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Electronic Medical Records: From Risks of Errors to Patient Safety Improvement

Moving Patient Safety Into the 21st Century: Measuring Monitoring and Improving Safety in Real Time with EHRs and AI

David Classen MD MS

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A Patient Safety Case in The HIT Era

27 year old women evaluated in the ER for severe lower abdominal pain

Taken to surgery for what was felt to be an acute abdomen

At surgery she was found to be pregnant and the fetus did not survive

On review of the case a problem with interoperability lead to another patients lower abdominal ultrasound report being inadvertently inserted into this patients EHR record

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Can CPOE Cause Errors?

JOBNAME: JAMA XML PAGE: 1 SESS: 22 OUTPUT: Mon Feb 21 08:12:20 2005
/jama/05jobs/weekly/09mar05/joc42133 DATE: 02/18/05 TIME: 15:20 USER: raiken

DRAFT

ORIGINAL CONTRIBUTION

Role of Computerized Physician Order Entry Systems in Facilitating Medication Errors

Ross Koppel, PhD
Joshua P. Metlay, MD, PhD
Abigail Cohen, PhD
Brian Abaluck, BS
A. Russell Localio, JD, MPH, MS
Stephen E. Kimmel, MD, MSCE
Brian L. Strom, MD, MPH

Context Hospital computerized physician order entry (CPOE) systems are widely regarded as the technical solution to medication ordering errors, the largest identified source of preventable hospital medical error. Published studies report that CPOE reduces medication errors up to 81%. Few researchers, however, have focused on the existence or types of medication errors facilitated by CPOE.

Objective To identify and quantify the role of CPOE in facilitating prescription error risks.

Design, Setting, and Participants We performed a qualitative and quantitative study of house staff interaction with a CPOE system at a tertiary-care teaching hospital (2002-2004). We surveyed house staff (N=261; 88% of CPOE users); conducted 5 focus groups and 32 intensive one-on-one interviews with house staff, information technology leaders, pharmacy leaders, attending physicians, and nurses; shadowed house staff and nurses; and observed them using CPOE. Participants included house staff, nurses, and hospital leaders.

Main Outcome Measure Examples of medication errors caused or exacerbated by the CPOE system.

ADVERSE DRUG EVENTS (ADEs) are estimated to injure or kill more than 770 000 people in hospitals annually.[1] Prescribing errors are the most frequent source.[2-5] Computerized physician order entry (CPOE) systems are widely

PEDIATRICS®

Unexpected Increased Mortality After Implementation of a Commercially Sold Computerized Physician Order Entry System

Scott Watson, Trung C. Nguyen, Hülya Bayir and Richard A. Orr

Yong Y. Han, Joseph A. Carcillo, Shekhar T. Venkataraman, Robert S.B. Clark,Richard A Orr.

Pediatrics 2005;116;1506-1512

THE UNI

High Rates of Adverse Drug Events in a Highly Computerized Hospital

ARCHIVES EXPRESS

Jonathan R. Nebeker, MS, MD; Jennifer M. Hoffman, PharmD; Charlene R. Weir, RN, PhD; Charles L. Bennett, MD, PhD, MPP; John F. Hurdle, MD, PhD

Background: Numerous studies have shown that specific computerized interventions may reduce medication errors, but few have examined adverse drug events (ADEs) across all stages of the computerized medication process. We describe the frequency and type of inpatient ADEs that occurred following the adoption of multiple computerized medication ordering and administration systems, including computerized physician order entry (CPOE).

Methods: Using explicit standardized criteria, pharmacists classified inpatient ADEs from prospective daily reviews of electronic medical records from a random sample of all admissions during a 20-week period at a Veterans Administration hospital. We analyzed ADEs that necessitated a changed treatment plan.

Results: Among 937 hospital admissions, 483 clinically significant inpatient ADEs were identified, accounting for 52 ADEs per 100 admissions and an incidence density of 70 ADEs per 1000 patient-days. One quarter of the hospitalizations had at least 1 ADE. Of all ADEs, 9% resulted in serious harm, 22% in additional monitoring and interventions, 32% in interventions alone, and 11% in monitoring alone; 27% should have resulted in additional interventions or monitoring. Medication errors contributed to 27% of these ADEs. Errors associated with ADEs occurred in the following stages: 61% ordering, 25% monitoring, 13% administration, 1% dispensing, and 0% transcription. The medical record reflected recognition of 76% of the ADEs.

Conclusions: High rates of ADEs may continue to occur after implementation of CPOE and related computerized medication systems that lack decision support for drug selection, dosing, and monitoring.

Arch Intern Med. 2005;165:1111-1116

Author Affiliations: Veterans Administration Salt Lake City Health Care System, Geriatric Research, Education, and Clinical Center, Salt Lake City, Utah (Drs Nebeker, Hoffman, Weir, and Hurdle); Department of Medicine (Drs Nebeker and Hurdle), Department of Medical Informatics (Drs Weir and Hurdle), and Department of Pharmacy Practice (Dr Hoffman), University of Utah, Salt Lake City; and Veterans Administration Midwest Center for Health Services and Policy Research, Lakeside Division, Division of Hematology/Oncology, Department of Medicine, Northwestern University, Chicago, Ill (Dr Bennett).
Financial Disclosure: None.

MULTIPLE BROAD-BASED studies during the past 15 years have demonstrated that adverse drug events (ADEs) account for up to 41%[1] of all hospital admissions and more than $2 billion annually in inpatient costs.[2-4] Several of these studies have also estimated that as many as a quarter of inpatient ADEs may be preventable through interventions such as computerized physician order entry (CPOE) and related systems.[5-7] On the basis of these projections and the proven success of these systems in identifying ADEs and reducing medication errors,[8-11] computerized medication processes have been widely promoted as essential to preventing actual ADEs.[9,12,13]

Recently, some researchers have questioned the extent to which currently available CPOE and related systems are preventing ADEs.[14-16] There are concerns that features of commercial CPOE products vary widely and that few can match the sophistication of custom systems developed at institutions that have successfully reduced targeted ADEs.[13,17-21] Moreover, broad-based surveys of ADEs in institutions that have implemented multiple computerized medication systems have not been published; it is unclear how these interventions together have affected the occurrence of ADEs linked to problems across stages of medication processing (ie, ordering, transcription, dispensing, administration, and monitoring).[5]

The Veterans Administration (VA) Healthcare System, one of the largest integrated delivery systems in the country, is a leader in patient safety and has actively sought to reduce medication errors using multiple computerized interventions such as CPOE,[22-26] bar code–controlled medication delivery,[9,27,28] a complete electronic medical record,[1,29-31] automated drug-drug interaction checking,[32-33] and computerized allergy tracking and alerting.[36-38] The White House has

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The New York Times | https://nyti.ms/2Oiwt2e

How Chaos at Chain Pharmacies is Putting Patients at Risk

Pharmacists across the U.S. warn that the [illegible] has [illegible] medication errors more likely. "I [illegible]

By Ellen Rabber

Jan. 31, 2020

For Alyssa Watrous, the medication mix-up meant a pounding headache, nausea and dizziness. In September, Ms. Watrous, a 17-year-old from Connecticut, was about to take another asthma pill when she realized CVS had mistakenly given her blood pressure medication intended for someone else.

Edward Walker, 38, landed in an emergency room, his eyes swollen and burning after he put drops in them for five days in November 2018 to treat a mild irritation. A Walgreens in Illinois had accidentally supplied him with ear drops — not eye drops.

For Mary Scheuerman, 85, the error was discovered only when she was dying in a Florida hospital in December 2018. A Publix pharmacy had dispensed a powerful chemotherapy drug instead of the antidepressant her doctor had prescribed. She died about two weeks later.

The Chicago Tribune tested 255 pharmacies to see how often stores would dispense risky drug pairs without warning patients. Fifty-tw
percent of the tested pharmacies sold the medications without mentioning the potential interaction. (Chicago Tribune)

By **Sam Roe, Ray Long and Karisa King**
Chicago Tribune

DECEMBER 15, 2016, 8:44 AM

The Tribune reporter walked into an Evanston CVS pharmacy carrying two prescriptions: one for a common antibiotic, the other for a popular anti-cholesterol drug.

Taken alone, these two drugs, clarithromycin and simvastatin, are relatively safe. But taken together they can cause a severe breakdown in muscle tissue and lead to kidney failure and death.

But that's not what happened. The two medications were packaged, labeled and sold within minutes, without a word of caution.

The same thing happened when a reporter presented prescriptions for a different potentially deadly drug pair at a Walgreens on the Magnificent Mile.

And at a Wal-Mart in Evergreen Park, a Jewel-Osco in River Forest and a Kmart in Springfield.

In the largest and most comprehensive study of its kind, the Tribune tested 255 pharmacies to see how often stores would dispense dangerous drug pairs without warning patients. Fifty-two percent of the pharmacies sold the medications without mentioning the potential interaction, striking evidence of an industrywide failure that places millions of consumers at risk.

CVS, the nation's largest pharmacy retailer by store count, had the highest failure rate of any chain in the Tribune tests, dispensing the medications with no warning 63 percent of the time. Walgreens, one of CVS' main competitors, had the lowest failure rate at 30 percent — but that's still missing nearly 1 in 3 interactions.

Health IT and Patient Safety:

Building Safer Systems for Better Care

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IOM Recommendation 1 (continued)

b. The Office of the National Coordinator for Health IT (ONC) should expand its funding of processes that promote safety that should be followed in the development of health IT products, including standardized testing procedures to be used by manufacturers and health care organizations to assess the safety of health IT products.

c. ONC and AHRQ should work with health IT vendors and health care organizations to promote post-deployment safety testing of EHRs for high prevalence, high impact EHR-related patient safety risks.

d. Health care accrediting organizations should adopt criteria relating to EHR safety.

e. AHRQ should fund the development of new methods for measuring the impact of health IT on safety using data from EHRs.

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EHR Flight Simulator

Simulations of EHR Use with CPOE

The assessment pairs medication orders that would cause a serious adverse drug event with a fictitious patient.

A physician enters the order …

Patient AB

Female
52 years old
Weighs 60 kg
Allergy to morphine
Normal creatinine

and observes and records the type of CDS-generated advice that is given (if any).

Coumadin (Warfarin) 5 mg po three times a day.

FOCUS ON QUALITY

By Jane Metzger, Emily Welebob, David W. Bates, Stuart Lipsitz, and David C. Classen

Mixed Results In The Safety Performance Of Computerized Physician Order Entry

DOI: 10.1377/hlthaff.2010.0160
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NO. 4 (2010): 655–663
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The People-to-People Health
Foundation, Inc.

ABSTRACT **Computerized physician order entry is a required feature for hospitals seeking to demonstrate meaningful use of electronic medical record systems and qualify for federal financial incentives. A national sample of sixty-two hospitals voluntarily used a simulation tool designed to assess how well safety decision support worked when applied to medication orders in computerized order entry. The simulation detected only 53 percent of the medication orders that would have resulted in fatalities and 10–82 percent of the test orders that would have caused serious adverse drug events. It is important to ascertain whether actual implementations of computerized physician order entry are achieving goals such as improved patient safety.**

Jane Metzger (jmetzger2@csc.com) is a principal researcher at CSC Healthcare in Waltham, Massachusetts.

Emily Welebob is an independent consultant in Indianapolis, Indiana.

David W. Bates is division chief for general internal medicine at Brigham and Women's Hospital in Boston, Massachusetts.

Stuart Lipsitz is a researcher at Brigham and Women's Hospital.

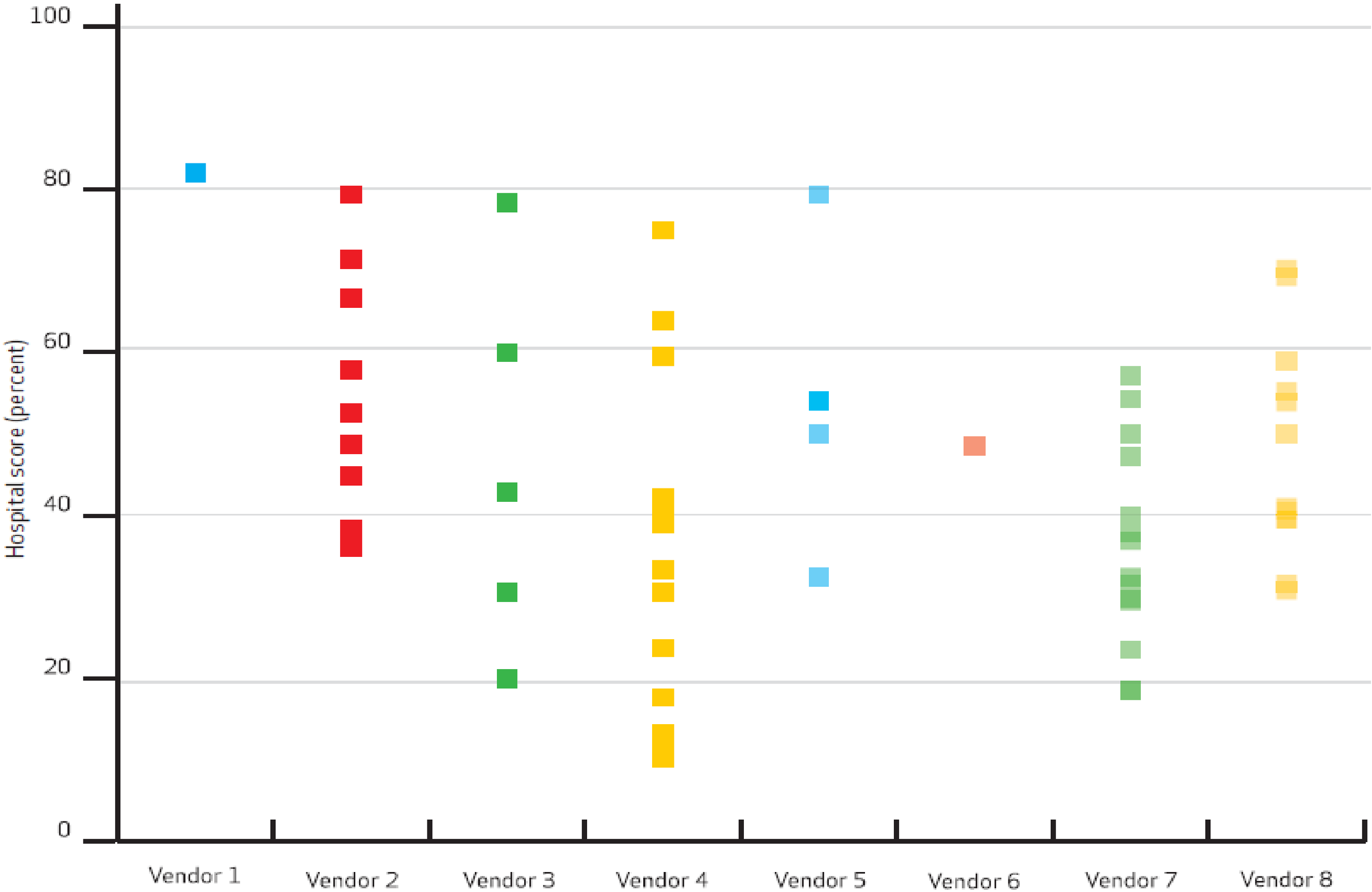
David C. Classen is an associate professor of medicine at the University of Utah in Salt Lake City, and is also with CSC Healthcare.

