Failure to Rescue:  
*Bedside Patient Rescue A Great Opportunity*

April 20, 2017  
Webinar Month 101

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Welcome

Charles Denham, MD
Chairman, TMIT
TMIT High Performer Webinar
April 20, 2017
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Chasing
WINNING THE WAR ON HEALTHCARE HARM

Chasing Zero™: Winning the War on Healthcare Harm
Join Dennis Quaid and Dr. Charles Denham as they document the dangers in healthcare, as well as the leaders and practices that are winning the war on healthcare harm.

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We are undertaking high impact research activities in the fields of Imaging of Adults and Children, Pain Care, Back Care, Testing, and Surgery to convert Waste to Value and Harm to Healing. For more information on each collaborative, click Imaging, Imaging Children, Back, Pain, Testing, Cancer, or Surgery.

Surfing the Healthcare Tsunami Hospital Leaders Toolbox
The Surfing the Healthcare Tsunami Hospital Leaders Toolbox has been released online! Go deeper into the subject matter of the documentary by exploring the 5 Rights of Imaging™, the Boardroom, Racing & Aviation, and much more. Click here for more details.

Click here to watch the entire 53-minute documentary online.
High Performer Webinar

April 20, 2017, 12:00 pm – 1:30 pm CT / 1:00 pm – 2:30 pm ET

Failure to Rescue: Bedside Patient Rescue – A Great Opportunity

Session Overview

Failure to Rescue, according to Dr. Jeanne Huddleston, the leading researcher in mortality reviews at the Mayo Clinic, is one of the most common “Opportunities for Improvement” and a great area to have impact. Opportunities of omission have been identified as a major interest area of our research test bed through multiple surveys. She will introduce the topic and lead our discussions.

Dr. Santiago Romero-Brufau of the Mayo Clinic, will present the Bedside Patient Rescue program developed from the information yielded by mortality reviews as a great opportunity for performance improvement. A reactor panel of patient advocates and experts will react to the presentation.

We offer these online webinars at no cost to our participants.

Webinar Video and Downloads

The webinar video will be available within five business days after the webinar airs.

Speaker Slide Sets:
If you wish to follow us on Twitter, go to: http://twitter.com/TMIT1 or use #safetyleaders hashtag

Also, go to: www.facebook.com/SafetyLeaders and related sites
Our Purpose:
We will measure our success by how we protect and enrich the lives of families...patients AND caregivers.

Our Mission:
To accelerate performance solutions that save lives, save money, and create value in the communities we serve and ventures we undertake.
Disclosure Statement

The following panelists certify:
that unless otherwise noted below, each presenter provided full disclosure information; does not intend to discuss
an unapproved/investigative use of a commercial product/device; and has no significant financial relationship(s) to
disclose. If unapproved uses of products are discussed, presenters are expected to disclose this to participants.
None of the participants have any relationship medication or device companies discussed in their presentations.

Jeanne M. Huddleston, MD, FACP, FHM, is a past President of the Society of Hospital Medicine, the founder of Hospital Medicine and past Program Director of the Hospital Medicine Fellowship at Mayo Clinic, Rochester, MN. She is Chairperson of Mayo Clinic's Mortality Review Subcommittee, a multi-disciplinary group of providers that review every death in search of where the health care delivery system may have failed the providers and/or the patient. She has nothing to disclose.

Santiago Romero-Brufau, MD, started his university training in Aeronautical Engineering, and went on to study Medicine, completing his MD in 2012. During that time he also interned in several of the leading molecular biology labs in Europe. He soon after joined Mayo Clinic as a post-doc to Dr. Jeanne Huddleston. The main focus of his work has been in predictive analytics and its implementation, in particular focusing on the prediction of inpatient physiological deterioration using machine learning, developing and implementing the Mayo Clinic Early Warning Score (MC-EWS). He is currently dual Assistant Professor of Medicine and Healthcare Systems Engineering at the Mayo Clinic College of Medicine and Science, and a Research Associate at the Mayo Clinic Center for Innovation. He has nothing to disclose.

Gregory H. Botz, MD, FCCM, is a professor in the Department of Critical Care at the UT MD Anderson Cancer Center. He received his medical degree from George Washington University School of Medicine in Washington, DC. He completed an internship in internal medicine at Huntington Memorial Hospital and then completed a residency in anesthesiology and a fellowship in critical care medicine at Stanford University in California. He also completed a medical simulation fellowship at Stanford with Dr. David Gaba and the Laboratory for Human Performance in Healthcare. Dr. Botz is board-certified in anesthesiology and critical care medicine. He is a Fellow of the American College of Critical Care Medicine. He has nothing to disclose.

