From Crisis to Confidence
Creating high reliability in healthcare

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This presentation ties together the most recent patient safety thinking with the information infrastructure necessary to create high reliability organizations.
The principles and practices of high reliability organizations are well known and will be elaborated in this presentation. There are, however, several confounding factors in health care which make high reliability even more elusive than in other industries. As suggested by learning objective number two, there were significant design limitations in electronic health records in the late twentieth century. As in other industries, the “human factors” of the user interface challenged the installers and implementers of these early systems to deliver solutions that ensured high reliability results.

In this presentation, as outlined in learning objective number three, we will illustrate the specific steps and specific attributes associated with planning and successfully deploying electronic health records to promote reliability in healthcare improvement.
It is a well known adage that a “good implementation factors in the people, process, and technology issues associated with the broader goals.”

In other industries, achieving high reliability has required discipline around the three primary elements shown here. Each has distinctive contributions from people, process and technology.

The communication redesign covers three areas that have been associated with the significant challenges and failures. The first is human-to-human. Second is system-to-system communication, and third is system-to-human communication.

Structural redesign refers to the way we do broad classes of things that span many processes. For example, the method we should use to bring together various data elements to form an informative picture can be implemented in a variety of ways. With the advent of technology such as computerized physician order entry (CPOE), the methods used to bring together various data elements to form an informative picture can and does vary for each orderable. If the methods necessary to support building and maintaining an environment for doing this supports little or no customization, as did earlier systems, rigid and error prone results can be expected.

The third element in achieving high reliability in health care is process redesign. The quality improvement movement offers numerous examples of process redesign, and in this presentation, we will focus on those attributes of process redesign specifically associated with high reliability organizations.
It’s useful to share a story to elaborate on how these three elements are involved in accidents.

This story is about American Airlines Flight 965. There are several lessons to learn from the aviation industry that are directly relevant to healthcare delivery. Fifty years ago, aviation had its IOM report equivalent. The risk of airplane crashes was several orders of magnitude higher than it is today. The crash you are about to hear about took place ten years ago. As we go through the story, imagine that you work for American Airlines. In fact, imagine that you are the pilot of this flight.
THE RELIABILITY FACTORS

Was it the pilot’s fault?

- December 1995
- Boeing 757
- Miami to Cali, Columbia, on landing approach
- Plane, Pilot, Weather were okay

And with these details in mind, ask yourself whether the crash was the pilot's fault.

Flight 965 took off in a Boeing 757 from Miami, Florida on its way to Cali, Colombia.

Up until the final minute of the flight, and in fact, up until the final seconds, the plane was in perfect working order, the pilot was in good health, a veteran of over 30 years of flying and had recently been recertified, and the weather was unremarkable.

The geography, however, did play a role. The final approach flight path into the Cali Airport involves flying in between the Andes mountains, as shown in the next two slides.
TIME & PLACE

At a high level, this story was rather simple. In the final approach to landing at Cali, the pilot went to enter the last radio beacon, named “ROZO”, into an instrument. This was initiated by typing the letter R.

The radio responded with a list of radio beacons whose names start with that letter. The pilot selected the first one that appeared to be correct in terms of latitude and longitude.

Unfortunately, the list came back in alphabetic order, and “ROMEO” headed the list, not ROZO. Romeo was also approximately the correct latitude and longitude. It was, however, behind the plane and the automation responded by attempting to fly toward ROMEO.
When the plane began turning, the crew realized that something was wrong. Seeing the Andes Mountains coming in front of them, they attempted climbing to avoid hitting the mountains. In the eleven seconds between the time when the pilot selected the radio fix and when they crashed, they did not have adequate time to determine what was happening and select a more prudent course - stopping the plane from turning rather than trying to climb out of the canyon, which was not possible.

Was the crash the pilot’s fault?

The correct, simple answer is of course, it was the pilot’s fault.

When looking at the situation from the perspective of high reliability, the issues of human error and system error become equally important.
But What Human Error?

- System Design – Structure
- Approach Guidance – Process
- Failure to Display Romeo or Rozo – Communication

From a system design perspective, the pilot was set up to fail. [Wilson and Funk] “It would be highly unlikely that a gross navigational error such as this could occur without the automated systems.”

Two important dimensions are: 1) the radio didn’t sort likely from unlikely selections; and 2) the automatic pilot system did not factor in terrain when carrying out the misguided destination request.

As with most errors in complex systems, there were multiple contributing factors. From the process perspective, there was a language barrier between the pilot and ground control. This was listed in the published root-cause analysis. Although it did not directly contribute to the crash, it raised the stress for the crew. Stress levels increase the error rates of otherwise seemingly unrelated tasks.