Many people have suggested that electronic health records represent essential infrastructure for the provision of safe health care in the United States. For several years, the Institute of Medicine, the Leapfrog Group, the National Quality

In this application of clinical decision support, physicians are made aware of potential safety issues that can result—for example, when ampicillin is given to a patient with a known allergy to penicillin, or the dose being ordered for a pediatric patient is much higher than the therapeutic range for a child of this age and weight. Prescrib-

EXHIBIT 2

Hospital Scores For Detection Of Test Orders That Would Cause An Adverse Drug Event In An Adult Patient According To The Software Product (Vendor) Implemented



JAMA Network | Open

Original Investigation | Health Informatics

National Trends in the Safety Performance of Electronic Health Record Systems From 2009 to 2018

David C. Classen, MD, MS; A. Jay Holmgren, MHI; Zoe Co, BS; Lisa P. Newmark, BA; Diane Seger, RPh; Mellissa Danforth, BA; David W. Bates, MD, MSc

Abstract

IMPORTANCE Despite the broad adoption of electronic health record (EHR) systems across the continuum of care, safety problems persist.

OBJECTIVE To measure the safety performance of operational EHRs in hospitals across the country during a 10-year period.

DESIGN, SETTING, AND PARTICIPANTS This case series included all US adult hospitals nationwide that used the National Quality Forum Health IT Safety Measure EHR computerized physician order entry safety test administered by the Leapfrog Group between 2009 and 2018. Data were analyzed from July 1, 2018 to December 1, 2019.

EXPOSURE The Health IT Safety Measure test, which uses simulated medication orders that have either injured or killed patients previously to evaluate how well hospital EHRs could identify medication errors with potential for patient harm.

MAIN OUTCOMES AND MEASURES Descriptive statistics for performance on the assessment test over time were calculated at the overall test score level, type of decision support category level, and EHR vendor level.

RESULTS Among 8657 hospital-years observed during the study, mean (SD) scores on the overall test increased from 53.9% (18.3%) in 2009 to 65.6% (15.4%) in 2018. Mean (SD) hospital score for the categories representing basic clinical decision support increased from 69.8% (20.8%) in 2009 to 85.6% (14.9%) in 2018. For the categories representing advanced clinical decision support, the mean (SD) score increased from 29.6% (22.4%) in 2009 to 46.1% (21.6%) in 2018. There was considerable variation in test performance by EHR vendor and associated variation in national hospital quality reporting metrics by vendor as well.

CONCLUSIONS AND RELEVANCE These findings suggest that despite broad adoption and optimization of EHR systems in hospitals, wide variation in the safety performance of operational EHR systems remains across a large sample of hospitals and EHR vendors. Hospitals using some EHR vendors had significantly higher test scores. Overall, substantial safety risk persists in current hospital EHR systems.

JAMA Network Open. 2020;3(5):e205547. doi:10.1001/jamanetworkopen.2020.5547

Key Points

Question How did safety performance of electronic health record systems (EHRs) change in the US from 2009 to 2018?

Findings In this case series using 8657 hospital-year observations from adult hospitals nationwide that used the National Quality Forum Health IT Safety Measure, a computerized physician order entry and EHR safety test, from 2009 to 2018, mean scores on the overall test increased from 53.9% in 2009 to 65.6% in 2018. There was considerable variation in test performance by hospital and EHR vendor.

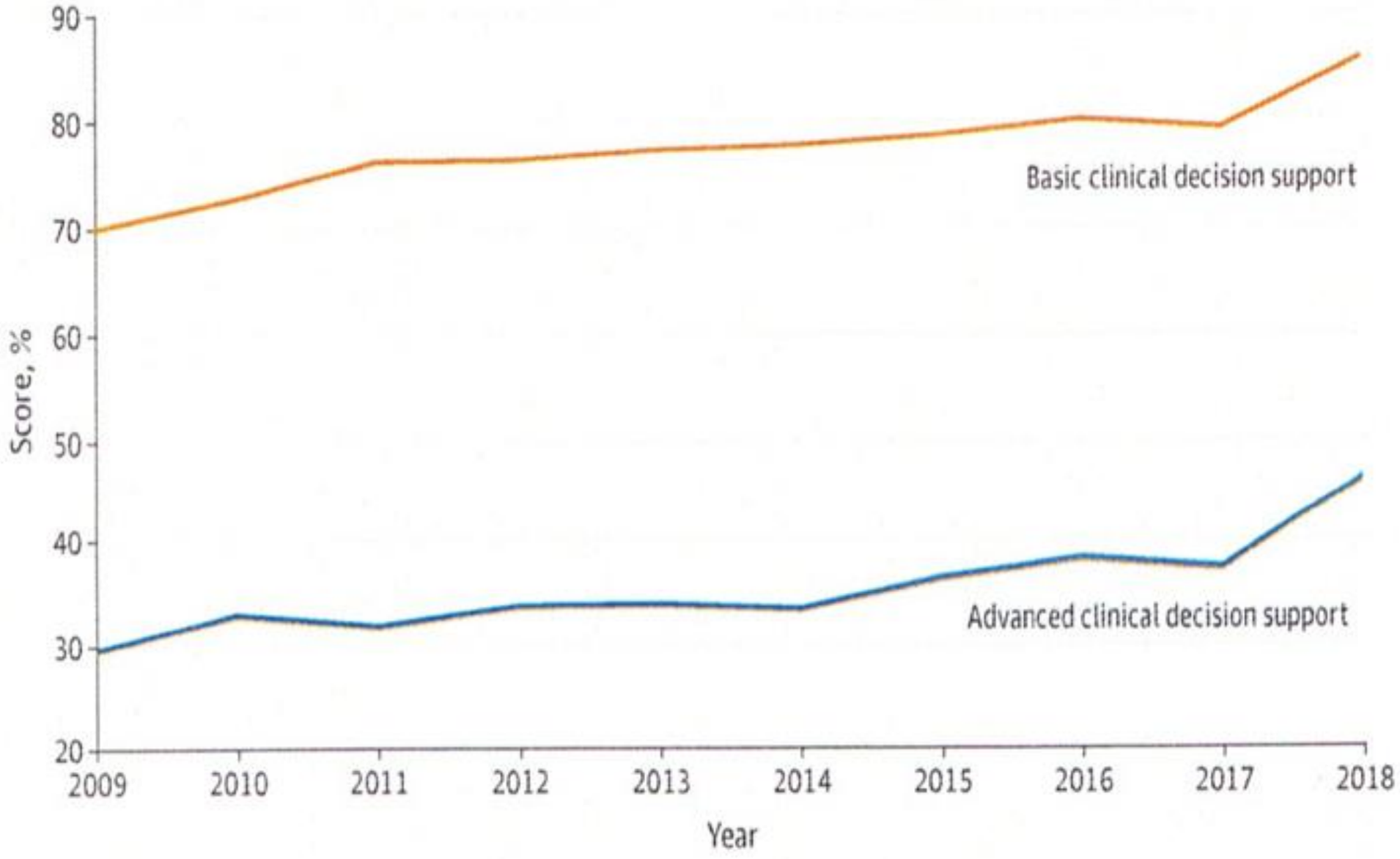
Meaning These findings suggest that, despite broad adoption and optimization of EHR systems in hospitals, wide variation in the safety performance of operational EHR systems remains across a large sample of hospitals and EHR vendors, and serious safety vulnerabilities persist in these operational EHRs.

+ Invited Commentary

+ Supplemental content and Audio

Author affiliations and article information are listed at the end of this article.

Figure 1. Basic and Advanced Clinical Decision Support Test Scores Over 10 Years



JAMA Network Open. 2020;3(5):e205547. doi:10.1001/jamanetworkopen.2020.5547

JAMA Network Open

Original Investigation | Health Informatics

Inpatient EHR User Experience and Hospital EHR Safety Performance

David C. Classen, MD, MS; Christopher A. Longhurst, MD, MS; Taylor Davis, MSStat, MBA; Julia Adler Milstein, PhD; David W. Bates, MD, MSc

Abstract

IMPORTANCE Despite the broad adoption and optimization of electronic health record (EHR) systems across the continuum of care, serious usability and safety problems persist.

OBJECTIVE To assess whether EHR safety performance is associated with EHR frontline user experience in a national sample of hospitals.

DESIGN, SETTING, AND PARTICIPANTS This cross-sectional study included all US adult hospitals that used the National Quality Forum Leapfrog Health IT Safety Measure and also used the ARCH Collaborative EHR User experience survey from January 1, 2017, to January 1, 2019. Data analysis was performed from September 2020 to November 2022.

MAIN OUTCOMES AND MEASURES The primary outcomes were hospital performance on the Leapfrog Health IT Safety measure (overall and 10 subcomponents) and the ARCH collaborative frontline user experience scores (overall and 8 subcomponents). Ordinary least squares models with survey responses clustered by hospital were used to assess associations between the overall measures and their subcomponents.

RESULTS There were 112 hospitals and 5689 frontline user surveys included in the study. Hospitals scored a mean of 0.673 (range, 0.297-0.973) on the Leapfrog Health IT safety measure; the mean ARCH EHR user experience score was 3.377 (range, 1 [best] to 5 [worst]). The adjusted β coefficient between the overall safety score and overall user experience score was 0.011 (95% CI, 0.006-0.016). The ARCH overall score was also significantly associated with 10 subcategory scores of the Leapfrog Health IT safety score, and the overall Leapfrog score was associated with the 8 subcategory scores of the ARCH user experience score.

CONCLUSIONS AND RELEVANCE This cross-sectional study found a positive association between frontline user–rated EHR usability and EHR safety performance. This finding suggests that improving EHR usability, which is a current well-known pain point for EHR users, could have direct benefits in terms of improved EHR safety.

JAMA Network Open. 2023;6(9):e2333152. doi:10.1001/jamanetworkopen.2023.33152

Key Points

Question Is the safety performance of electronic health record (EHR) systems associated with frontline usability of such systems?

Findings In this cross-sectional study of 112 US hospitals from 2017 and 2018, there was a significant association between the overall scores of the National Quality Forum Health IT Safety Measure, a computerized physician order entry and EHR safety test, and the ARCH Collaborative EHR User Experience Survey. In addition, there was an association between the overall EHR Safety Test Score and the subcategory scores on the ARCH Survey mean scores and the overall ARCH Survey score and the subcomponent scores in the EHR Safety Score.

Meaning These findings suggest that EHR safety performance is associated with frontline EHR usability and that current broad efforts to improve EHR usability may be associated with improvements in EHR safety performance as well.

+ Supplemental content

Author affiliations and article information are listed at the end of this article.

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How Reliable is Healthcare

The rate of adverse events in hospital care is:

1. 1in 1,000,000 hospitalizations
2. 1 in 100,000 hospitalizations
3. 1 in 10,000 hospitalizations
4. 1in 1000 hospitalizations
5. 1 in 100 hospitalizations
6. 1 in 10 hospitalizations

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How safe is care today?

Results from Safe Care published January 12, 2023

The NEW ENGLAND JOURNAL of MEDICINE

SPECIAL ARTICLE

The Safety of Inpatient Health Care

David W. Bates, M.D., David M. Levine, M.D., M.P.H.,
Hojjat Salmasian, M.D., Ph.D., M.P.H., Ania Syrowatka, Ph.D., David M. Shahian, M.D.,
Stuart Lipsitz, Sc.D., Jonathan P. Zebrowski, M.D., M.H.Q.S.,
Laura C. Myers, M.D., M.P.H., Merranda S. Logan, M.D., M.P.H.,
Christopher G. Roy, M.D., M.P.H., Christine Iannaccone, M.P.H., Michelle L. Frits, B.A.,
Lynn A. Volk, M.H.S., Sevan Dulgarian, B.S., B.A., Mary G. Amato, Pharm.D., M.P.H.,
Heba H. Edrees, Pharm.D., Luke Sato, M.D., Patricia Folcarelli, Ph.D., R.N.,
Jonathan S. Einbinder, M.D., M.P.H., Mark E. Reynolds, B.A.,
and Elizabeth Mort, M.D., M.P.H.

ABSTRACT

BACKGROUND

Adverse events during hospitalization are a major cause of patient harm, as documented in the 1991 Harvard Medical Practice Study. Patient safety has changed substantially in the decades since that study was conducted, and a more current assessment of harm during hospitalization is warranted.

JOURNAL REPORTS: HEALTHCARE

Why Hospitals Still Make Serious Medical Errors—and How They Are Trying to Reduce Them

Some medical mistakes have been stubbornly hard to eliminate. Now, hospitals hope technology can make a difference.