Charles Denham, MD, is the Chairman of TMIT; a former TMIT education grantee of CareFusion and AORN with co-production by Discovery Channel for Chasing Zero documentary and Toolbox including models; and an education grantee of GE with co-production by Discovery Channel for Surfing the Healthcare Tsunami documentary and Toolbox, including models. HCC is a former contractor for GE and CareFusion, and a former contractor with Siemens and Nanosonics, which produces a sterilization device, Trophon. HCC is a former contractor with Senior Care Centers. HCC is a former contractor for ByoPlanet, a producer of sanitation devices for multiple industries. He does not currently work with any pharmaceutical or device company. His current area of research is in threat management to institutions and continuing professional education and consumer education. Dr. Denham is a collaborator with Professor Christensen.
Speakers and Reactors

Jeanne Huddleston
Santiago Romero-Brufau
Gregory Botz
Jennifer Dingman
William Adcox
Voice of the Patient and Family

Jennifer Dingman

Founder, Persons United Limiting Substandards and Errors in Healthcare (PULSE), Colorado Division
Co-founder, PULSE American Division
TMIT Patient Advocate Team Member
Pueblo, CO

TMIT High Performer Webinar
April 20, 2017
In the News and National Survey Highlights:

News Update and

March 2017 Webinar National Survey

Charles Denham, MD
Chairman, TMIT
TMIT High Performer Webinar
April 20, 2017
Reuters recently worked with the Centers for Disease Control and Prevention to scan the text of death certificates for clues about deaths linked to resistant bacteria. Their findings were startling: **between 2003 and 2014, there were 180,000 such deaths.**

Alcohol-related deaths apparently go undocumented, too. One analysis of death certificates from 1999 to 2009 found that, officially, only about 3 percent of traffic deaths were linked to alcohol—**yet national traffic safety records indicate the number was seven times greater.** A recent study published in BMJ suggested that **weak coding on death certificates allows medical errors to remain hidden when they should be recognized as the third leading cause of death in the U.S.** (The CDC disputes that number and maintains that most underreporting of errors stems from litigation concerns or reluctance to admit wrongdoing.)

Once we have better information on the causes of death, we can make better decisions about when and how to spend our research and health care dollars. Understanding what kills us will help keep us healthier.

The Zero Hero Consumer Survey was commissioned by Nationwide Children's Hospital and conducted by Harris Poll. In all, 2,018 adults were surveyed across the United States, 542 of whom were parents of a child under 18.

The results revealed both a high level of confidence in those who care for children in the hospital setting, yet a continued concern over accidents and mistakes.

Ninety three percent of respondents agree that hospital staff, including physicians, nurses and technicians, are well-prepared to handle medical emergencies involving children. Nearly as many (91 percent) say they would trust hospitals to care for their child should the need arise.

But there are some reservations. Nearly 40 percent of those surveyed say they are somewhat to very concerned that their child might be injured in a fall during their hospital stay, or that their child will get sick due to medication errors made by medical staff members.

More than half (53 percent) say they are somewhat or very concerned about their child developing an infection in the hospital following surgery.

Their concerns are certainly justified. Hospital-acquired conditions affect patients of all ages, at times with devastating consequences. In fact, about 1 in 25 patients acquires an infection in the hospital every day, and too many are fatal …

It is unacceptable that medicine is ever considered dangerous or that errors are considered routine – we all must reach for a higher standard, and for the sake of our children, strive to become Zero Heroes – it takes a heroic effort to achieve zero harm, and we can do it by working together toward this common goal.

Authority analysts found that HIT-related errors occurred during every step of the medication use process and further, a majority of errors reached the patient. High-alert medications (i.e., medications that bear a heightened risk of patient harm if used in error) such as opioids, insulin, and anticoagulants, comprised three of the top five drug categories involved in most events.

"We can examine HIT system failures for both human and system errors. Conducting a root-cause analysis when errors occur, developing a strong culture of safety in which workers feel empowered to report unsafe conditions, and routine HIT system surveillance are just a few approaches to reducing HIT related medication errors. We can also learn from systems that work well," says Dr. Ellen Deutsch, medical director for the Authority.

Opioid overdose deaths are at a record high in the U.S., and deaths from prescription painkillers, including oxycodone, hydrocodone and methadone, are implicated in almost half of all cases. Less well known is the fact that 

**benzodiazepines, such as Xanax and Valium**, prescription tranquilizers used to treat anxiety, insomnia and seizures, are involved in about **30 percent of those prescription opioid deaths**, perhaps due to deadly interactions.

Even though it’s well known that opioids and benzodiazepines can have potentially dangerous interactions when taken together, and the U.S. Centers for Disease Control and Prevention recommends against taking both at the same time, a new analysis by researchers at Stanford University School of Medicine shows that doctors are prescribing them together at increasing rates. In 2001, 9 percent of opioid users also filled prescriptions for benzodiazepines, and that increased to **17 percent in 2013**.

If doctors can stop prescribing both drugs at the same time, the U.S. will see at least a **15 percent reduction of overdoses that result in hospitalization**, according to the Stanford study, and this applies to people who use opioids long term or occasionally.

Source: Almendrala A. This Prescription Drug Is Implicated In Almost A Third Of All Opioid Overdose Deaths. The Huffington Post. 2017 Mar 15. Available at http://www.huffingtonpost.com/entry/opioid-overdoses-combination-benzodiazepine_us_58c83e16e4b01c029d76f5ad
In The News …

Opioid and heroin overdose antidote, Naloxone, can solve these problems if it was made available over-the-counter. Good thing for Pennsylvania and New Jersey citizens, Acme pharmacy has made Narcan Nasal Spray easy to buy even without a doctor's prescription. There are about 96 Acme pharmacies in Pennsylvania and New Jersey who have made it available, reported NJ.com. Not only them but also Walgreens, which started selling the drug over-the-counter a year ago, is selling it.