Lastly, there was a more basic communication problem involving communication between the system (radio) and the pilot. As it turns out, the radio didn’t display the names of the radio beacons in the list of possible choices. It only listed the latitude and longitude information on which the decision was made. This design flaw constitutes a system design failure, a process failure (inadequate functional support), and a communications failure (system-to-human).
Shown here, is the actual user interface involved.

Part of building, implementing, and using highly reliable systems involves close attention to human factors.

Marion Ball, one of the great innovators and communicators in medical informatics, talks about application design in this way. It is first necessary to replicate the familiar in order that users are able to embrace new technology. It then becomes possible to innovate on this technological base; ultimately transformation is both possible and often desirable.
With that in mind, let’s innovate on the technology that was available to the pilot in 1995. Rather than burdening the pilot with the data entry for “ROZO”, as the flight plan called for, let’s have the radio present a shorter list of choices. In fact, let’s go one step further. If there’s only one feasible choice, and the choice is safe, let’s let the radio select automatically. With acknowledgement, of course! Now, the pilot is setup for success rather than for failure.

Interesting aspects to this new “high reliability” approach: The pilot no longer needs to type anything, reducing user keystrokes and mouse clicks, in today’s parlance. It also reduces the number of steps in the process. We have also introduced a new system behavior: anticipation. Once again, in today’s parlance, that’s called Decision Support.

From a structural design, process design and communication design standpoint, it creates clarity about what information needs to be looked at, and in the end, what actions need to be taken.
Apply the same thinking to healthcare, and instead of a radio beacon, pick an appropriate dose medication for a specific clinical context.

Take the drug associated with the highest frequency of adverse drug events in hospitals, Coumadin. To replicate the analogous situation that the pilot faced in Flight 965, we offer the physician a choice of several doses for the Coumadin. And, we consider the design of their system to be sufficient and complete once we do.

Just as the pilot’s plan always included selecting ROZO as the final radio beacon, the physician also has a plan. Selecting a dosage for Coumadin involves knowing the desired target effect, the current distance to that target and the current setting of the controls (the previous doses of Coumadin that the patient has taken).

As the arena of the Andes had a devastating impact on the pilot’s decision (inadequate time to recover from an error), context plays a role for the physician ordering Coumadin: the specific diagnosis being treated, the duration of the anticoagulation intended, and overt signs of toxicity.

In addition to choosing a dose for the Coumadin, managing other issues that should be done at the same time is important. Example: the factors mentioned in the previous paragraph will need to be reviewed the next time dosage decision needs to be made. Ensuring the appropriate tests are ordered is part of assuring the reliability of the larger process and reliability goals intended.
When presenting the Flight 965 question of pilot error to clinicians, there are always “yes” responses offered with strong confidence. I also get “yes and no”, “it’s a systems problem” and “the pilot was set up to fail.”

Implications:

In both cases, we improved the user-friendliness by removing obligate actions like forcing the user to navigate the interface with unnecessary and error-prone keystrokes and mouse clicks. Second, all of the relevant information is integrated, reducing the likelihood of the user failing to review necessary data. Third, by setting the user up for success, we have reduced their personal risk of error. Fourth, by structuring the information design to produce information integration, we've laid the groundwork for improved documentation. Fifth, we've produced a benefit for the patient by reducing the latent error present in a system that only focused on capturing information, be it right or wrong. Sixth, we’ve addressed the orientation and training challenge for providers. Orientation, training, and communication deficits are the leading contributing factors to sentinel errors in patient harm as determined by JCAHO. Lastly, we’ve demonstrated that it's possible and critical for healthcare IT to anticipate the needs of providers and patients to ensure reliability of care delivery.
True ‘anticipation’ of users needs is based on patient context, the providers preferences and the intended plan of care.

Once again, looking at other industries, this anticipation is similar to how Google and Amazon put relevant information on the screen, including options that the user wasn't necessarily aware of or knowledgeable enough to ask for. The anticipation also takes the more subtle form, like Google and Amazon, of putting the most likely and best choices at the top of the list. As we saw with the ROZO-ROMEO story, subtle placement deficits can and do have catastrophic unintended consequences.

Information Architecture means that you can display, collect and report on any clinically meaningful patient information, everywhere in the application. This is assumed to be present in most EMRs and isn't there. This was highlighted in our example of how to handle improving medication safety in the Coumadin management example.
Famous information design author Edward Tufte makes the point that to understand data, you must ask the question “compared to what?” It would be hard to argue the point made in the prior slide, “that it would be useful if the computer anticipated needs.” And yet, when you look at the computer applications built in the twentieth century, most display elements of a bad design. I’m not referring to aesthetics or personal preferences, but to attributes that make them more error-prone and harder to use.