Hospitals are using technology in a new effort to target medical errors.
ILLUSTRATION: JON KRAUSE

By Laura Landro
March 12, 2023 10:00 am ET

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ERRORS & ADVERSE EVENTS

By David C. Classen, Roger Resar, Frances Griffin, Frank Federico, Terri Frankel, Nancy Kimmel, John C. Whittington, Allan Frankel, Andrew Seger, and Brent C. James

'Global Trigger Tool' Shows That Adverse Events In Hospitals May Be Ten Times Greater Than Previously Measured

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HEALTH AFFAIRS 30,
NO. 4 (2011): –
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The People-to-People Health
Foundation, Inc.

ABSTRACT Identification and measurement of adverse medical events is central to patient safety, forming a foundation for accountability, prioritizing problems to work on, generating ideas for safer care, and testing which interventions work. We compared three methods to detect adverse events in hospitalized patients, using the same patient sample set from three leading hospitals. We found that the adverse event detection methods commonly used to track patient safety in the United States today—voluntary reporting and the Agency for Healthcare Research and Quality's Patient Safety Indicators—fared very poorly compared to other methods and missed 90 percent of the adverse events. The Institute for Healthcare Improvement's Global Trigger Tool found at least ten times more confirmed, serious events than these other methods. Overall, adverse events occurred in one-third of hospital admissions. Reliance on voluntary reporting and the Patient Safety Indicators could produce misleading conclusions about the current safety of care in the US health care system and misdirect efforts to improve patient safety.

David C. Classen (dclassen@csc.com) is an associate professor of medicine at the University of Utah, in Salt Lake City.

Roger Resar is a senior fellow at the Institute for Healthcare Improvement, in Cambridge, Massachusetts.

Frances Griffin is a faculty member at the Institute for Healthcare Improvement.

Frank Federico is an executive director at the Institute for Healthcare Improvement.

Terri Frankel is a director at the Institute for Healthcare Improvement.

Nancy Kimmel is director of quality and safety at the Missouri Baptist Medical Center, in St. Louis.

EXHIBIT 4

Adverse Event Detection, By Severity Level And Hospital

	IHI Global Trigger Tool	AHRQ Patient Safety Indicators	Hospital voluntary reporting system
SEVERITY LEVEL			
E	204	23	0
F	124	7	2
G	8	1	2
H	14	0	0
I	4	4	0
Total	354	35	4
HOSPITAL			
Hospital A	161	13	0
Hospital B	92	13	3
Hospital C	101	9	1
Total	354	35	4

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The NEW ENGLAND JOURNAL of MEDICINE

SPECIAL ARTICLE

Temporal Trends in Rates of Patient Harm Resulting from Medical Care

Christopher P. Landrigan, M.D., M.P.H., Gareth J. Parry, Ph.D.,
Catherine B. Bones, M.S.W., Andrew D. Hackbarth, M.Phil.,
Donald A. Goldmann, M.D., and Paul J. Sharek, M.D., M.P.H.

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Summary Of Medicare OIG Trigger Tool Studies 2008-2018

Rates of All Cause Harm Found in Different Settings of Care

Hospitals 27%--25%
Skilled Nursing Facilities 33%
Rehab Units 29%
Nursing Homes 43%

U.S. Department of Veterans Affairs

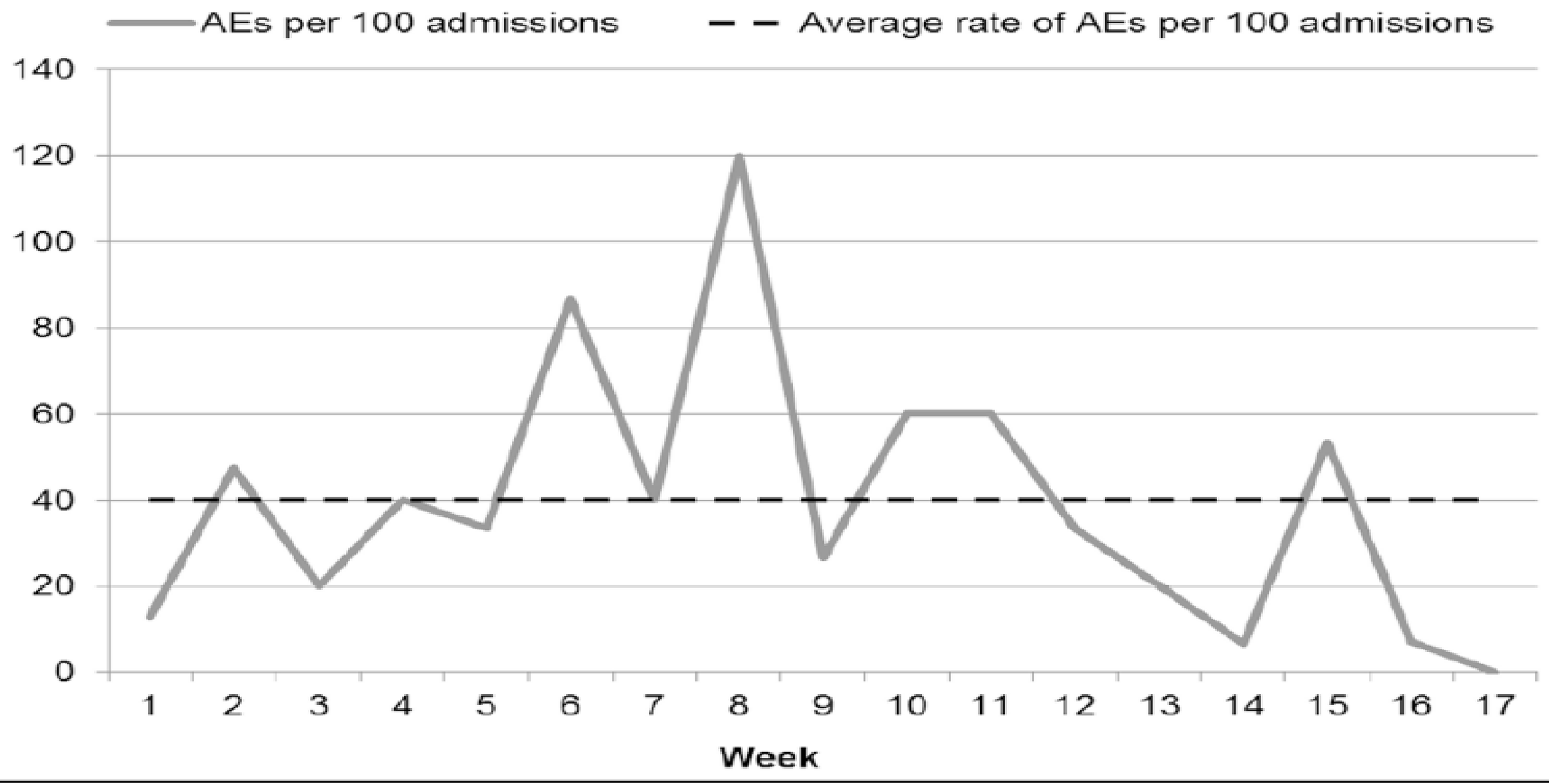
Public Access Author manuscript

Qual Manag Health Care. Author manuscript; available in PMC 2015 September 15.

Published in final edited form as:

Qual Manag Health Care. 2015 ; 24(3): 140–146. doi:10.1097/QMH.0000000000000060.

Identifying Previously Undetected Harm: Piloting the Institute for Healthcare Improvement's Global Trigger Tool in the Veterans Health Administration



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EMERGING HIT

The Foundation: Automated GTT the "First Step" to Real-time Patient Safety

IDEAS AND OPINIONS — Annals of Internal Medicine

Measuring Patient Safety in Real Time: An Essential Method for Effectively Improving the Safety of Care

David C. Classen, MD, MS; Frances A. Griffin, RRT, MPA; and Donald M. Berwick, MD, MPP

The continuing evidence of preventable deaths due to medical error has led to recent calls to improve measurement of safety in hospitals. This need can be adequately addressed by harnessing health information technology. Electronic health records (EHRs), which have been broadly adopted, offer the opportunity for measurement of all-cause harm in hospitalized and ambulatory patients and real-time mitigation to reduce it. Yet, the recent Institute of Medicine (IOM) report, "Health IT and Patient Safety," which recommends this method, notes that this opportunity has generally not been taken (1).

Widespread preventable injury to hospitalized patients persists more than 15 years after the IOM report, "To Err is Human," brought it to international attention. In fact, medical error was recently cited as the third leading cause of death in U.S. hospitalized patients (2). This magnitude of harm will likely persist until it is measured effectively and consistently by every hospital, as many have called for. Among the barriers to measurement of harm are the lack of standard definitions for it, the perceived burden of data collection, and the limitations of current ways of estimating the true incidence of harm. All of these barriers can be lowered with better methods to measure harm through the use of EHRs.

Studies estimating the amount of patient harm from medical error have historically relied on retrospective review of medical records, particularly paper records. The Harvard Medical Practice Study (3), on which the IOM based many of its estimates, involved detailed, manual retrospective review of more than 30 000 medical records. Most hospitals do not have sufficient resources to conduct this type of intensive review; they rely instead on data collected for other purposes, such as administrative billing data.

The Harvard approach remained the most commonly cited method for review of all-cause harm until the 2011 publication of a study that performed expedited retrospective review by searching for triggers typically associated with the most frequent and harmful adverse events. This method allows for detection and measurement of adverse events or all-cause harm with lower resource intensity through the use of sampling and has been shown to identify more than 90% of harm in hospitalized patients. Other indicators based on billing data capture less than 10% of actual harm, and voluntary reporting finds less than 5% (4).

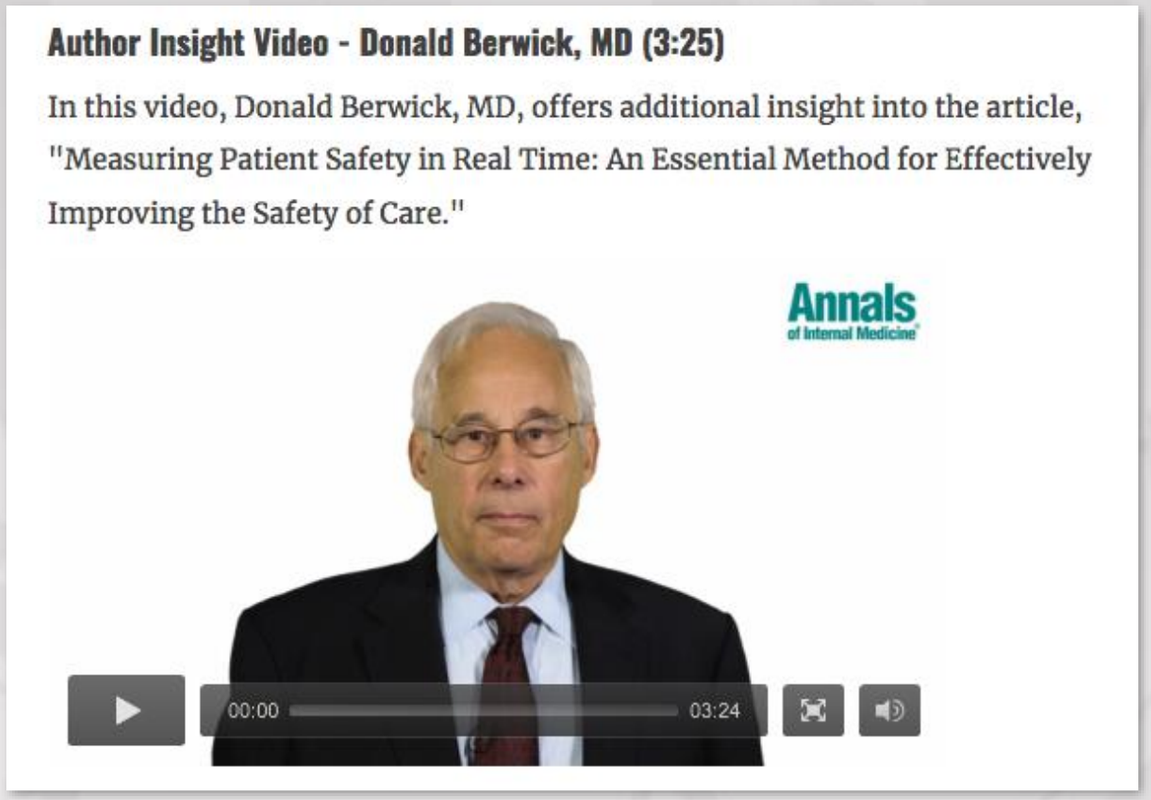
In 2010, the Office of Inspector General of the U.S. Department of Health and Human Services evaluated 5 methods for measuring the rate of adverse events in hospitalized Medicare beneficiaries and determined that a trigger review method was the most effective (5), subsequently using it to conduct a study that was reported to Congress (6). A trigger method has been used by thousands of hospitals worldwide to measure all-cause harm and is recommended by the World Health Organization and in national initiatives to improve safety in the United Kingdom, Norway, and other nations. However, this manual method is limited due to resource requirements and its retrospective nature. It does not allow for real-time prevention or rapid amelioration of safety problems.

A recent survey by the U.S. Office of the National Coordinator found that more than 96% of U.S. hospitals have implemented an EHR system (7). However, most hospitals do not use the EHR to directly measure patient harm. Instead, measurement is more often based on electronic voluntary reporting systems and automated coding of medical records at discharge. One clinical area—infection prevention surveillance—has harnessed the power of EHRs to improve detection of safety problems. Electronic surveillance for infections has enabled practitioners to monitor all hospitalized patients efficiently and to improve detection through automated identification of laboratory diagnostics, such as positive blood culture results. This approach has greatly enhanced detection and identification of serious infections, such as central line–associated bloodstream infections, and the measurement of these has accelerated efforts to reduce such harm.