Experts all over the country are working to make Naloxone's availability easier to the public like the law enforcements, fire fighters, first responders, departments of health, local school districts, colleges, community-based organizations and homeless shelters. "No area of this country is safe from this epidemic," said Jennifer Plumb, a doctor from Salt Lake, Utah. Utah ranked as 7th highest in the U.S. for the rate of opioid overdose deaths stated Yahoo.

On its second day of deliberations, the jury in Harrisburg, Pa., found Graham B. Spanier [Former President of Penn State] guilty of one misdemeanor count, punishable by up to five years in prison and a $10,000 fine. He was also found not guilty of two felony charges, for his handling of allegations against Jerry Sandusky, a former assistant coach.

Mr. Sandusky was convicted in 2012 of sexually abusing 10 young boys and was sentenced to 30 to 60 years in prison. In 2013, Penn State agreed to pay $59.7 million to 26 sexual abuse victims in exchange for an end to their claims against the university.

“College administrators have been put on notice that if you know an employee is sexually assaulting people and you leave them in place, you could be held responsible, including legally responsible,” said John D. Foubert, a professor of higher education at Oklahoma State University who has written extensively on campus sexual assault.

The count on which Mr. Spanier [Former President of Penn State] was convicted was charged as a felony, but the jury instead chose to convict him of the misdemeanor version of it. The jury acquitted him of another felony count of child endangerment, and a charge of conspiracy, also a felony.

“Science had changed. It was global and interconnected. Questions about reproducibility had bubbled up. And it was increasingly clear that issues about proper conduct of research weren’t isolated to the individual labs, but influenced by a continuously evolving academic, publishing, and funding environment.

• “We’ve been fond of the ‘BAD APPLE’ narrative, and we’re talking about switching to the BARRELS AND BARREL MAKERS”

• "We're not just talking about misconduct here, which is formally defined in the U.S. as fabrication of data, falsification or plagiarism," said committee member

• "We recognize there's a fuller range of behavior that we refer to as detrimental research practices."

Source: National Academy of Sciences, Fostering Integrity Report 2017
Misconduct Definitions:

- **Research Misconduct:** Research misconduct is defined as fabrication, falsification, or plagiarism in proposing, performing, or reviewing research, or in reporting research results. (Research misconduct does not include honest error or differences of opinion.)
- **Fabrication:** This comprises the creation of false data or other aspects of research, including documentation and participant consent.
- **Falsification:** This comprises the inappropriate manipulation and/or selection of data, imagery and/or consents.
- **Plagiarism:** This comprises the misappropriation or use of others’ ideas, intellectual property or work (written or otherwise), without acknowledgement or permission.

Retractions Due to Fraud and Misbehavior:

Other recent research has examined retractions of scientific articles in journals (Fang et al., 2012; Steen et al., 2013; Grieneisen and Zhang, 2012). Articles may be retracted for a number of reasons, including unintentional errors on the part of authors or publishers as well as research misconduct. One recent analysis that focused on articles contained in the PubMed database found that more than TWO-THIRDS of retractions were due to misconduct defined as Fabrication, Falsification, or Plagiarism (Fang et al., 2012). Another analysis that examined retractions of articles in a variety of databases that collectively covered all disciplines between 1980 and 2011 found that 17 percent of the 3,631 retractions in which a cause was identified were due to data fabrication or falsification, and 22 percent were due to plagiarism (Grieneisen and Zhang, 2012).
Fostering Integrity in Research: The Cost of Harm From Misbehavior

Source: National Academy of Sciences, Fostering Integrity Report 2017
Top 10 Patient Safety Concerns for Healthcare Organizations 2017

ECRI’s Top 10 Patient Safety Concerns

1. Information management in EHRs
2. Unrecognized patient deterioration
3. Implementation and use of clinical decision support
4. Test result reporting and follow-up
5. Antimicrobial stewardship
6. Patient identification
7. Opioid administration and monitoring in acute care
8. Behavioral health issues in non-behavioral-health settings
9. Management of new oral anticoagulants
10. Inadequate organization systems or processes to improve safety and quality

I am interested in ECRI PATIENT SAFETY CONCERNS for 2017.

92% Agreed and 77% Strongly or Very Strongly Agreed, and 67% Very Strongly Agreed

March 16, 2017 National Survey

ECRI PATIENT SAFETY CONCERNS
topics I would like to be covered first include:

- Behavioral health issues in non-behavioral-health settings
- Management of new oral anticoagulants
- Unrecognized patient deterioration
- All
- All ten of these concerns
- Communication and transition coordination
- Communication barriers among physicians resulting in poor management of care and how to address the problem.
- Delayed recognition of deteriorating patients
- Discharging patient with poor vital signs for the last reading
- EHR
- EHR
- Event identification
- Failure to rescue
- Failure to rescue and opioid overdose
- Getting more patients to be aware of end of life paperwork.
- Healthcare violence
- How do we protect our patients from outside threats, i.e. Individuals posing as family members
- I have received the ECRI publication. I would be interested in infusion errors
- Inadequate organization systems or processes to improve safety and quality - tension between patient safety and risk management/legal
- Initiating a systems approach to enhancing patient safety
- More information regarding address system reviewing as opposed to traditional peer review.
- More on mortality review and strategies used to decrease mortality
- Pediatric medication safety
- Preventable deaths from the community to after-care
- Restraints; just culture; fostering change
- Testing and how to educate the public
- Unrecognized deterioration
- Work place violence; high reliability; opioid abuse; science of addiction