This presentation is not intended to be a design critique or course. However, reliability suffers when screens offer too many actions, esoteric icons, labels, and functions. The user has to spend valuable time and concentration trying to find what they need.

These twentieth century interfaces, which sadly include some of the even more modern portal products, have a very disturbing attribute: every time a shortcoming is identified, an additional button or tab is added as a solution. The work of finding information, as well as the risk of not finding it increases as it grows.
USABILITY

“FORMS” – alternative examples include:

- Problems: Allergies & Medicines
- MAR
- Congestive Heart Failure
- Pre-operative Checklist: Anesthesia
- Diabetic Progress

My Common Views
My Common Orders
My Preferences

There is an alternative which we will elaborate on shortly. It is based on an industry standard information model called “Health Level Seven.”

By adopting the discipline to communicate patient information from a palette of all observations about the patient into a standard and consistent display “form”, it is possible to overcome the bad design traps described in the previous slide, and simultaneously create a mechanism to deliver the anticipation we’ve been discussing.

Instead of having tabs for every information task defined during the design of the product, the forms-based-on-observations model allows ad hoc assembly of information for any task. Once an application is designed around forms of this type, the only remaining challenge is supporting the nearly infinite cross-walks between informative views that are possible. Borrowing from the “favorites” concept of Web browsers, the crosswalk challenge melts away.

Navigation becomes consistent, the interface becomes clear, the customization barriers are lifted, and several forms of integrated decision support are facilitated.
WHY WE’RE ALL IN HEALTHCARE . . .

Promote Health

The airline crash and subsequent usability before – after story sets us up to explore the whats, whys, and hows of using health care information technology to enable significant improvements in the reliability of health care delivery.

As suggested by the title of this book, which was published in 1987, the idea of accidentally killing patients was a humorous absurdity.

Less than ten years later a string of tragic events brought increasing visibility around medical safety. Betsy Lehman, the 39-year old Boston Globe newspaper reporter who was given an inappropriately lethal dose of chemotherapy, subsequent notoriety around a wrong side of surgery case in Florida, and a torrent of public awareness in 1999 with an IOM report.

As satirical as London's book title is, it has been replaced by identification of specific problem areas such as medication adverse events and their prevention. Leading organizations are addressing broad goals such as “pursuing perfection,” or as Cincinnati Children's Hospital puts it, “pursuing perfect care.” [ref. Robert Wood Johnson Foundation and the Institute for Healthcare Improvement (IHI.org)].
RAISING EXPLICIT EXPECTATIONS
ON PROVIDERS –  Dr. Don Berwick, IHI, 2003

Spec 1: Don’t kill me
Spec 2: Don’t hurt me
  ▪ Don’t do things that cannot help me
  ▪ Reliably do things that can help me
  ▪ Relieve my physical and emotional pain

Don Berwick, the president and CEO of the IHI knows the complication rates and avoidable death rates in U.S. Hospitals; and here’s the kicker, he’s going to need a total knee replacement soon. His satirical (wit to expose weakness), yet poignant way to frame the problem is to address the quality concern. In selecting a vendor for the total knee replacement service, he’s issued an RFP.

If you find this concept intriguing, I strongly encourage you to go to: http://www.ihi.org/IHI/Products/Video/MyRightKnee.htm and get the VHS or DVD.

Here is his description, over a year before the 2004 World Series was to be played:
In his plenary speech opening the 15th Annual National Forum on Quality Improvement in Health Care on December 4, 2003 in New Orleans, Louisiana, Dr. Berwick issued his "Request for Proposals" to hospitals interested in performing his knee replacement surgery and asks the question, "Which will happen first, the health care we ought to have, or the Red Sox winning the World Series?"
RAISING EXPLICIT EXPECTATIONS ON PROVIDERS

Spec 3: Don’t make me feel helpless
- Share information
- Give me choices
- Remember me
- Follow my orders

Spec 4: Don’t make me wait
- Manage access
- Manage flow
- Keep track of things

Spec 5: Don’t waste money

Here is an excerpt from the RFP:
(http://www.ihi.org/IHI/Topics/Improvement/ImprovementMethods/Literature/RequestforProposalsReplacingDonsRightKnee.htm

But)