Research and development on the automation of all-cause harm detection using the infection prevention surveillance model is well under way and was initially based on work at Kaiser Permanente, which has automated detection using data from its EHR system and almost all of the triggers from the Institute for Healthcare Improvement Global Trigger Tool (8). Other leading health systems using data from their EHRs have expanded on this work, such as Adventist Health System, Baylor Scott & White Health, Dignity Health, Providence Health & Services, and Cook Children's Health Care System. These organizations have demonstrated the ability to measure all causes of harm in real time in the whole inpatient population, allowing for more robust measurement and actionable intervention to reduce or mitigate harm. Surveillance for harm in the electronic record using the leading commercial EHR vendors' products can be affordable, sustainable, and actionable. It not only provides a full-hospital population approach to patient safety but also can help to predict which patients might experience harm and when, supporting prevention before harm occurs (9).

Nearly 20 years have elapsed since the landmark IOM report on patient safety without sustainable, mea-

This article was published at Annals.org on 21 November 2017.



Don Berwick – "Using the EHR for Safety" via pascalmetrics.com

Conclusion: *"All hospitals should use their EHRs ["as a lens"] to measure harm and better guide and monitor the real effect of their patient safety efforts."*

CMS New Patient Safety Measure

- Measure the occurrence of harm to patients in the hospital setting, using data from electronic health records (EHR) Using Electronic IHI Global Triggers
- Develop a quality measure that allows for comparison across hospitals to incentivize improvements
- Consider a wide range of harms for potential inclusion
- Identify limited set of harms initially and expand measure over time ultimately a composite safety measure
- Initial 7 trigger based safety measures undergoing hospital testing

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New CMS Harms Measures

Opioid-Related Adverse Events

Pressure Injury

Hypoglycemia

Hyperglycemia

Acute Kidney Injury

Medication-Related Bleeding

Falls

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QUALITY OF CARE

By David Classen, Michael Li, Suzanne Miller, and Drew Ladner

An Electronic Health Record–Based Real-Time Analytics Program For Patient Safety Surveillance And Improvement

ABSTRACT **Twenty years after publication of the report *To Err Is Human*, studies demonstrate persisting high levels of patient harm. Most patient safety measurement remains highly retrospective, relying on voluntary reporting and post discharge administrative coding. Progress has been limited by the lack of advances in measurement accuracy, detection sensitivity, and timely actionability. The broad adoption of electronic health records (EHRs) offers a significant opportunity to leverage digital information to improve safety measurement and management using real-time data. We developed a novel method to extract safety indicators from EHRs to identify harm and its precursors by implementing a patient safety active management system (PSAM) in hospitals within a national Patient Safety Organization (PSO). The PSAM generated validated adverse event outcomes and leveraged EHR data to develop a real-time safety predictive model. This study describes the PSAM's pilot at two large community hospitals in 2014–17. We found that the PSAM could detect harm in real time, at higher rates than current levels are detected, and that such harm could be predicted. In addition to outlining future opportunities and challenges with this EHR-enabled PSAM approach, we discuss implications and next steps for policy and practice.**

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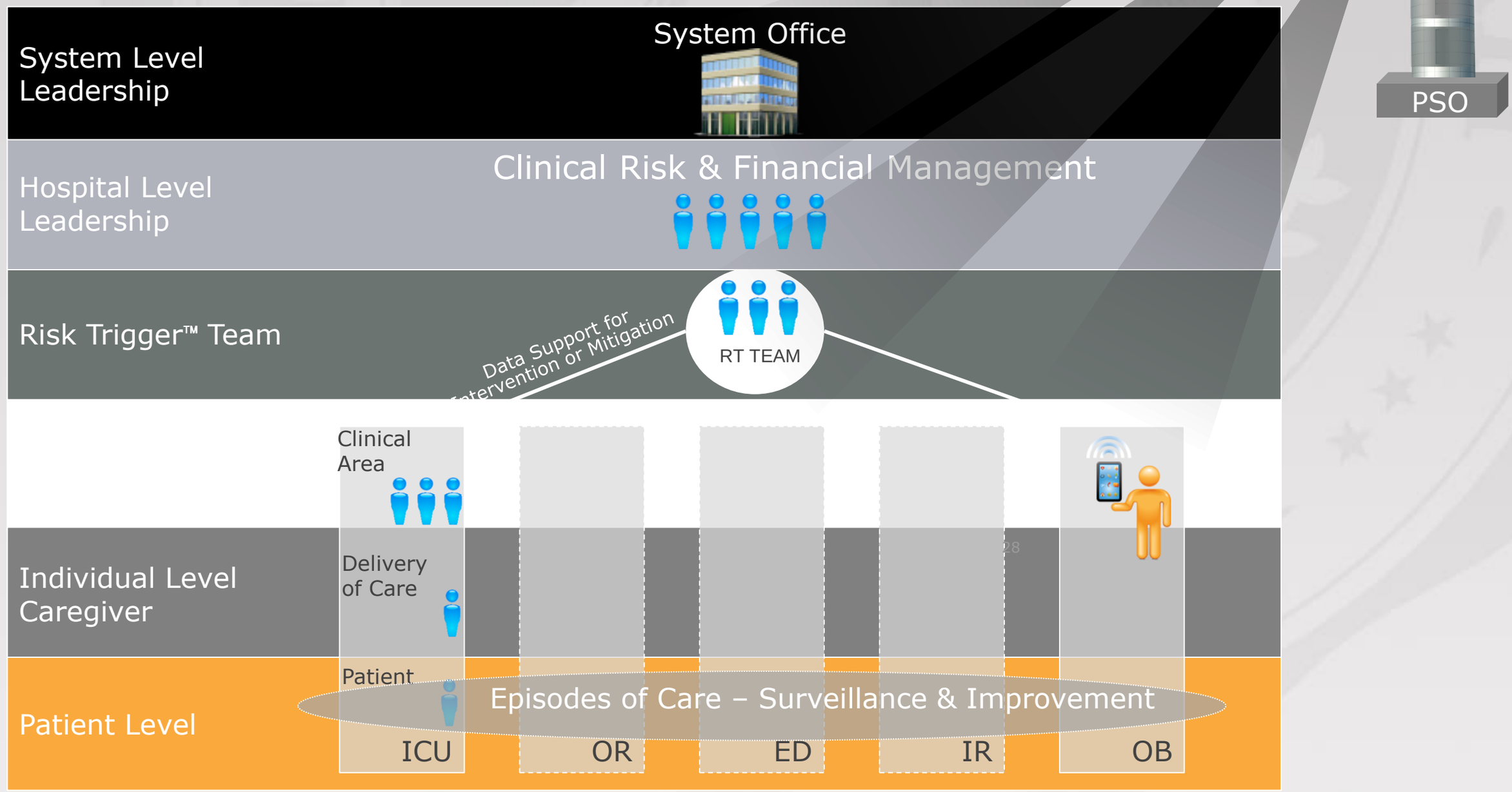
PATIENT SAFETY ORGANIZATION (PSO)
REAL-TIME PATIENT SAFETY & IMPROVEMENT

Healthcare Provider



✓*Enabling healthcare systems at each level of care to anticipate and avoid/ameliorate patient harm and related cost*

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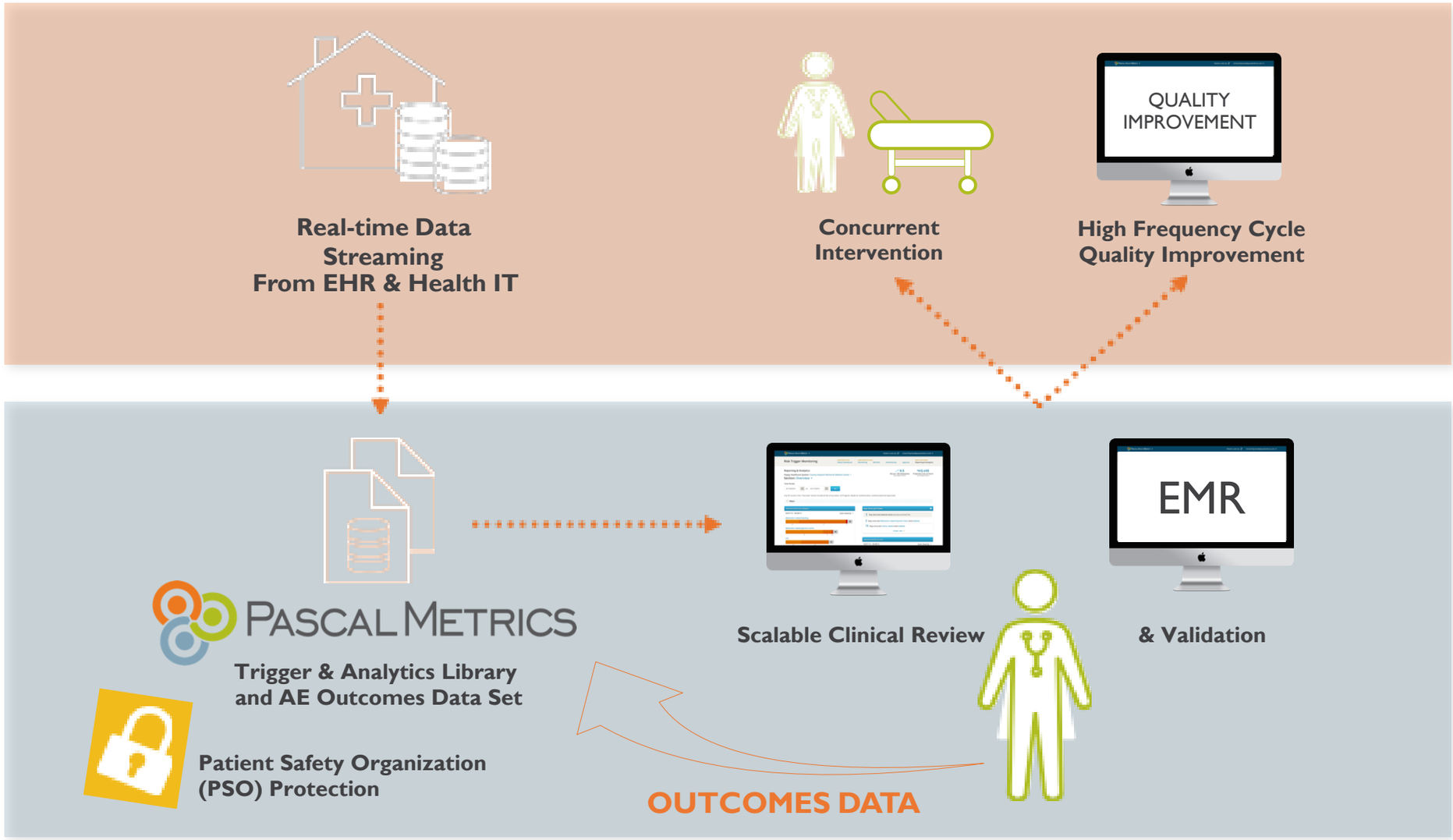
Solution Software: Risk Trigger® Monitoring



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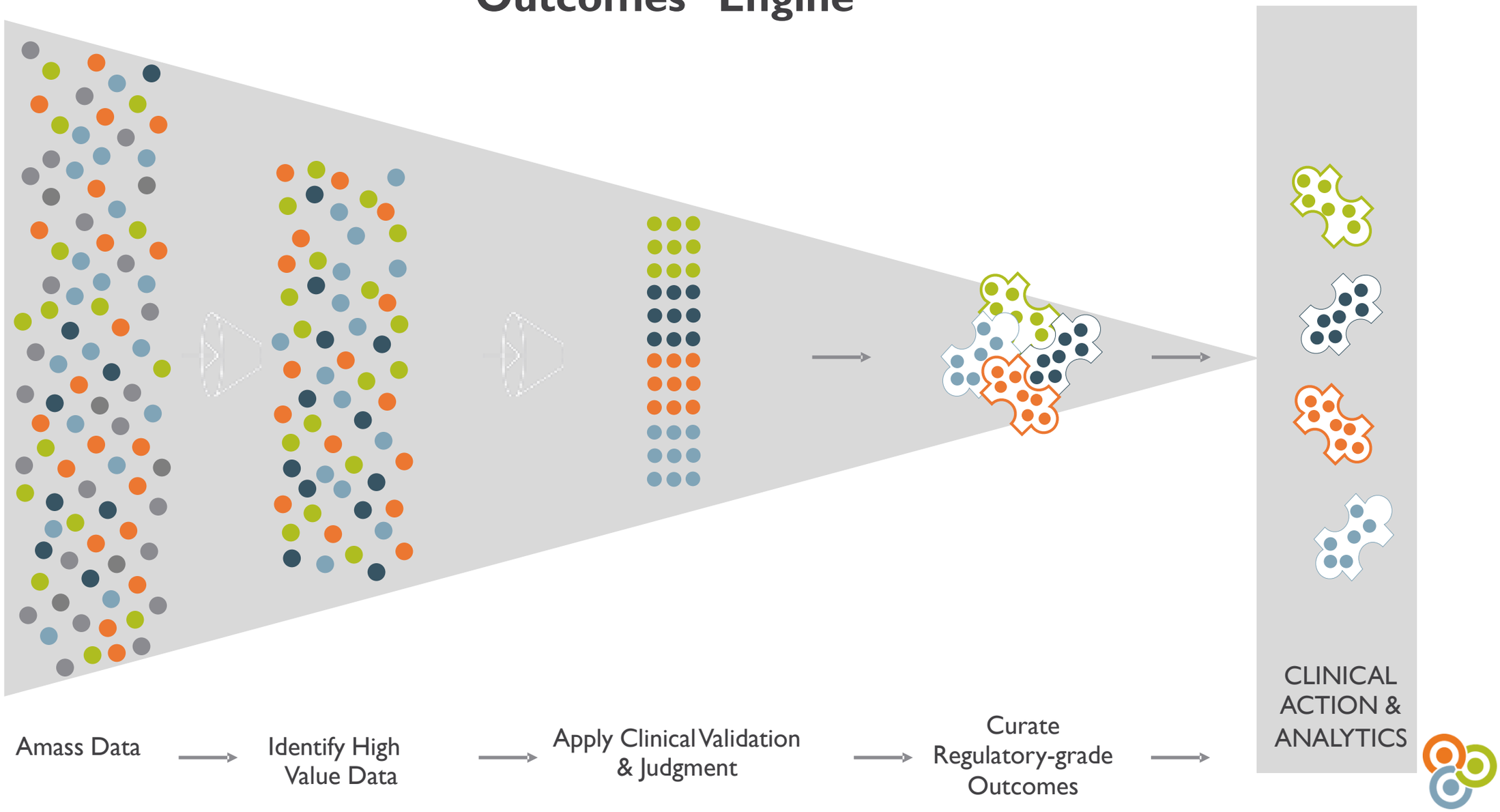
Solution Model: The Foundation of the Adverse Event Outcomes "Engine"