Mayo Clinic Mortality Reviews

Jeanne M. Huddleston, MD, FACP, FHM
Hospitalist
Chair of Mortality Review Subcommittee
Mayo Clinic
Rochester, MN
January 2017

Omission vs. Commission
An Anonymous Survey was conducted to gauge interest in FAILURE TO RESCUE performance improvement topics. The results showed that 95% of respondents agreed, with 81% strongly or very strongly agreeing, and 64% very strongly agreeing.
FAILURE TO RESCUE topics I would like to be covered first include:

- Any
- Best strategies to identify when to rescue - early identification and best communication practices when identified
- Changes outside of the ICU - recurrence of sepsis, stroke
- Delirium vs. Other pathological conditions resulting in increased LOS and increased utilizations of higher level of cares
- Detection of deterioration
- Early warning systems effectiveness
- ETOH withdrawal, BIPAP issues
- Failure to control glucose levels
- Failure to recognize sepsis on general med/surgery unit
- Identifying sepsis
- Liability Opioid use
- Overcrowding and management of patients
- Pharmacovigilance
- Sepsis
- Sepsis
- Sepsis programs
- Sleep apnea treatment after procedures
- Unsure
- Updated protocols for SEPSIS, STEMIS, etc.

Anonymous Survey Questions

I am interested in TRIAGE and MISSED DIAGNOSIS performance improvement topics.

94% Agreed and 69% Strongly or Very Strongly Agreed, and 63% Very Strongly Agreed

TRIAGE and MISSED DIAGNOSIS topics I would like to be covered first include:

- AAA
- All
- Care in the ED
- Diagnosing the people with advanced age
- Early sepsis
- ED lobby overflow - hallway beds; MD does not listen to nurse; the art and theory of unknowing so as not to miss things - listen to patients
- Ethics in testing vs. Wasting resources
- Hand-off, communication
- How to improve hand offs of care which often lead to miss diagnosis
- Lab results, miss-read pathos. slides
- N/a
- Results of missed diagnosis about limes disease
- Sepsis
- Sepsis
- Sepsis core measure failure and mortality
- SEPSIS, delirium/dementia in elderly surgical patients.
- Sepsis, improvement strategies for early identification and treatment.
- Stroke

A **Medical-Tactical Approach** undertaken by clinical and non-clinical people can have enormous impact on loss of life and harm from very common hazards:

- **High Impact Care Hazards** are frequent, severe, preventable, and measurable.
- **Lifeline Behaviors** undertaken by anyone can save lives.

**The Program:**
- Free afterschool courses for grade three and above.
- Courses for Boy and Girl Scouts, Clubs, and Communities.
- Courses for non-clinical staff and families ideal for healthcare institutions.
- Continuing Education for Clinical Caregivers (CME, CEU, and continuing ed for most caregivers)
High Impact Care Hazards to Patients, Students, and Employees

A National Trauma Care System: Integrating Military and Civilian Trauma Systems to Achieve Zero Preventable Deaths After Injury


Dr. Don Berwick
Chairman
“Whether it’s a vehicle attack in Sweden, a church bombing in Egypt or an elementary school shooting in San Bernardino, the common denominators is that civilians are always there first,” Lichtman said. “We know it’s just a matter of time before this happens again.”
Anonymous Survey Questions

I am interested in helping develop a MED TAC PROGRAM in my community.

56% Agreed and 33% Strongly or Very Strongly Agreed, and 32% Very Strongly Agreed

The topics I would like to know more about starting a MED TAC PROGRAM include:

- Already have a committee going
- Cardiac arrest
- Continued diagnosis and treatment in the ED hold area
- How to begin a med tac program
- How to do it
- How to get my institution and community to understand the need for Med Tac
- If we have a county search and rescue program would they be the ones to oversee/incorporate this program or would it be under our local EMS service?
- Means of organizing misc. Medical personnel for emergency responses from main hospital areas. How can lpn's and medical assistants become part of volunteer, community TAC unit in case of major disasters and national emergencies.
- N/a
- Not qualified to help develop Med Tac program, but interested in every TMIT topic presented
- Not sure, need to learn more overall first
- Not yet
- Opioid crisis; infection prevention
- Public school education
- Workplace violence
Failure to Rescue
What we Learned from Mortality Reviews

Jeanne M. Huddleston, MD, FACP, FHM
Hospitalist Chairperson of Mortality Review Subcommittee
Mayo Clinic Rochester, MN
TMIT High Performer Webinar
April 20, 2017
Our Mortality Reviews and Failure to Rescue Deaths
The Mayo Story

Jeanne M Huddleston, MD, MS
Associate Professor of Medicine
Chair, Morbidity & Mortality Council
Associate Medical Director, Department of Development
Mayo Clinic, MN, USA
Annual Patient Encounters

Total clinic patients: 1,260,000
Hospital admissions: 131,000
Hospital days: 608,000
Employees: > 60,000
St Marys Campus, Mayo Clinic Hospital
14 years of learning about process of care failures….