I. “No Needless Death” – Don’t kill Don
   A. Show evidence that you know the risks of fatal injury from your care.
   B. Discuss how you mitigate those risks, including, but not limited to:
      1. Eliminating surgical site infections
      2. Eliminating respirator-acquired pneumonia
      3. Eliminating deep vein thrombosis and embolism
      4. Eliminating medication errors
      5. Eliminating blood product transfusions mishaps
      6. Detecting esophageal intubation promptly
   C. Report your current frequency of injuries (using the IHI’s “Trigger Tool”), and the number of avoidable deaths last year.
   D. Report your Hospital Standardized Mortality Rate, year-by-year.
WHY WE’RE ALL IN HEALTHCARE

Promote Health

- Promote Safety
- Promote Reliability

Reliability is defined as the consistent achievement of desired goals in the face of present or potential risk of error.

So, we came to work in healthcare to promote health. To do that, we learned a few years ago that promoting health included promoting safety. Now, it seems we’re learning that to promote safety we must focus on promoting reliability.
Talking about high reliability in healthcare could sound very cold and academic; it’s not.

Let’s start with a problem definition that’s the same but broader. *How can I make sure that I never, ever, ever run over my children, or anyone else’s, with a car?*

At what rate would it be okay to run over a child? It’s immediately clear that having a 3% ADE rate, i.e. adverse driving event rate, would be completely unacceptable. The word unacceptable is absurd. The parallels with healthcare processes that avoidably harm patients are obvious. We’ve done such a good job of detaching ourselves from our patients to maintain a professional distance, we’ve lost touch with the ability to see our patients as ourselves.

This talk is about sharing what is known about building and operating high reliability organizations. Other industries, including nuclear power and aviation are the dramatic examples of transformation from error prone to error resistant. They’ve made their progress over the last 50 years and their lessons are just as applicable to healthcare as they are to other industries, and to not running over children.
HIGH RELIABILITY ORGANIZATIONS

Manage complexity and the unexpected with these characteristics:

Anticipating
- Preoccupation with Failure
- Reluctance to Simplify Interpretations
- Sensitivity to Operations

Containing
- Commitment to Resilience
- Deference to Expertise

Weick and Sutcliffe

Preoccupation with failure - recognizing the potential failure that, if anticipated, can be avoided. Example: redundant backup systems.

Reluctance to simplify interpretations – its human nature to assign blame, leading to premature closure of the analysis and response to prior failures. Methods to facilitate this characteristic are performing root cause analyses where appropriate or dialog mapping, to elaborate issues and tease out social dynamic conflict during a problem definition.

Sensitivity to operations - critical need to perform current state analysis, as well as process mapping in the planning processes. We race to some goal with inadequate awareness of our current state so that solutions do not match problems. (CPOE without addressing and automating the nurse and pharmacist aspects of the medication management cycle?)

Commitment to resilience and deference to expertise speak to attitude and culture (Flight 965 example - today, prior to the decent into the canyons of the Andes, the procedures for what should be reflexively done in the event of a unexpected engine failure are reviewed.)

You now have a framework with the five behavioral characteristics of high reliability organizations.

In a patient safety officer training program, instructor Dr. Alan Frankel pointed out the notions of reliability and the lower and interrelated goals of healthcare organizations. Specifically, the safety and risk management goals may be diametrically opposed in terms of values like transparency. From a high reliability organizational perspective in terms of the five characteristics, the opposition is brought into a better context.

When reliability principles are applied to the financial operations such as revenue cycle, unreliable practices such as the use of first-in, last-out queues become apparent and the process can be better managed. According to The Gartner Group, this practice is a common cause of inappropriately managed accounts.

In our earlier ROZO analogy, we saw an example of how improved structural design to promote reliability has a byproduct of improving ease of use. Lastly, the mind set of valuing the anticipation and containment of the errors has promised to drive the necessary technical knowledge acquisitions and willingness to change necessary to overcome their current status quo.
Over the past half century, multiple industries and institutions have found themselves plagued by alarmingly high error or mishap rates. There are numerous great success stories describing how many of them substantially reduced these rates by several orders of magnitude. In virtually every case, they instituted communication redesign, structural redesign, and process redesign as we discussed earlier.

For example, let's take a closer look at one of these institutions, Naval Aviation. We will then turn our attention solely back to improving reliability in healthcare through close attention to healthcare information technology management.
Shown here, on the Y axis, is the mishap or error rate for aircraft over an almost 50-year period. Note that rate fell from over 50 per 100,000 flight hours to under 2.5, through a series of initiatives during that time.