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Results – Identification: EHR-based vs. Industry Standard, i.e. Voluntary Event Reporting (VER)

Illustrative Example: 1 Hospital with Strong Culture Over 7 Years

3,740

Adverse events ID'd with Pascal EHR-based method

147

# of those adverse events ID'd with Standard VER

CLINICAL EFFECTIVENESS COMPARISON: **25x**

The Joint Commission Journal on Quality and Patient Safety 2017; ■■:■■–■■

Developing and Evaluating an Automated All-Cause Harm Trigger System

Christine Sammer, DrPH, RN; Susanne Miller, RN, MS; Cason Jones, MLS, MHA; Antoinette Nelson, RN, BSN, MSHSA; Paul Garrett, MD; David Classen, MD, MS; David Stockwell, MD

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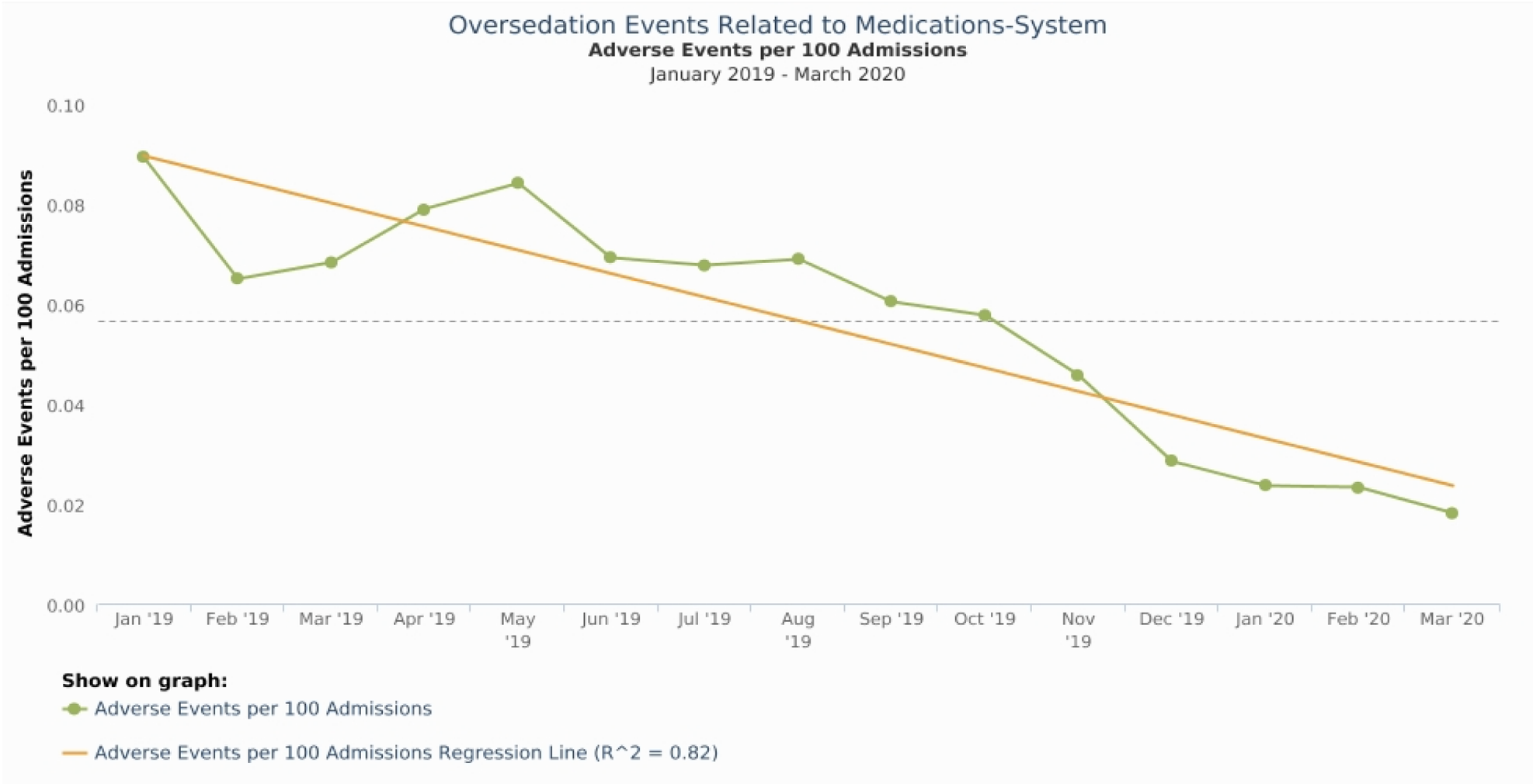
Results – Reduction: Specific Harm, System-wide



Source: Pascal Community Collaborative internal data.

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Patient: Allen, Jonathan

Southwest Regional, Johnson Memorial Medical Center

Current Global Safety Risk: **HIGH 62**

As of: 8/5/2014 06:57

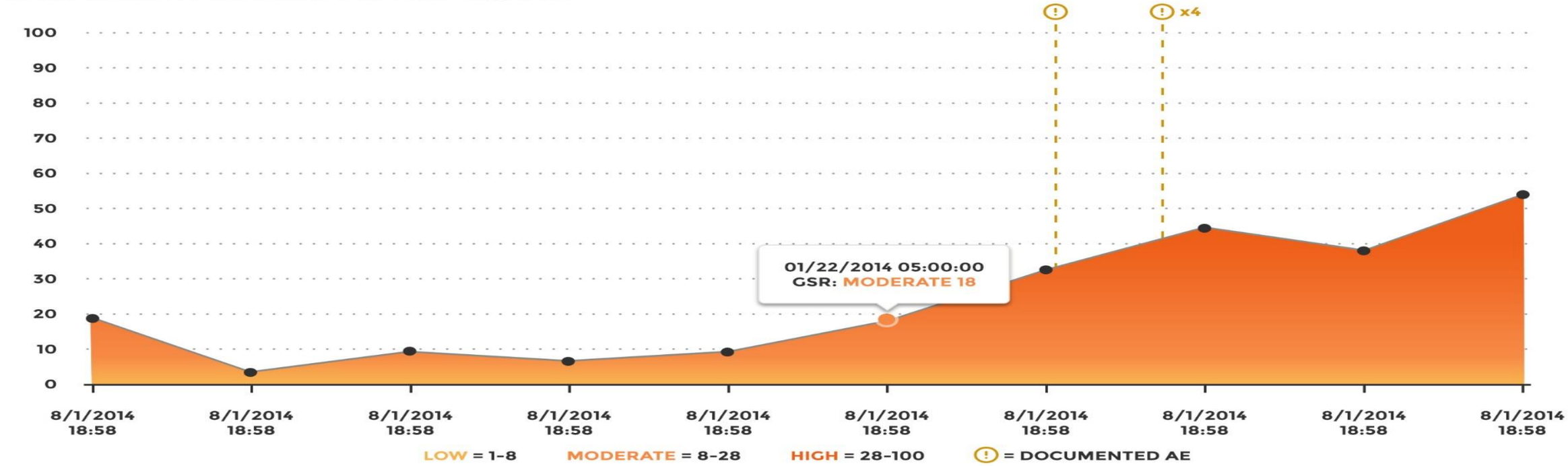
EMPI:	Gender:	Current Visit Date:	Current Unit:	Reason for Current Visit:
75643987	**Male**	**11/14/2013 13:43**	**10 MCU-ORM**	**ABDOMINAL PAIN, LEUKOCYTOSIS, LEFT FOOT DIABETIC FOOT ULCER**
MRN:	Date of Birth (Age):	Discharge Date:	Current Location:	
456321	**14 April 1942 (71)**	**--**	**Room 302-Bed A**	
Current Visit #:	Weight:	Current Pt. Class:	Current Attending Physician:	
8123456-9	**8.5 kg**	**I**	**Rodriguez MD, Jonathan**	

POSITIVE TRIGGERS – 1 | TRIGGER HISTORY | ALL DOCUMENTS | GLOBAL SAFETY RISK | SPECIFIC RISKS | AUDIT LOG

Below is a graph of the Patient's Global Safety Risk Score over time.
Click the "i" icon in the top right section of the page for more information.

Updated: 6/23/2014 06:52:30
BETA VERSION

The data shown here is NOT RELATED to the Positive Triggers tab.



The data elements in the table below contribute to this patient's cumulative safety risk, represented by the Global Safety Risk score.
They reflect parts of the patient's current clinical state as well as clinical information that occurred earlier in the hospitalization.

You can click each GSR score to see the data elements for that specific score

Currently Viewing: **01/22/2014 05:00:00 | GSR: MODERATE 18**

RANKING	DATA ELEMENT	VALUE	DATE/TIME
1	Hct	21.7%	01/07/2015 11:23:31
2	Number of surgies	2	01/06/2015 11:44:00
3	Hgb	6.9 g/dL	01/07/2015 11:23:31
4	WBC	20.9X10'3/microL	01/07/2015 11:23:31
5	Platelet	674.0x10'3/microL	01/06/2015 11:44:00
6	Platelet	674.0x10'3/microL	01/06/2015 11:44:00
7	Braden Total	16.0	12/28/2014 20:00:00

Safety Dashboard

BETA VERSION

Southwest Regional, Johnson Hospital Memorial Medical Center

In Patient Unit

Johnson Hopital Memorial Medical Center ▾ ⚙

ICU-JHMMC

Patients in thins Unit by **Global Safety Risk** ⓘ

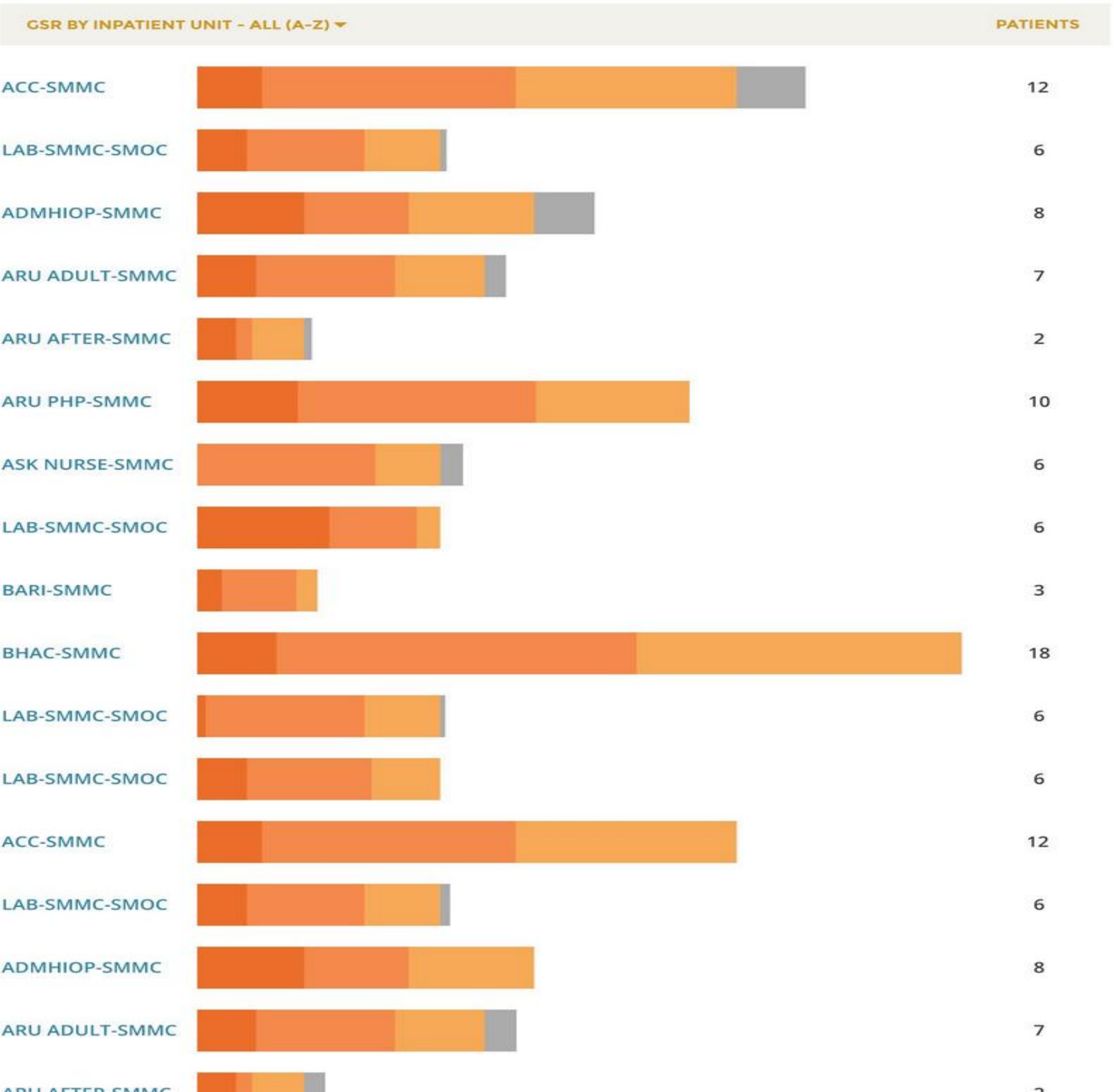
15 PATIENTS **3** HIGH **5** MODERATE **7** LOW