SPECIAL ARTICLE

Learning From Every Death

Jeanne M. Huddleston, MD,*† Daniel A. Diedrich, MD,§ Gail C. Kinsey, RN,||
Mark J. Enzler, MD,‡ and Dennis M. Manning, MD*

The concepts of peer review and the venerable morbidity and mortality conference are familiar improvement approaches to health care providers. These 2 entities are typically provider or patient centric and are not typically extended within hospitals and health systems as a tool for organizational learning for care process or system failures. Out of a desire to deepen our understanding and accelerate learning about quality and safety opportunities in our hospitals, Mayo Clinic embarked on journey to analyze the stories of all patient deaths. This paper illuminates the lessons learned through the development and evolution of the Mayo Clinic Mortality Review System (Rochester, MN).

Guiding principle of Mayo Clinic Mortality Review System:
“No one should ever suffer or die as the result of process of care or system failure.”
Original Charge from Hospital Leadership

1. To create a meaningful mechanism to review deaths at MCR hospitals:
   • Thoroughly understandable
   • Measurable
   • Improvable

2. To identify and quantify unanticipated deaths

3. To identify rate of adverse events in patients who die in MCR hospitals

4. To classify and quantify system level changes which will improve mortality rate.
Compare and Contrast

Peer Review

Problem identified → Reviewed and discussed by peers → Individual contributes

Safety Learning System

Patient is a member of a cohort of interest → Reviewed and discussed by group of multi-disciplinary and multispecialty practicing providers → Opportunity identified → Learning shared broadly
Omission vs. Commission
Example: delayed diagnosis of sepsis & delayed recognition of a postoperative complication

- 59 year old female underwent TAH
- POD #3 – AKI, urinary retention with new abdominal distension and pain
- POD #4 – AKI worse, significant abdominal pain – narcotics stopped. Episode of PAF (130’s)
- POD #5 – hypotensive (70/45) with diaphoresis and nausea
- RRT called but no blood pressure on their arrival
Example of missed opportunity for monitoring after treatment

- 56 year old female with uncontrolled diabetes and poor compliance presents to ED via ambulance with weakness.
- \( K > 8 \)
- Treated with single doses of insulin, calcium, bicarb, glucose, Kayexelate
- No repeat labs
- 4 hours later coded in CT scanner
RR 62.1
FTR
death
Case Example

55-year-old male with CLL with MUD peripheral blood stem cell transplant 7/10 (2 months before). Dismissed 9/14

Labs:
Hb: 7.1, Leukocytes: 2.3
Creat (9/29): 3  (2-month baseline): 1.6

Trend

- Pulse Rate
- NIBP-Systolic
- Respiratory Rate

Clear change in physiologic state
Met RRT Criteria
RRT called

44 hours
27 hours

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Hybrid HSE and Practice Model

- Quality, Research and Clinical Leadership
- Requirements
- Analytics
- Systems Architecture
- Clinical Verification & Validation
- Clinical Pilot Team
- Clinical Integration & Diffusion Team

Reengineering/Planning Phase
- Failure Modes and Effect Analysis, Data mining, Predictive analytics, Financial Effect Analyses
- Workflow analyses & Simulation Modeling

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<th>Reengineering/Planning Phase</th>
<th>Implementation Phase</th>
<th>Diffusion Phase</th>
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<td>Iterative DMAIC steps</td>
<td>Mayo Clinic Model of Diffusion</td>
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Research

Practice
Deterioration

Observation  →  Detection  →  Notification  →  Recognition  →  Facilitation  →  Communication  →  Intervention

MERT
YES, WE CAN!

BLAZE rule (Kirkland)
ICU and ED sepsis sniffer (Gajic)
Enterprise Simulation
Remote Monitoring

Resuscitation
Top 5 Failure Modes (>2000 providers)

1. The patient's **clinical condition is not re-assessed at the bed**side following new interventions (medication, fluid bolus, tests results).

2. Care providers of all types can feel that there are **too many complex things to do** in a short period of time.

3. A **physician does NOT review nursing notes** documented in the electronic medical record.

4. Care team attributes a patient's acute physiological deterioration to the **wrong cause**.

5. Some care providers (nurses or physicians) believe that a **standard, or clear definition of acute patient deterioration does NOT exist**.
Top 5 Failure Modes (New Zealand)

1. **Physician team structure/hierarchy** is difficult to navigate for escalation of care.

2. Care providers of all types can feel that there are **too many complex things to do** in a short period of time.

3. A care team dismisses an openly stated patient or family concern.

4. A physician or nurse may NOT call the RRT, even when the patient is meeting calling criteria, because he/she believes the **clinical calling thresholds are not relevant** to their patient.

5. A **physician does NOT review nursing notes** documented in the electronic medical record.
Top 5 Failure Modes (Australia)

1. Care providers of all types can feel that there are **too many complex things to do** in a short period of time.

2. A **physician does NOT review nursing notes** documented in the electronic medical record.

3. Even when patient continues to deteriorate, nurses do not call the MET because the **physician care team is at the bedside ordering interventions**.

4. The patient's **clinical condition is not re-assessed at the bedside** following new interventions (medication, fluid bolus, tests results).