Angled-deck “Super Carriers” became reality in 1954 with the launch of the USS FORESTALL (CV-59). The concept of an angled deck (structural) was actually devised by the Brits, who first implemented it. They are consistent innovators in naval architecture, as evidenced by the steam catapult, VSTOL (vertical and short takeoff and landing) aircraft, and jump-jet decks, all of which but the last have been adopted by the U.S. Navy.

The Naval Aviation Safety Center (1956) is still very much a part of Naval Aviation’s high reliability structure. It is charged with compiling and disseminating information (communication) to the fleet concerning accidents, their nature, cause, and disposition.

Naval Air Training and Operating Procedures Standardization (NATOP-1961) is also very active (procedure). NATOPS is a series of procedural directives issued in both printed and electronic formats to ashore and afloat military maintenance personnel. They include “learned by experience” and anticipatory directives. True Knowledge Management.
Moving back to health care, and adjusting the Y axis to show defects per million opportunities, we see a comparably large decline in anesthesia death rates in just the last twenty years.
On the same axes we’ve now added inpatient medication errors and preventable hospital deaths. There are too few studies to draw arrows downward to the right, although BWH, LDS, and HealthPartners have shown preliminary results indicating a "55-83% decrease in hospital non-intercepted serious ADEs using CPOE" and lower rates in outpatient drug interaction checking with resulting changed prescriptions.

References:
Harvard Medical Practice Study, Brennan and Leape, NEJM 1991; 324:370


NEJM 1998; 339:489-97

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There are studies from multiple sources showing that physicians do not have all of their patients’ available medical information at the time they make decisions. This results in repeating tests to get results. This results in delays in diagnosis and treatment. And, this results in under-informed decision making.

Some people put it this way: “what is wrong with paper?”

1. Paper can get lost and you can’t find it.
2. It can be illegible.
3. Only one person can have it for reading and writing at a time.
4. Finding information in a thick chart can take a prohibitively long period of time.
5. The paper chart is often distributed across several locations: a chart at the unit station, another sheet of paper at the bedside with vital signs, weights, etc, a third sheet or sheets of paper constituting the medication administration record, and often a fourth location such as a piece of paper in a nurse’s pocket which will be transcribed for the chart at the end of her shift.

When looked at from this perspective, it’s easy to see that many decisions are made without all the available patient information in most significant care settings.
So, in summary, there are three ovals representing significant defect rates in healthcare. Most of us have a pretty strong sense that we can move each of these of ovals down and to the right. Few of us, however, have a clear sense of whether that’s going to take two years, five years, ten years, or twenty years to achieve.

The economics of paying to move the ovals is another un-modeled problem.

The third question raised in the slide is, “what are the unintended consequences?” Will more sophisticated information systems cause clinicians to be less careful, vigilant, and less sensitive to the latent error issues we’ve been discussing?

One model that is used to drive estimation of the cost and time lines of achieving safety is the “seven steps” shown on the next slide. This model was developed under the leadership of the Linda Creps, to help with both project planning and risk management.
The Leapfrog group, an employer/healthcare purchaser coalition, is often criticized by providers for setting computerized physician order entry as an industry goal. These critical providers have realized that to do order entry, an underlying functional automated medical records system is required. Since only a small minority of hospitals are automated to step four on this chart, and there are unique and multifaceted challenges with steps five and six, the providers pushed back on Leapfrog stating that the goal is out of reach.

[paraphrasing the Leapfrog group] “We knew that and we are glad that now, you’re figuring it out as well. And, though by the way, we in virtually every other industry, keep records of what we do for management and follow-up purposes. We expect you to do so as well if you hope to continue to get our business.”

The seven steps shown in this slide summarize building an infrastructure to capture and manage those records.
PRINCIPLES APPLIED TO HEALTHCARE IT

Fundamental to Reliability Management:

- Complex, tightly-coupled processes are error prone
- Manual practices are riddled with the present and potential risk of error
PRINCIPLES APPLIED TO HEALTHCARE IT

Critical in Healthcare IT are:

- Form – Display, Orders, Data Entry
- Model – HL7 Reference Information Model
- Interaction – Human User Factors
- Delivery – Knowledge Management
- Content – Policy, Preferences

We’ve spoken of the discipline and how this plan was based on forms which pulled together observations about patients.

The HL7 Reference Information Model version three is not proprietary and is a ratified industry standard. Observations can include definitions of things that can be ordered, were charted, preliminary forms such as the intention to place an order, actual orders and results, and other so-called ‘moods’ of events. The model was explicitly built to overcome flaws in earlier messaging standards.

The importance of human factors in the interaction design has been identified by every industry that has sought to become highly reliable.