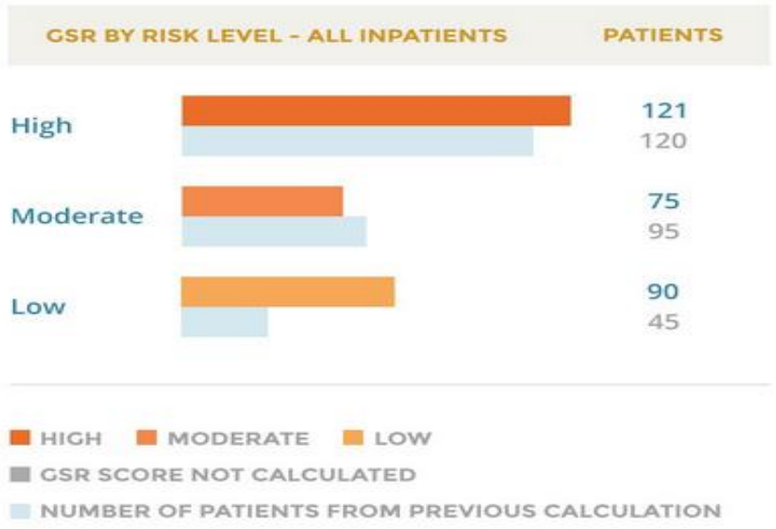
CURRENT GLOBAL SAFETY RISK ▾	PATIENT NAME	AS OF	ROOM	POSITIVE TRIGGERS	AEs
↗ HIGH .84	Allen, Jonathan	8/5/2014 06:57	305-2	3	1
↘ HIGH .7	Alejo, Smith	9/5/2014 07:57	302-1	2	2
↗ HIGH .62	Matthew, James	8/5/2014 06:57	307-4	-	1
↘ MODERATE .58	Bennet, Jacob	8/5/2014 06:57	305-5	2	1
↘ MODERATE .57	Allen, Jonathan	8/5/2014 06:57	205-1	3	1
↗ MODERATE .51	Robinson, Alicia	8/5/2014 06:57	305-2	-	1
↗ MODERATE .46	Alejo, Smith	8/5/2014 06:57	300-1	-	1
↗ MODERATE .42	Allen, Jonathan	8/7/2014 07:33	305-2	-	1
↘ LOW .23	Matthew, James	8/5/2014 06:57	101-1	3	1
↗ LOW .2	Bennet, Jacob	8/5/2014 06:57	305-2	1	1

Risk Trigger Monitoring

Safety Dashboard
Southwest Regional: County Hospital Memorial Medical Center

Latest Global Safety Risk (GSR) score calculation: **03/09/2015 05:00**





ROBERT WOOD JOHNSON PROJECT

Share real time EHR based electronic safety information with patients, families, and care givers across multiple IT platforms as part of their own integrated care across the continuum of care

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John Smith

Born: 1/1/1960

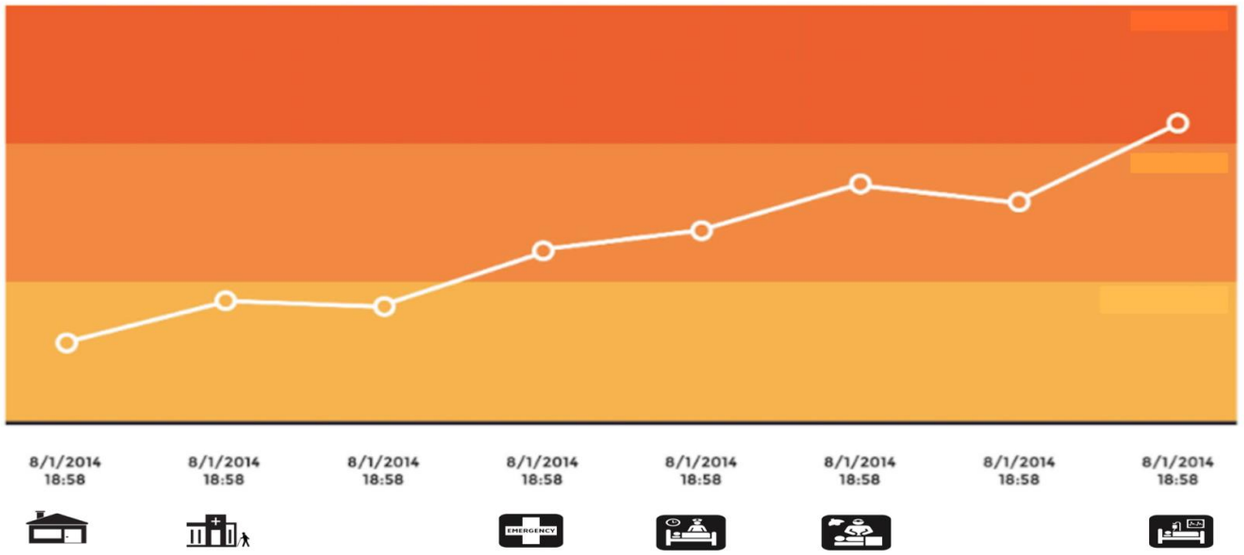
My Safety Advisor

Overall Risk Score

Nurse Manager:

Jill Jones

Contact info



1d **3d** 1wk 1mo all

My Safety Issues	Questions you should ask	Things you can do	More Information
Today			
You have tested positive for a bacteria in your urine	Why did this happen? What can I do to prevent this from happening again? What will you do to prevent this from happening again?	Talk to your doctor and nurses to make sure you understand why this happened and how this should be treated , and how it can be avoided in the future Make sure you understand the source of this infection and how it is being treated If you leave the hospital with a urinary catheter in place make sure you have detailed instructions for how to care for it	Medline Plus on Urine Culture
Yesterday			
Your stool has tested positive for a bacteria called C. difficile	Why did this happen? What can I do to prevent this from happening again? What will you do to prevent this from happening again *Make note of your question here...*	Always wash your hands and nails before eating and after using the restroom Make sure everyone who treats you in the hospital (doctors, nurses, therapists, etc.) Wash their hand before and after seeing you At home make sure all clothes are washed with soap and bleach	Medline Plus on C. Difficile

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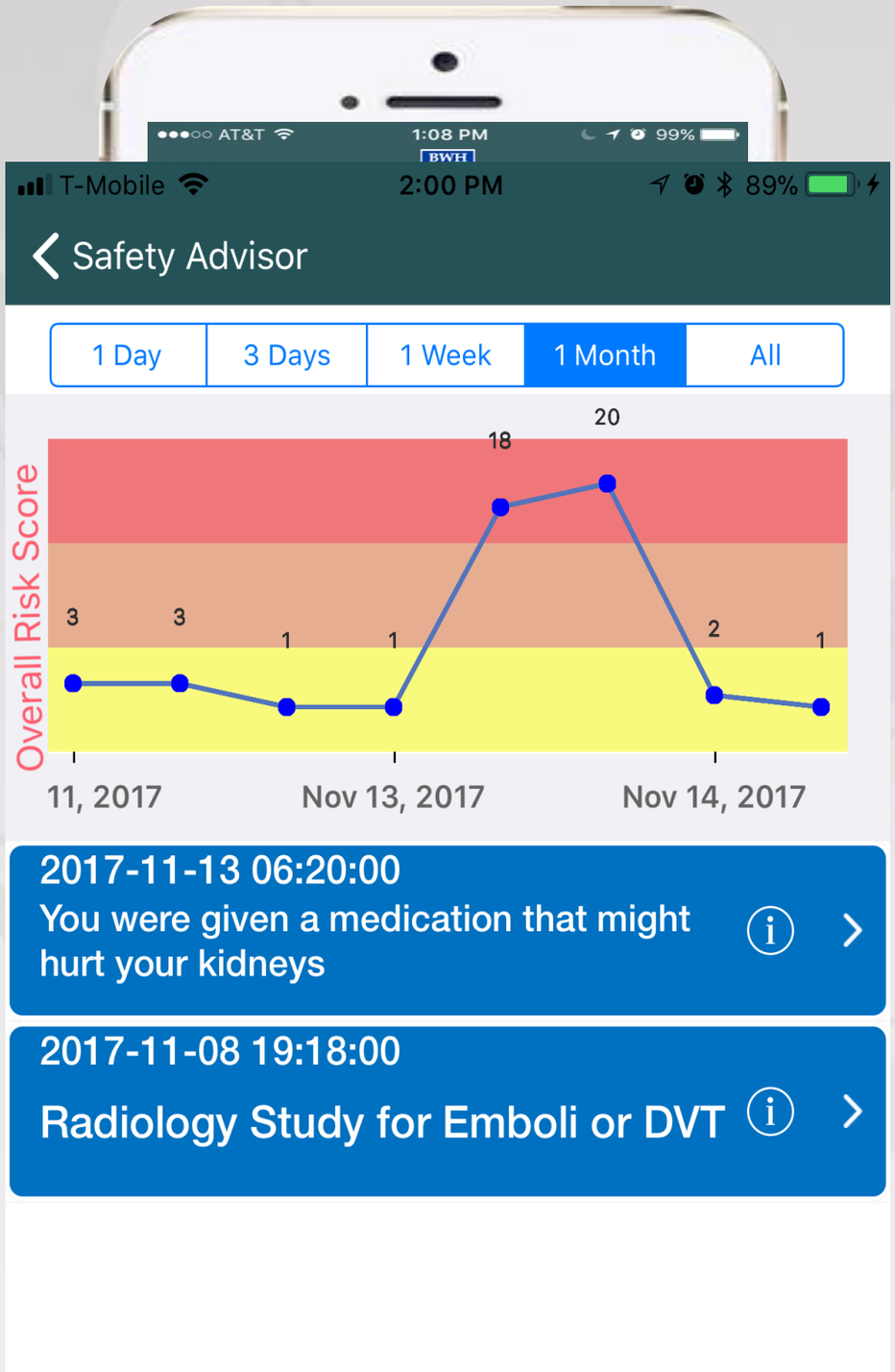
Real Time Safety Patient Mobile App



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Clinical Trial Impact on Patient Outcomes

Primary Outcomes

- Higher PAM Scores in E Dashboard User
- Lower 30 day readmission in High E Dashboard User
- Lower 30 day mortality in High E E Dashboard User

Secondary Outcomes

- No Increase in Fear Response
- Very Good Patient Acceptance and Value
- Good Usability Scores
- Heavy use of I-Phone and Family at Home Use

I ALREADY REGRET ADDING ARTIFICIAL INTELLIGENCE TO OUR COFFEE MAKER.
IT'S WITHHOLDING COFFEE UNTIL WE GIVE IT A PRIVATE OFFICE.
STUPID MACHINE!
THAT' LL COST YOU A BITCOIN

Steam
*Fresh Care

Sensing Wash Rinse Spin

AI

Pre-wash
*Remote Start

Extra Hot Extra High Heavy Fresh Care

Warm Medium Normal

Delay Wash
*Wi-Fi

Tap Cold No Spin Light On/Off

Add Item | Temp. | Spin | Soil | Signal

Cold Wa

Extra Rins

Rinse+Spin
*Control Lock

All Cold Rinses

INVERTER
DIRECT DRIVE
MOTOR

10 YEAR
WARRANTY

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Artificial Intelligence-Definitions

The theory and development of computer systems able to perform tasks that normally require human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages (Oxford)

Artificial Intelligence or sometimes called machine intelligence, is intelligence demonstrated by machines, in contrast to the natural intelligence displayed by humans and other animals. Some of the activities that it is designed to do is speech recognition, learning, planning and problem solving. (Wiki)

Artificial intelligence (AI) applies advanced analysis and logic-based techniques, including machine learning, to interpret events, support and automate decisions, and take actions. (Gartner)

Background- AI at Healthcare Systems

Concise Research Report | Published: 08 April 2022

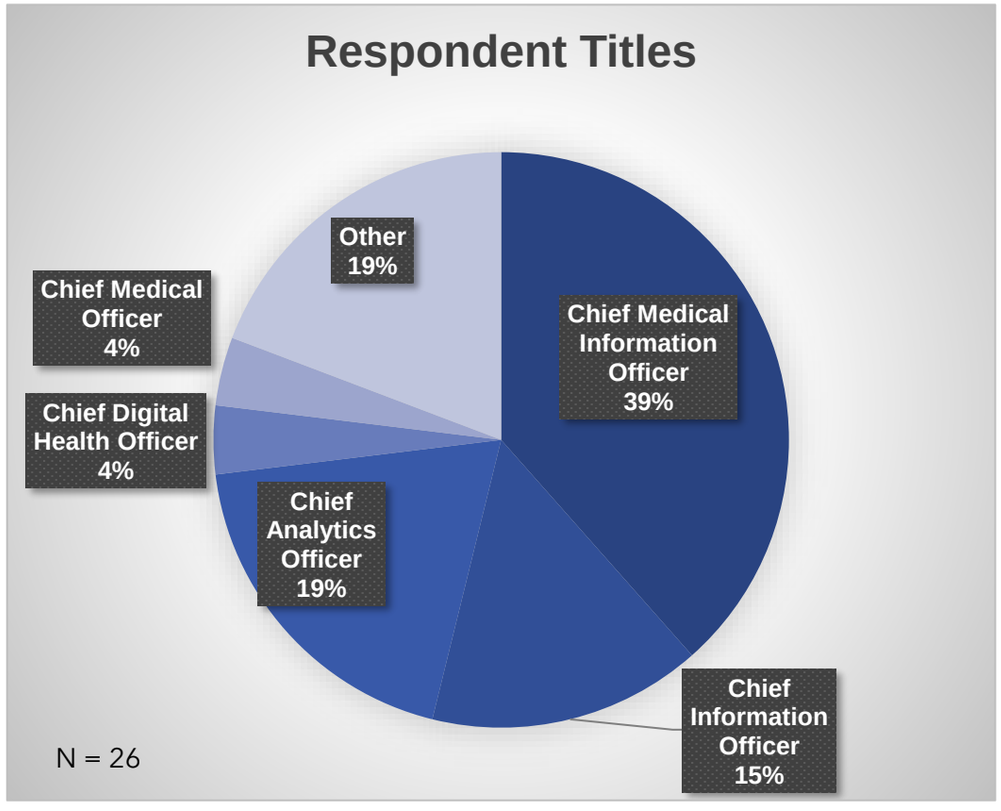
Predictive Analytics Programs at Large Healthcare Systems in the USA: a National Survey