5. A physician or nurse may NOT call the RRT, even when the patient is meeting calling criteria, because he/she believes the **clinical calling thresholds are not relevant** to their patient.
Hybrid HSE and Practice Model

Quality, Research and Clinical Leadership

Requirements
Analytics
Systems Architecture
Clinical Verification & Validation
Clinical Pilot Team
Clinical Integration & Diffusion Team

Reengineering/Planning Phase

| Failure Modes and Effect Analysis, Data mining, Predictive analytics, Financial Effect Analyses | Implementation Phase | Diffusion Phase |
| Workflows analyses & Simulation Modeling | Iterative DMAIC steps | Mayo Clinic Model of Diffusion |

Research

1

Practice

2

3
Bedside Patient Rescue at the Mayo Clinic

Santiago Romero-Brufau, MD

Assistant Professor of Medicine and Healthcare Systems Engineering
Mayo Clinic College of Medicine and Science
Research Associate
Mayo Clinic Center for Innovation
Rochester, MN

TMIT High Performer Webinar
April 20, 2017
The Mayo Clinic Early Warning Score and the Bedside Patient Rescue Project

BPR Project Team
Santiago Romero-Brufau, MD
Jeanne M. Huddleston, MD MS

TMIT Webinar
April 20th
Our solution

• Some set of objective criteria to help with detection of deterioration.

• Standardized response with time-limited escalation of expertise to the bedside.
Building the Golden Gate
Safety net
Halfway to hell club
Well, what is in the literature?
What is an Early Warning Score

- Set of objective criteria
- Helps identify patient deterioration.
- There’s more than 70 of them, all very similar.

### MEWS (Modified Early Warning System)

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<td></td>
<td>More</td>
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<td></td>
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<tr>
<td>Conscious level (AVPU)</td>
<td>Unrespon</td>
<td>Responds</td>
<td>Responds</td>
<td>Alert</td>
<td>New agitation</td>
<td></td>
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<tr>
<td></td>
<td>sive</td>
<td>to Pain</td>
<td>to Voice</td>
<td></td>
<td>Confusion</td>
<td></td>
<td></td>
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<tr>
<td>Temperature (°C)</td>
<td>Less</td>
<td>Less</td>
<td>Less</td>
<td>Less</td>
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<td></td>
<td>35.0</td>
<td>35.1-36</td>
<td>36.1-38</td>
<td>38.1-38.5</td>
<td>More</td>
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<td>than</td>
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</tr>
<tr>
<td>Hourly Urine For 2 hours</td>
<td>Less</td>
<td>Less</td>
<td>Less</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>than</td>
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<td>than</td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>10 ml / hr</td>
<td>30 ml / hr</td>
<td>45 ml / hr</td>
<td></td>
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</tr>
</tbody>
</table>

Early Warning Scoring to detect adult patients who have or are developing critical illness:
- Is the score in your patient 1-2?
- Is the score of your patient 3?
- "If the MEWS is deteriorating: the doctor must attend"
- Is the score of your patient 4 or more?
- perform 2 hourly observations and inform nurse in charge
- perform 1-2 hourly observations and inform nurse in charge
- perform observations every 30 mins ensure medical advice is sought
- and contact urgent care team
Why we needed to develop our own EWS
Detection with a warning system tool

MEWS

What area would we want an ideal EWS to be?

![Graph showing sensitivity vs. alerts per week per 10 patients]

- A
- B
- C
- D

MEWS

Sensitivity

Alerts (per week per 10 patients)
Detection with a warning system tool
Widely used EWS

Widely used EWS are not very accurate

Graph showing the number of alerts per week per 10 patients against sensitivity. The graph compares different EWS systems, including GMEWS, MEWS, SEWS, NEWS, Kirkland, Worthing, and ViEWS. The data points indicate that these systems have varying degrees of sensitivity, with some systems showing lower sensitivity and higher alert frequencies.
Detection with a warning system tool

MEWS

The ideal EWS has a high sensitivity, and a low number of alerts.

MEWS is not very accurate

- Alerts (per week per 10 patients)
- Sensitivity

MEWS Threshold
Detection with a warning system tool

MEWS

The ideal EWS has a high sensitivity, and a low number of alerts.
How we developed the Mayo Clinic Early Warning Score (MC-EWS)
1) We created the best possible model

- All variables we could think of
  - Vital signs
  - Laboratory results
  - Urine output
  - Nursing assessments
  - Medications (including fluids)

- Creating interaction terms based on clinical knowledge
  - Shock index = heart rate / systolic blood pressure
  - Maximum shock index in the last 24h
  - Respiratory index = (RR-10)/(SpO2-70)
  - ...

- Using machine learning
How a “gradient boosted machine” builds a model
2) We balanced prediction improvement and programming effort

- Through meetings with Blaze programmers
Why the Mayo Clinic Early Warning Score (MC-EWS) is better
## Elements of the algorithms

<table>
<thead>
<tr>
<th>MEWS</th>
<th>MC-EWS</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 variables: 4 Vital signs, mental status, and urine output</td>
<td>60 data elements (vitals, labs, patient’s condition, nursing assessment, etc.)</td>
</tr>
<tr>
<td>NO interaction terms</td>
<td>~60 Interaction terms (e.g. hemoglobin and heart rate)</td>
</tr>
<tr>
<td>NO variables over time</td>
<td>Variables over time</td>
</tr>
</tbody>
</table>
Kirkland score

\[= -0.5238 + (0.8639 \times \text{Shock index}) + (-0.0998 \times \text{Braden}) + (0.0814 \times \text{Respiratory rate}) + (-0.0275 \times \text{SpO2})\]

Respiratory index

\[= \frac{RR - 10}{SpO2 - 70}\]

Shock index

\[= \frac{\text{heart rate}}{\text{systolic BP}}\]
And... the Factor Score

• Nurses knew “something was not right” before deterioration.