Delivery of knowledge to users in the context of their workflow - note the case of Coumadin where knowledge was a flow sheet display form and orders form. Since “people don’t know what they don’t know,” we need a mechanism for delivering that knowledge without the user explicitly asking for it. By leveraging the discipline of the earlier three layers (form, model, interaction), reliable knowledge delivery becomes possible and sufficiently inexpensive to be deployable.

Content management and its relationship to the aforementioned structures are beyond the scope of this presentation.
THOUGHT LEADERSHIP

IHI – Berwick, Frankel, Griffin

- Humans make errors at a rate of 1 in 1,000 opportunities
- “Harm” framework and “Trigger Tools” end the question of error rates
- “The Goal of Patient Safety is High Reliability”
- Escape Fire: “design must include forcing functions” (Structural redesign in knowledge delivery)
- My Right Knee: we need to see our patients as ourselves; not 3%, it’s 100%

The concepts synthesized in this presentation have been developed through thousands of person hours of work. Leading this work has been the IHI, the Institute for Healthcare Improvement. They are a not-for-profit organization which seeks to be “a reliable source of energy, knowledge, and support for a never ending campaign to improve health care worldwide.”

Their leadership team recognized and disseminated the higher reliability organizational principles of Weick and Sutcliffe many years ago and they continue to this day.
THOUGHT LEADERSHIP

IOM – Fineberg
- Critical importance of design, “actors”, systems, and priorities to reliability

HL7 – Schadow, Russler
- Key insight: a shared and unified action and information model is critical to process fidelity

PST/HIMSS – Osheroff, Pifer, Sittig, Jenders, Teich
- Clinical Decision Support Implementers’ Workbook

The underpinnings of the Healthcare Information Technology Model for High Reliability is built upon the thought leadership of the IOM, HL7 and the Patient Safety Task Force of HIMSS.

The Clinical Decision Support Implementers Workbook is a great resource and is available from HIMSS at http://www.himss.org/asp/cds_workbook.asp.
Now that we have defined the characteristics of high reliability organizations, provided some examples of high reliability practices, and introduced the critical structures for healthcare information technology to enable high reliability, let’s turn our attention to drawing the explicit linkage between data and reliability.

The picture on the slide comes from a book called *The Logic Of Failure* by Dietrich Dornier. In it, he elaborates the critical role of simulation in understanding and avoiding calamity. I’ve yet to find a better picture that brings together the importance of a strong foundation, built on standards, and designed to support an arbitrarily long dynamic load.
Getting to the high reliability organization comes directly from choosing practices that lead to reliability.

Depicted in the slide, is one such practice, the use of bar code technology to ensure the reliable administration of drugs, to the right patient, by the right provider of the drug, at the right time, through the right route.
RELIABLE PRACTICES

Planning

- Having the supplies to change a diaper
- Having the medication to fulfill an order correctly and on time

Implications

Pre-occupation with Failure

- Having the supplies (Process Model)
- Knowing where they are (Structure Model)
- Getting handoffs correct (Communication Model)

Reliable practices require planning.

They are always designed from the “preoccupation with failure” perspective.

Reliable practices factor in explicit processes, unambiguous structural models, and clear communication models.
RELIABLE PRACTICES
The problem with making things foolproof is that fools are so ingenious!

Humor with a point.

Part of a “preoccupation with failure” means recognizing that people will do things outside of the prescribed processes and structure. As shown here, this two year old overcame a toilet seat lock in less time than it took his parents to install it; installation time – approximately ten seconds. Defeat time – approximately three seconds.
Requires shared and unambiguous:

- Expectations about workflow
- Names and storage locations notions
- Information reference model for communication between and within systems

The medication team at the Brigham & Women’s Hospital was kind enough to share their flowchart of the 40+ step process from the time a Physician orders an IV medication until the time the first dose is given.

This is a fabulous example of an team committed to making their hospital a high reliability organization.

See Handout Addendum 1 for a detailed B&WH flow chart.
Practices come from a broader set of known options with known characteristics. Choosing the appropriate option or options comes from recognizing the triggering revoking patterns to associate with one to deploy a particular option.

Broadly, this is Based on the Concept of Mindfulness:
“…the combination of ongoing scrutiny of existing expectations, continuous refinement…based on newer experience, willingness and capability to invent new expectations,… a more nuanced appreciation of context…[resulting in] improve(d) foresight and current functioning”
Weick and Sutcliffe
Shown here is the means to and linkage between data and reliability.