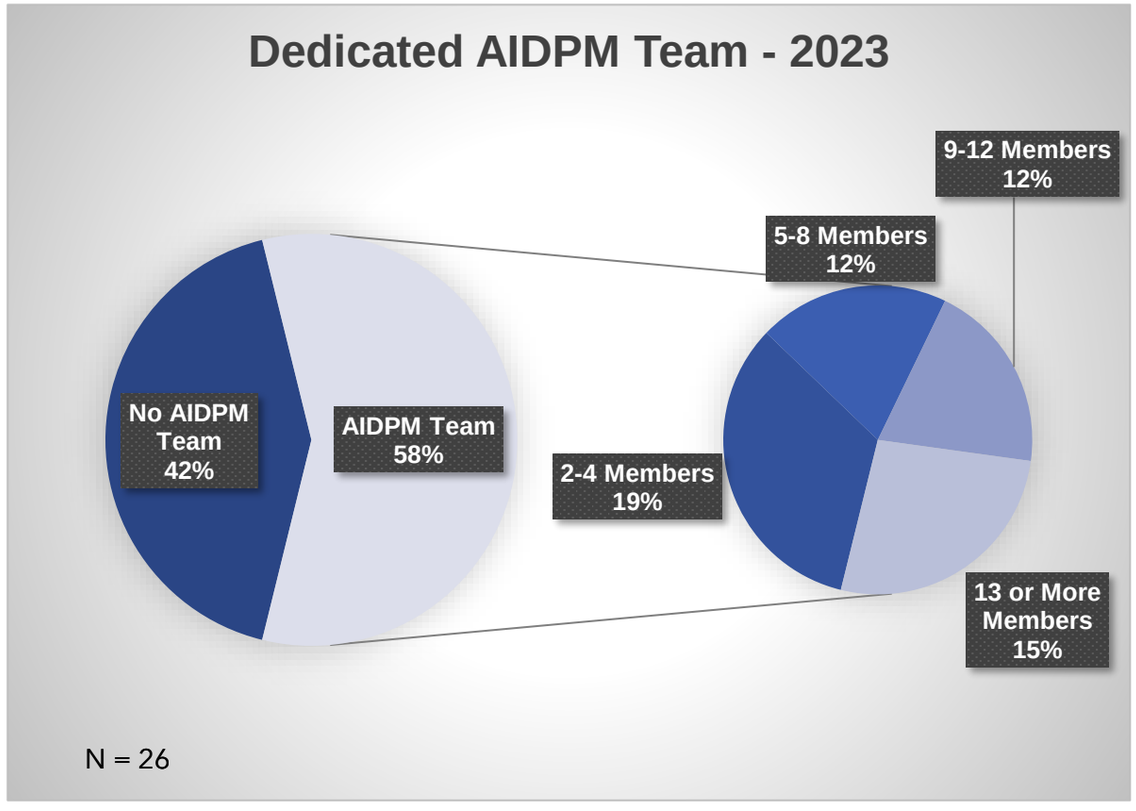
Juan C. Rojas MD, Gordon Rohweder MBA, Janet Guptill MPH, Vineet M. Arora MD, MAPP & Craig A. Umscheid MD, MS

Journal of General Internal Medicine **37**, 4015–4017 (2022) | Cite this article

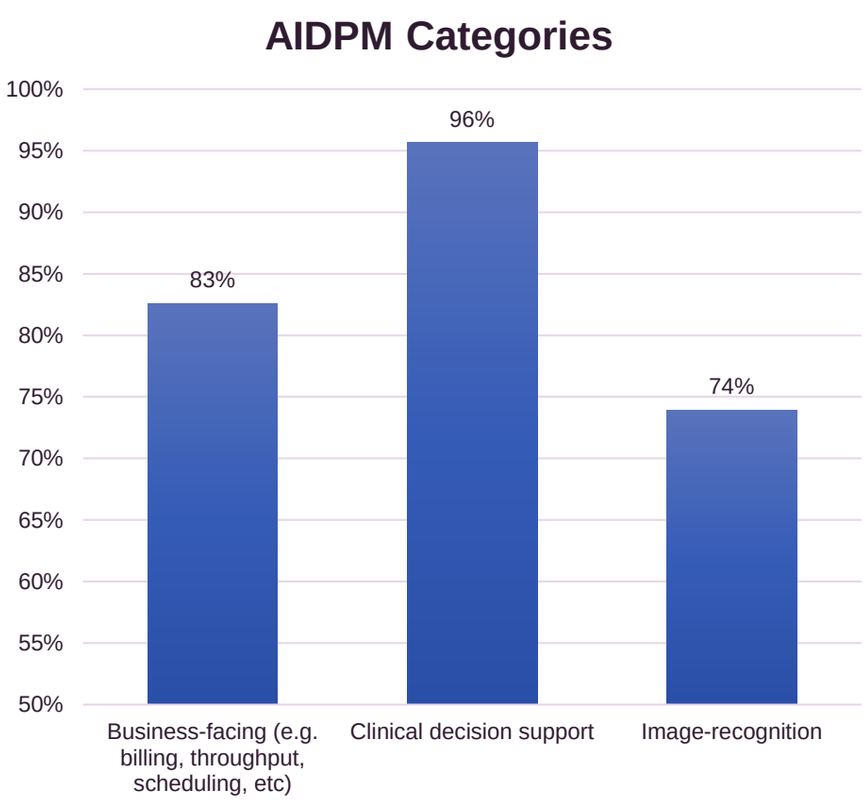
- In 2021, a partnership with SI helped conduct one of the first surveys examining how U.S. healthcare systems integrate artificial intelligence-derived predictive models (AIDPM) into everyday clinical care
- The landscape has changed substantially, so we modified and repeated the study to assess for practice changes, this time with a focus on use cases and on how to integrate health equity into this work
- Response rate 60% (25/42) in 2021, down to 38% (25/65) in 2023, but a wider net was cast