• Pattern recognition is described in the psychology scientific literature.

• It could increase accuracy of detection/prediction.
Psychology has something to say…
Two systems in the brain

• System 1
  • Recognizes patterns
  • Unconscious
  • “Black box”

• System 2
  • Effortful
  • Logical thinking
Intuitive expertise

• To develop “System 1” intuitive expertise:
  • Repeated exposure
  • Intentional training
  • Feedback
Worry Factor Score

0- No concern
1- Slight concern
2- Moderate concern
3- Significant concern
4- Extreme concern

Higher potential risk based on history so staying alert, OK now.

Scores 2-4: You believe the patient may be deteriorating.
Worry Factor accuracy

P<0.05 for the comparison between <1 year and >1 year of experience.
Detection with a warning system tool

**MEWS v. MC-EWS v. MC-EWS+FS**

The ideal EWS has a high sensitivity, and a low number of alerts.

**MC-EWS is more accurate than MEWS**

![Graph showing sensitivity and alerts for MEWS, MC-EWS, and MC-EWS+FS]

- Red line: MEWS
- Blue line: MC-EWS
- Green line: MC-EWS + FS

**Axes:**
- **Sensitivity** (0% to 100%)
- **Alerts (per week per 10 patients)** (0 to 30)

**Thresholds:**
- MEWS Threshold
- MC-MEWS + FS Threshold
Detection with a warning system tool

**MEWS v. MC-EWS v. MC-EWS+FS**

The ideal EWS has a high sensitivity, and a low number of alerts.

**MC-EWS is more accurate than MEWS**

The graph shows the comparison of different warning systems (MEWS, MC-EWS, MC-EWS+FS) in terms of alerts (per week per 10 patients) versus sensitivity. The graph indicates that MC-EWS is more accurate than MEWS.
Practice requirement: Sensitive yet Specific

- **MEWS**

240 alerts
Still misses 5 patients

- **MC-EWS**

150 alerts
Deteriorating patient (detected)
Misses 4 patients

- **MC-EWS + Factor Score**

120 alerts
Misses 3 patients

Alerts are for 100 beds over a month.

Legend:
- # Alerts
  - size is proportional to # of alerts
- Deteriorating patient (detected)
- Deteriorating patient (missed)
Overview

• The alarm goes off, now what?
• What would you do?
• What did we do?
• How did we (try to) do it?
• How did we do?
Design decisions

- What score to use
- Push Vs pull system
- Mandated bedside assessment?
- Automated follow-up prompt?
- Automated escalation?
What score to use?

• Accuracy: PPV and sensitivity
• Transparency: is it obvious why a score is high?
Push vs pull

“Pull” system

Dashboard
Least intrusive to workflow
Less timely

“Push” system

Automated alerts
More intrusive
More timely, quicker
Mandated bedside assessment?

Response at provider discretion

Follow-up actively prompted

At discretion
Least intrusive to workflow
Likely to miss patients

Prescribed bedside assessment
More intrusive
More timely, quicker
Follow-up prompts?

Follow-up at provider discretion

At discretion
Least intrusive to workflow
Likely to miss patients

Follow-up actively prompted

Automated alert after 2h
More intrusive
Ensures follow-up
Automated escalation?

Escalation at provider discretion

Call to consultant at discretion

Least intrusive to workflow

Automated alert to consultant after 3h

More intrusive
Ensures escalation
Connotation: police system
Design options

**RECOGNITION**  ➔  **ACTIVATION**  ➔  **INTERVENTION**

**Alert**
- MEWS
- MC-EWS

**Aware**
- “Pull” system
- “Push” system

**Assess**
- Response at provider discretion
- Bedside assessment expected

**Reassess**
- Follow-up at provider discretion
- Follow-up actively prompted

**Escalate**
- Escalation at provider discretion
- Escalation automated
What did we do?

~100 variables
Vital signs
Labs
Assessments

~80%

MC-EWS +FS
“Push” system

Calculates every 15’

Patient at risk
Alert Through paging system

Patient NOT at risk

~20%

Nursing Factor Score
What did we do?

- Time-limited escalation of expertise to the bedside
What did we do?

• Intentional Design from the FMEA
  • The patient's **clinical condition is not re-assessed at the bedside** following new interventions
  • Care providers of all types can feel that there are **too many complex things to do** in a short period of time.
  • Care team attributes a patient's acute physiological deterioration to the **wrong cause. This may result in incorrect treatment choices** and a delay in the appropriate care.
  • **Uncertainty and variation amongst providers** of how and when to respond to acute patient needs.
  • Care team **fails to recognize subtle changes in vital sign trends** over time.