The linkage between information and knowledge is often referred to as 'context'.
There are numerous examples in healthcare where pulling together related pieces of data creates information. For example, an isolated piece of data such as the lab results showing a blood sugar level of 200 means little. However, when combined with a history of diabetes, insulin use, and an ophthalmologist’s report showing diabetic retinopathy, a pattern of information is formed.

A diabetic assessment flow sheet “form” could have been used to frame the data to create “speed to focus” for a provider to get from the data level to the information level in this diagram. If that form could not include the ophthalmologist’s report, because perhaps it was in a different silo of information, the information system has now become substantially less reliable. All competent vendors finished up the late 1990s by delivering portal products that were incapable of seamlessly integrating all data into single forms. All of the information within that diabetic assessment flow sheet might have been available; it was, however, necessary for the clinician to navigate through various sections to assemble the information in their mind.

The likelihood of recognizing and understanding patterns when information is disparate like this is more difficult and therefore more error prone.
MESSY INFORMATION IS AN INDUSTRY PROBLEM

- Information is stored ambiguously in separate silos
- No enforced disciplines on naming or use
- Even with good interfaces and data warehouses, joining data is not free or reliable
- There is no “high fidelity” method of communicating, especially when the complexity and tight-coupling increase

E.g., One lab calls it sugar, the other lab calls it glucose

HL7 messages are misused or sender/receiver expectation mismatches

E.g., this is where we store allergies (trusted master)

Doctors and Nurses have incomplete info;

Management has even more incomplete reports
In other industries, business intelligence software applications create a "semantic layer" to shield the end user from needing to know about underlying database table structures and other technical gobbledygook.

This makes it possible for technically naive individuals to work in the world of their own language and with simple high level tools. This, combined with common task oriented 'wizards' allow users to accomplish tasks with simple "next, next, finish" style instructions.

By providing this catalog along with simple wizards, building flow sheets, order sets and defining the patterns and practices we've just described becomes very straightforward and available to all users. This allows the easy, fast and low cost deployment of reliable small systems such as the Coumadin micro system described at the beginning of this presentation.

See Handout Addendum 2 for a detailed HL7 flow chart.
Let's now go back to the data concept through the reliability concept framework and layer in the terms we've introduced.
Introduce how the information is managed from data to reliability.
This slide elaborates the underlying technologies and competencies that support the achievement of reliability.

Data is supported through the data management competencies of databases.

Information is supported by the information management competency: deployment through native technologies, using those to automate specific workflows, and disciplining the slotted data to controlled medical vocabularies where possible and appropriate.

Knowledge is supported by the knowledge management competency: knowledge codification and decision support strategies play roles here.

The liability is supported by the reliability management competency: here we are moving away from the technology issues, and more directly into the people issues.
This slide is more of a recap. In this talk, we invested time focused on the achievement of reliability. We used Coumadin ordering to illustrate knowledge delivery. We talked about human factors in general and showed how anticipation could translate knowledge forward. We showed how this could simultaneously make an application easier to use and more reliable at the same time. We also contrasted these approaches with traditional interface designs typical of the late 1990s. In doing so, we showed a clear picture of the limitations of portal wrapper technology, as compared with deeper integration models.

In the knowledge and information areas, we reviewed the sheer number of observations relating to the critical nature of implementation planning, current state assessment, and the re-factoring work necessary to reconcile semantics.
We illustrated knowledge delivery through the Coumadin ordering dialog.
KNOWLEDGE DELIVERY

Patient-specific, Coumadin-specific Management Form

Recommended Course of Action Considerations Form
Information design for reliability management is a big topic.

We weren’t able to talk much about “deep smarts”, a topic described by Dorothy Leonard and Walter Swap. In short, experts with a lot of experience are able to reach conclusions faster and more reliably than novices using more explicit and overt steps. Because of these kinds of cognitive differences, and because of cognitive preferences, an information system must allow individuals to personalize their forms and interactions to meet their information needs.
One of the implications of using forms to reframe data to create information and knowledge is that a variety of mechanisms can be helpful to find and select relevant forms.

Static lists of forms, such as the one shown here, are very useful. They work identically to a favorites list in a web browser.

Dynamic lists of forms, such as the order set options in the Coumadin example, are very useful in a different way. In contrast to the static lists, dynamic lists are responsive to patients' characteristics. Also, they now make lists that can be offered and maintained by third parties and similarly invoked by patient characteristics. This has the characteristic of finding and exploiting the "teachable moment."
Remember the Brigham and Women’s Hospital medication management process? If you’ll recall, there were approximately 40 steps in that process. If each step had a 1 in 1000 error rate, then, as shown in the table on the slide, there is a 3.9% probability of failure associated with each administration of IV medication.

