdiagnosis or improperly communicated diagnosis (so the medication is appropriate for what the prescriber thought the ailment was, but not for what it really was), withdrawal effects (tested much less thoroughly than direct effects in the drug approval process), and rare, previously unrecognized reactions. The point is that we cannot begin to identify the causes of these adverse effects not readily attributable to medical error until data are collected differently from the way they have been.

The Importance of Redefining Reportable Events

This example highlights the reporting deficiencies that can then corrupt the rest of the typical outcomes analysis. What is classified as an “error” is what is already considered preventable. At this stage, however, such judgments may be seriously misinformed and further distorted by providers’ reluctance to expose themselves to blame. Focusing on all medical injuries,

Medication errors vs. ADEs

Prospective daily surveillance of 202,222 inpatients for the occurrence of medication errors and adverse drug events



Definition of medication errors: Assumes that the physician orders correctly, but that the pharmacist then prepares the medication incorrectly, or that the nurse delivers it incorrectly. Specifically, (1) wrong preparation, (2) wrong dose, (3) wrong route of delivery, (4) wrong rate of delivery, and/or (5) wrong patient.

Figure 1

In the U.S.,
there are perhaps
as many as
200,000
preventable
deaths
per year, and as
many as
10 times
as many
injuries,
resulting from
system
failures
in medical care.

regardless of presumed cause, rather than those known to have resulted from a process judged to be faulty, provides a much better basis for the pattern analyses and resulting systems improvements that are needed. Then we can see which events, currently thought not to be preventable, actually can be prevented. This focus also drives a useful research agenda.

To conduct such assessment properly, it is necessary to be able to connect all the events in what medical analysts call an *episode of care*: all the events (including appointment scheduling and difficulties parking) associated with an ailment, from recognition to resolution. In typical medical data, the unit of analysis is the patient-provider encounter. If a patient goes to a clinic, then sees a physician, gets some lab results, has a couple of other physicians consult, and has a few follow-up visits with the original physician or others, what we see is the bills for individual procedures by each provider. What we need to see is how these events fit together.

This changed focus, emphasizing the totality of events that affect patients in the system, not just the services provided and the noted errors, if any, is the key element of the Intermountain-Cerner collaboration. In turn, this effort and the incentives in the new legislation will most likely inspire other, similar efforts. Analysts who can master the new approach to data – and get deeply enough immersed in it to meet the training and certification requirements for access to sensitive medical data, as required by privacy legislation – can look forward to many opportunities to contribute. Long-time readers of *OR/MS Today* may remember seeing the importance of information handling, and the systems improvement challenges and opportunities it offers, highlighted even earlier (Samuelson, 1995), with additional detail (Samuelson, 2000) about how

OR/MS analysts, if they were properly versed in healthcare terminology and methods, could be helpful.

Conclusions

More recent findings confirm and amplify the Institute of Medicine's findings about preventable deaths and injuries in the healthcare system. In the U.S., there are perhaps as many as 200,000 preventable deaths per year, and as many as 10 times as many injuries, resulting from system failures in medical care. These are almost all system failures, not errors by individual providers. Organizations, not individual physicians and nurses, control these systems of care. Preventing injuries requires designing safer systems of care. Such design efforts can only succeed if data are collected and analyzed in a different way from what has been customary. The ability to analyze in terms of episodes of care (the full course of what the patient experienced in connection with the ailment), rather than individual, unconnected patient-provider encounter records, and taking into account all adverse events, not just those readily attributable to specific medical errors, are the keys to effective analysis. This is the challenge in which OR/MS analysts, suitably trained and experienced, can work with medical profession-

als to generate substantial improvements in both quality and costs of care. **OR/MS**

Brent James, M.D., M.Stat., is the chief quality officer for Intermountain Healthcare, Salt Lake City, Utah, and was a member of the committee that produced the IOM report.

Douglas A. Samuelson (samuelsondoug@yahoo.com), D.Sc., is president and chief scientist of InfoLogix, Inc., a consulting and R&D company in Annandale, Va., and a contributing editor of OR/MS Today.

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