Follow-up actively prompted

Automated escalation

“Push” system
Simulation center

- We tested the alerts in the simulation center
- Feedback after the session
How did we (try to) do it?

| A | Morbidity and Mortality Subcommittee
   | Deaths with failure to rescue |
| D | Participation in development of factor score
   | Response cascade focus group |
| K | LMS (Online Module) including embedded Q&A
   | Multidisciplinary debriefs (video vignettes) |
| A | Weekly touch-points on unit after go-live
   | Face validity and break fixes |
| R | Sharing of metrics |
Pilot results
How did we (try to) do it?

- Quasi-experimental time series study design

Feb 2          May 16          Nov 29

Dom5D          Jo3B

June 20

Ei52 & Ei62    Fr1C & Fr2C

August 29

Dom3D          Jo3G
How did we do?
The Bedside Patient Rescue Pilot

• Primary outcome metrics
  • Time to provider involvement (measured by order entry)
  • Time to therapy (oxygen, fluid, med) order
    • Process metric
    • Hard to measure non-event, appropriateness
    • Some instances in which time is of the essence (e.g., sepsis, MI, CVA)
How did we do?
The Bedside Patient Rescue Pilot

• Primary outcome metrics
  • Time to provider involvement: 23 min earlier
    • 40% relative decrease; pre-post; difference-in-differences
How did we do?
The Bedside Patient Rescue Pilot

• Primary outcome metrics
  • Time to therapy order entry: 50 min earlier
    • 47% relative decrease; pre-post; difference-in-differences

47% decrease in time
How did we do?
The Bedside Patient Rescue Pilot

• Secondary outcome metrics
  • ICU transfers
  • RRT calls
    • Uncertain “desirable” directionality (counterbalance)
    • Differing trends—confounders? culture?
How did we do?
The Bedside Patient Rescue Pilot

- Secondary outcome metrics
  - ICU transfers

Surgical Units

Medical Unit (HIM, NP/PA)

Medical Unit (GIM, Residency)
How did we do?
The Bedside Patient Rescue Pilot

• Secondary outcome metrics
  • RRT calls

Surgical Units

Medical Unit (HIM, NP/PA)

Medical Unit (GIM, Residency)
The story continues…

• Hospital care delivery platform has endorsed an EWS-enabled environment on general care floors across the enterprise

• Workgroup convened to articulate principles of a response, balancing standardization and customization based on varied staffing models, workflows, etc.
Safety Learning System Collaborative

• Growing group of US and Australian healthcare systems using a standardized method for case review to “diagnose” process and system failures occurring during episodes of patient care

• Case review method developed at Mayo Clinic rooted in reliability and human factor science

• Integration of organizational learning, quality improvement and research

• Cultural reframe – moving away from peer review toward understanding the process failures that allow our colleagues to make mistakes
Safety Learning System Research Collaborative 2016

- Mayo Clinic Rochester
- Regions Hospital/Health Partners, Minneapolis
- Beaumont Health, Michigan
- Sharp HealthCare
- MedStar Health
- University of Mississippi Medical Center
- University of Washington Medical Center
Safety Learning System Research Collaborative 2017

- Aurora Healthcare
- Eastern Maine Healthcare
- Penn State Hershey Medical Center
- State of Tasmania, Australia
- Hoag Hospital System
- Providence Health, Vancouver, Canada
- University of Colorado
- Several others currently in approval process
What Are We Learning and Improving So Far

Sweet fruit

Bulk fruit

Low-hanging fruit

Ground fruit

• **Teamwork and Communication**
  • Chain of command; EHR challenges

• **Missed or delayed diagnosis / treatment**
  • Sepsis; Stroke; Known complications test

• **Protocols**: Abd pain, pre-op work up (Cardiac/delirium)
  • **Recognizing Subtle Signs of Deterioration**
    - Teach graphical trending in EHR
    - Teach systematic critical thinking*

• **Rapid Response Team**
  - Why nurses don’t call?
  - Automate Triggers; Family initiated calls?

• **Advance Illness Management (AIM)**
  - Addressing needs in the ED
  - Reliable access to POLST form
  - Bioethics Team

• **Clinical Documentation Improvement (CDI)**

Join our SLS Collaborative:
We can help you diagnose and treat your
Failure to Rescue opportunities for improvement

“No one should ever suffer
or die as a result of failures
in our systems or processes
of healthcare delivery.”

huddleston.jeanne@mayo.eu @jmhuddleston
Questions & Discussion
National Survey Questions

I am interested in MORE DETAIL ON FAILURE TO RESCUE.

FAILURE TO RESCUE
topics I would like to be FURTHER covered include:
I am interested in FAILURE TO RESCUE performance improvement topics.

FAILURE TO RESCUE topics I would like to be covered first include:
National Survey Questions

I am interested in TRIAGE performance improvement topics.

TRIAGE topics I would like to be covered first include:
Speakers and Reactors

Jeanne Huddleston
Santiago Romero-Brufau
Gregory Botz
Jennifer Dingman
William Adcox
Update Title

Jennifer Dingman

Founder, Persons United Limiting Substandards and Errors in Healthcare (PULSE), Colorado Division Co-founder, PULSE American Division TMIT Patient Advocate Team Member Pueblo, CO

TMIT High Performer Webinar
April 20, 2017