Take homes:
Train people, staff at right levels, establish safe practices: best is 96% success.
Reduce steps through automation: CPOE, Bar Codes, eMAR: best maybe 98%.
Conservative studies looking for ‘harm’ find many hospitals are in 10-20% today.
Eliminating the final 2/1000 errors is all based on people and processes.
THE HUMAN FACTOR

How frequently do we make errors?

- Omission Errors, 1 Per 100 Times
- Commission Errors, 3 Per 1000 Times
- 90% Risk of judgment errors under high stress

Salvendy

If that last slide wasn’t sobering enough, here is some additional data on the rate at which humans make errors. The notes below represent examples of the error types shown above.


Errors of commission:
- inappropriate or outmoded therapy
- technical surgical error
- inappropriate medication
- error in dose or use of medication

Errors of omission:
- failure to take precautions
- failure to use indicated tests
- avoidable delay in diagnosis
- failure to act on results of tests
- inadequate follow-up of therapy

Leap, NEJM 1991; 324 : 377
This slide shows the following: safe human behavior and practices are described by the lower left hand corner of this graph. Humans are wired to take shortcuts and exceed the speed limit to get done sooner. After a point, this goes from being unsafe to very unsafe.

Based on the theories of Tonya Hongsermeier, MD, MBA, the challenge of task interference is deeper than it appears at the surface. Each of us has a “cognitive preference” as described by Meyers and Briggs Type Inventory (MBTI); when we act discordant with our preference, we expend more energy and regard the behaviors as unpleasant. In the Judging-Perceiving axis, each of us has a preference for adherence to structure, or it’s opposite, living life in a more carefree manner. When someone with the latter cognitive preference finds themselves juggling a larger than usual number of tasks (i.e. being more productive), they are less likely to make and use checklists to assure thoroughness. This makes accidental oversights more likely. There are other intrinsic cognitive preferences with similar negative implications, such as introversion and reluctance to communicate adequately, with the “too busy to communicate” representing a drag to the right in this diagram.
COMMUNICATION . . .
AND SENTINEL EVENTS

▪ Breakdowns in communication were the primary root cause of over 60% of the 2034 sentinel events analyzed

▪ Of these sentinel events, 75% resulted in a patient death

Source: JCAHO

Communication Redesign is an important dimension in achieving reliability. We’ve talked extensively about system-to-human communication, in the ROZO example, the Coumadin example, and the description of using ‘information forms.’

It’s noteworthy that human-to-human communication breakdowns are a well recognized contributor to failures.
EFFECTIVE COMMUNICATION

Example – The SBAR Situational Briefing Model

- Situation – Identification
- Background – Pertinent information
- Assessment – Based upon knowledge and experience
- Recommendation – Action items

One technique to address this class of failures is the SBAR model. It has been presented at many JCAHO meetings because its absence is associated with poor communications. SBAR is based on a succinct and stylized communication processes.

A related method is using code words within the recommendations to ask for help in front of a patient or patient’s family without arousing a potentially undue degree of concern.
Similarly, the Joint Commission and other several other organizations have been studying and/or disseminating information on the impact of staffing levels on reliability. Several studies have shown significant correlation between proper staffing and higher reliability.
In summary, these are the attributes of using an information model to enable high reliability practices.
Summary.
LEARNING OBJECTIVES

Learning Objective 1
- Define the characteristics of a High Reliability Organization, and understand the rationale and methodology to implement them.

Learning Objective 2
- Define the critical components in the EHR architecture necessary to achieve high reliability.

Learning Objective 3
- Understand the steps required to transform your operations to be safer and less failure prone.

Summary
RELIABILITY PLANNING DISCIPLINE

Focusing on forms, model, interaction, inventories and re-design:

- Reduce/eliminate task steps – anticipate needs
- Support the team – prescribe safe practices, ease use, training, adequate devices
- Reduce omission and commission errors
- Standardize desired practices
- Bound critical processes
- Respect remaining autonomy – personalize, decentralize control
- Be mindful of unintended consequences

Summary of implications.
HIGH RELIABILITY ORGANIZATIONS

Manage complexity and the unexpected with these characteristics:

Anticipating
- Preoccupation with Failure
- Reluctance to Simplify Interpretations
- Sensitivity to Operations

Containing
- Commitment to Resilience
- Deference to Expertise

Weick and Sutcliffe

Summary restatement of HRO characteristics.
There Is No Enterprise-Wide High Reliability Organization in the United States.

Don Berwick, MD
THANK YOU

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Supplementary Reading:


Tools and Resources:

IHI.ORG

WWW.AHA.ORG