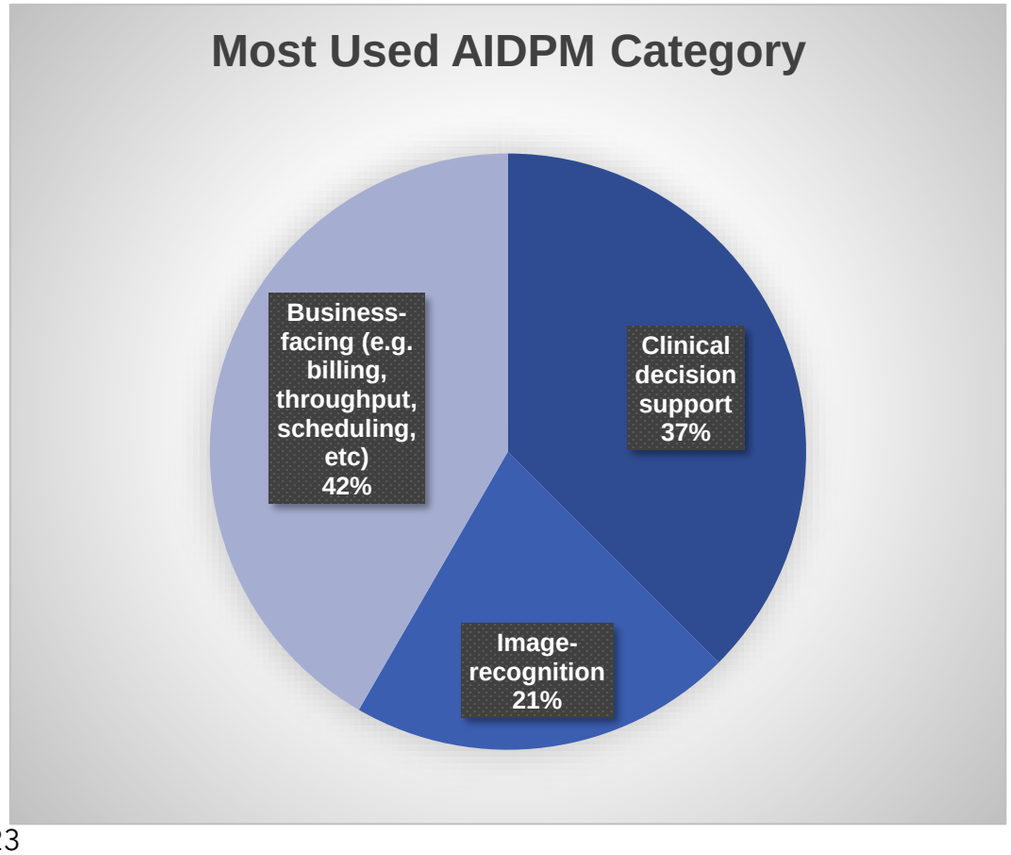
Teams and Governance





Use Cases

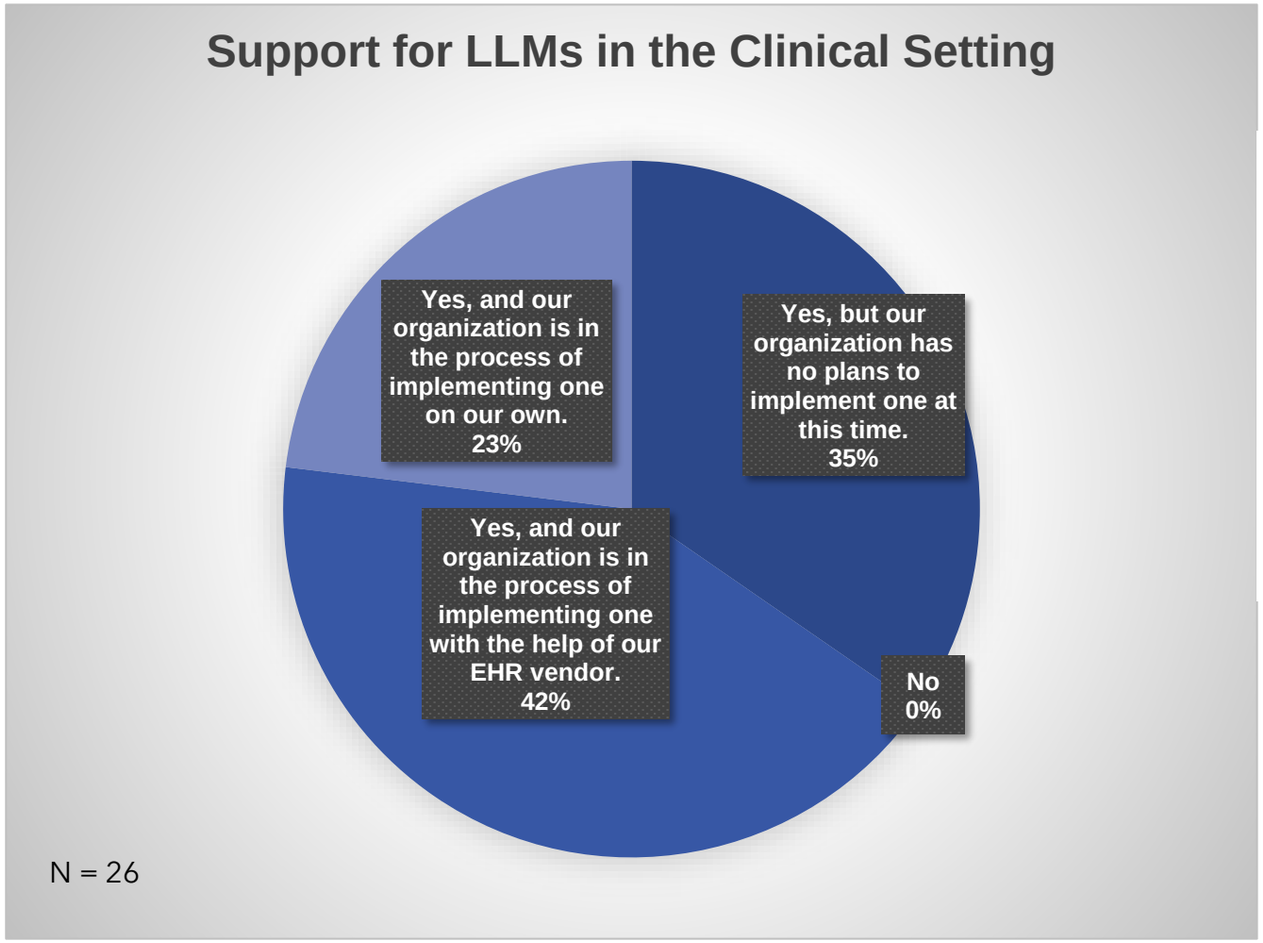




N = 23

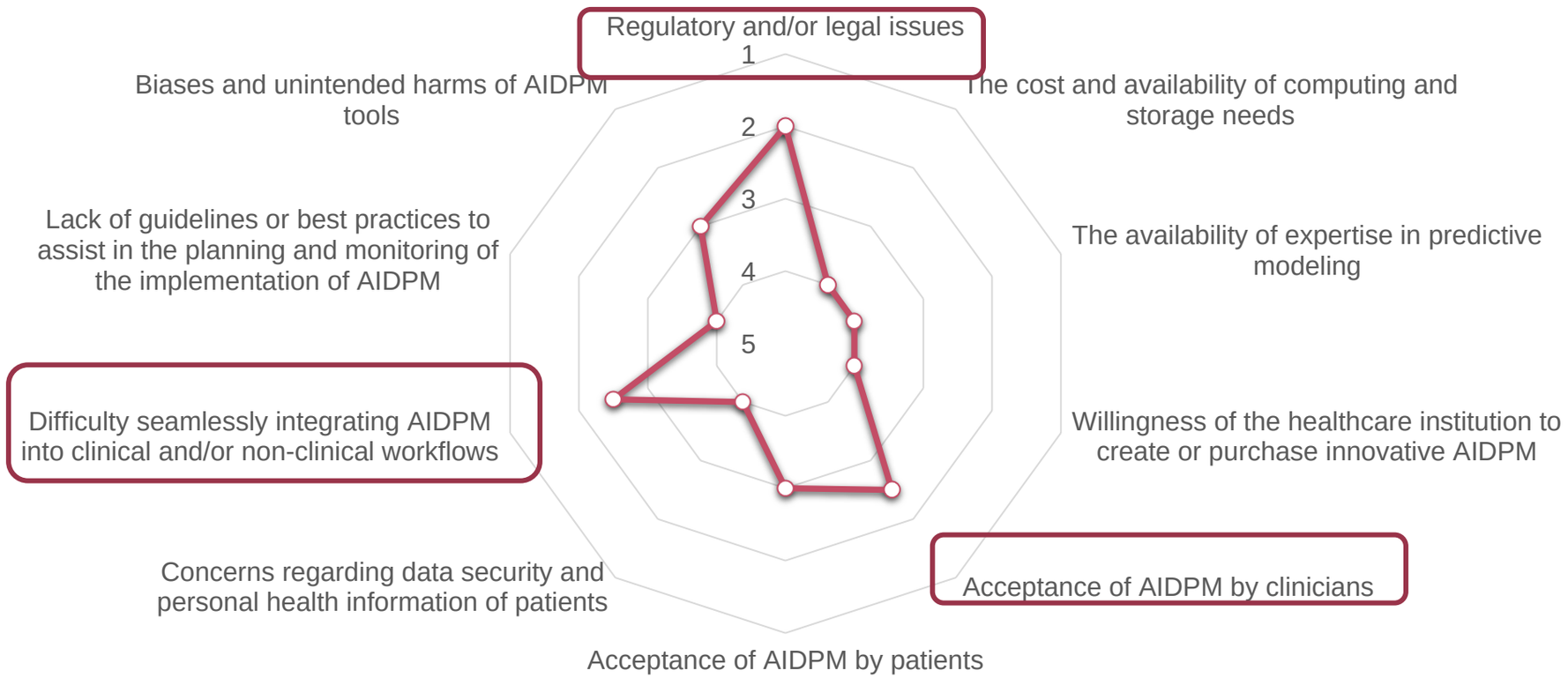
- Although the vast majority of organizations (96%) use their AIDPM to produce CDS tools, when looking at the “most used” categories, business-facing tools come out ahead.

Large Language Models (LLMs)



Examples of planned use cases for LLMs

Barriers to Incorporating AIDPM in Healthcare



N = 26

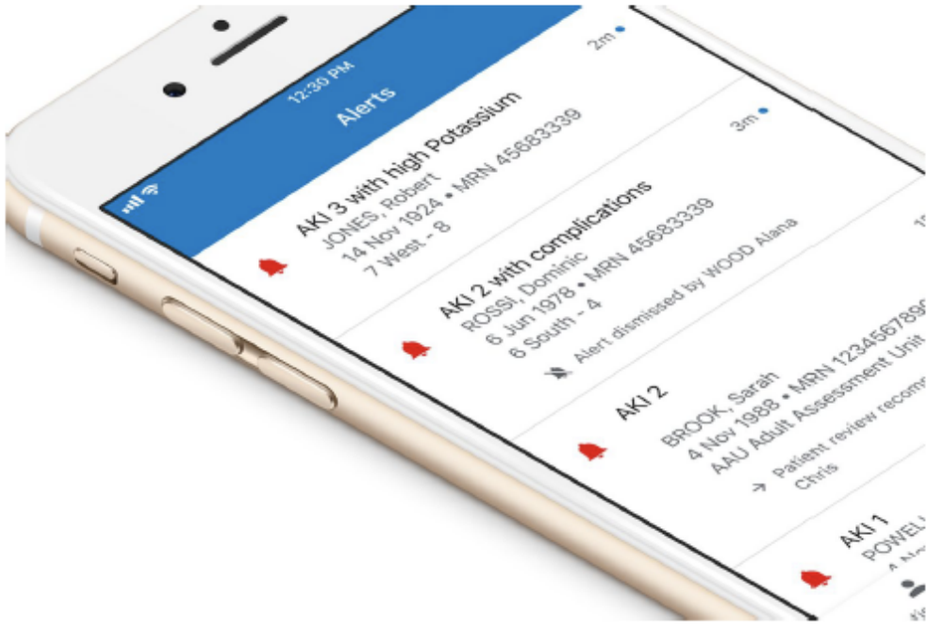
TECH

Google Algorithm Aims to Identify At-Risk Kidney Injury Patients

DeepMind unit's effort marks new application of machine learning in health care, but experts say model needs further testing before being applied in a live hospital setting

By Parmy Olson and Brianna Abbott

July 31, 2019 at 1:00 pm ET



The Streams app can use AI-powered software to detect the risk of kidney damage. PHOTO: DEEPMIND

Google's artificial-intelligence unit says it has developed an algorithm that can predict who

Special Article

A COMPUTER-ASSISTED MANAGEMENT PROGRAM FOR ANTIBIOTICS AND OTHER ANTIINFECTIVE AGENTS

R. Scott Evans, Ph.D., Stanley L. Pestotnik, M.S., R.Ph., David C. Classen, M.D., M.S., Terry P. Clemmer, M.D., Lindell K. Weaver, M.D., James F. Orme, Jr., M.D., James F. Lloyd, B.S., and John P. Burke, M.D.

Abstract

Background and Methods Optimal decisions about the use of antibiotics and other antiinfective agents in critically ill patients require access to a large amount of complex information. We have developed a computerized decision-support program linked to computer-based patient records that can assist physicians in the use of antiinfective agents and improve the quality of care. This program presents epidemiologic information, along with detailed recommendations and warnings. The program recommends antiinfective regimens and courses of therapy for particular patients and provides immediate feedback. We prospectively studied the use of the computerized antiinfectives-management program for one year in a 12-bed intensive care unit.

Results During the intervention period, all 545 patients admitted were cared for with the aid of the antiinfectives-management program. Measures of processes and outcomes were compared with those for the 1136 patients admitted to the same unit dur-

FACED with an increasing loss of autonomy in the managed care marketplace, physicians often view the debate about the quality of care as simply about finding ways to reward them for doing less for patients and to control costs by the use of arbitrary rules for clinical care.[1] Skeptics view quality-of-care projects as a disguised form of marketing; this skepticism will not disappear until physicians can see quality-of-care efforts that make difficult decisions easier and more accurate.[2,3] Establishing systems for improving care is difficult, at best, for groups of specialist physicians, but it is next to impossible for physicians working alone or for those who are employees in large bureaucratic organizations.[4] Both the provision of care and the monitoring of its quality depend on data that are often not available either in paper medical records or in administrative and billing data bases. Elaborate clinical computer systems, which are increasingly

Adjusted Outcomes of Patients Who Received Antiinfective Agents During Intervention Period

VARIABLE	INTERVENTION PERIOD		OVERALL	
	Computer Regimen Followed (N=203)†	Computer Regimen Overridden (N=195)‡	P VALUE	
No. of different antiifective agents ordered	1.5 (1.3-1.7)	2.7 (2.5-3.0)	<0.001	
Duration of antiinfective therapy - hr.	103 (45-160)	330 (270-392)	<0.001	
No. of antiinfective-agent doses	11.4 (6.2-16.7)	27.6 (22.0-33.1)	<0.001	
Days of excessive antiinfective dosage	1.4 (0-2.7)	3.6 (2.0-5.1)	<0.001	
Cost of antiinfective agents - $	102 (0-206)	427 (316-538)	<0.001	
No. of microbiology cultures	3.2 (1.5-4.9)	10.6 (8.7-12.6)	<0.001	
Length of stay in ICU - days	2.7 (1.5-4.0)	8.3 (7.0-9.5)	<0.001	
Days from ICU admission to hospital discharge	7.8 (5.9-9.7)	14.3 (12.2-16.3)	<0.001	
Total length of stay - days	10.0 (7.7-12.3)	16.7 (14.2-19.1)	<0.001	
Total cost of hospitalization - $	26,315 (20,393-32,237)	44,865 (38,564-51,166)	<0.001	

***Values shown are means per patient and 95 percent confidence intervals. Outcome variables have been adjusted for age, sex, Computer Severity Index score on admission to the Shock-Truama-Respiratory Intensi Care Unit (ICU), medical service, and mortality.**

†These patients always received the computer-suggested antiinfective regimen.

‡These patients did not always receive the computer-suggested antiinfective regimen.

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IHC Antibiotic Assistant

000000000 Doe, Jane Q E606 67yr F Dx:ABD SEPSIS
» Max 24 hr WBC=21.0↓ (21.3) Admit:07/27/98.14:55 Max 24hr Temp=38.7↑ (38.
Patient's Diff shows a left shift, max 24hr bands = 22 ↑ (11)
» RENAL FUNCTION: Decreased, CrCl = 50, Max 24hr Cr= 1.0↓ (1.1) IBWeight: 58
» ANTIBIOTIC ALLERGIES: Ampicillin,
» CURRENT ANTIBIOTICS:
1. 07/29/98 5DAYS TROVAFLOXACIN (TROVAN), VIAL 300. Q 24 hrs
2. 08/01/98 2DAYS AMPHOTERICIN B (FUNGIZONE), VIAL 35Q 24 hrs
Total amphotericin given = 70mg K= 3.6mg/dl 08/03/98 MAG= 2.5mg/dl 08/03/
» » » IDENTIFIED PATHOGENS SITE COLLECTED
p Gram negative Bacilli Peritoneal Fluid 07/27/98.17:12
Yeast Peritoneal Fluid 07/27/98.17:12
Torulopsis glabrata Peritoneal Fluid 07/27/98.17:12

» THERAPEUTIC SUGGESTION	DOSAGE	ROUTE	INTERVAL
Imipenem	500mg	IV	*q12h (infuse over 1hr)
Amphotericin B	35mg	IV	q24h(infuse over 2-4hrs)

Suggested Antibiotic Duration: 10 days
*Adjusted based on patient's renal function.
P=Prelim; Susceptibilities based on antibiogram or same pathogen w/ suscept.
<1>Micro <2>OrganismSuscept, <3>Drug Info, <4>ExplainLogic, <5>Empiric Abx,
<6>Abx Hx <7>ID Rnds, <8>Lab/Abx Levels, <9>Xray, <10>Data Input Screen,
<Esc>EXIT, <F1>Help, <0>UserInput, <.>OutpatientModels, <+orF12>Change Pa
↑↓, ORDER:<*>Suggested Abx, <Enter>Other Abx, </>D/C Abx, < - >Modify Abx,

Logic Used to Help Select Suggested Antibiotics

Patient should receive IV antibiotics.
Suggested antibiotics are not one of patient's known antibiotic allergies.
Renal function dictates that dosage should be adjusted.
Coagulase negative Staph. In sputum or urine was not considered a pathogen.
Cultures show fungi or yeast that were not considered pathogens.
Aminoglycosides potentiate ototoxicity if administered with loop diuretics.
Amphotericin B is suggested for serious fungus infections.
S. maltophilia is generally not pathogenic unless found in sterile site.
A staph or gram+ cocci reported in the blood was considered a contaminant.
***Ceftazidime is usually suggested until gram negative bacillus is identified.**
Suggested antibiotics should include Rx for possible abdominal anaerobes.
Suggest fluconazole for C. albicans in non immunosupressed patients.
Prophylactic antibiotics are not suggested for this patient at this time.
Identified pathogens are covered by the suggested antibiotic(s).
Suggested antibiotic(s) are least expensive of the appropriate antibiotics.

The antibiotic suggestions should not replace clinical judgement.
Press the 'Enter' key for next screen. . .

IHC ANTIBIOTIC ASSISTANT-Empiric Use

000000000 Doe, John Q E605 22yr M Dx: TRAUMA, MULTIPLE FX

SITE = Blood

Inpatient Hospital - acquired

PAST 5 YEARS

ORGANISM	#	(%)
Staph. Coagulase neg.	208	(61)
Enterococcus	28	(8)
Escherichia coli	27	(8)
Staph. Aureus	18	(5)
Pseudomonas aeruginosa	13	(4)
TOTAL	294	(86)

PAST 6 MONTHS

ORGANISM	#	(%)
Staph. Coagulase neg.	14	(50)
Escherichia coli	8	(29)
Enterobacter cloacae	2	(7)
Staph. Aureus	1	(4)
Pseudomonas aeruginosa	1.	(4)
TOTAL	26	(94)

ANTIBIOTIC	(%)	COST/24hr
Vancomyc+Amikacin	(99)	$116.33
Vancomyc+Ticar/cla	(99)	74.53
Vancomyc+Tobramyci	(98)	46.67
Vancomyc+Ceftazidi	(98)	57.03
Vancomyc+Aztreonam	(98)	60.24

ANTIBIOTIC	(%)	COST/24hr
Vancomyc+Tobramyci	(100)	$ 46.67
Vancomyc+Amikacin	(100)	116.33
Vancomyc+Piperacil	(100)	74.97
Vancomyc+Ceftazidi	(100)	57.03
Vancomyc+Aztreonam	(100)	60.24

EMPIRIC ANTIBIOTIC SUGGESTION: Vancomyc+Tobramyci

»ANTIBIOTIC ALLERGIES: None reported

»RENAL FUNCTION: Normal, CrCl: >120, Max 24hr Cr= .6↓ (.7) IBWeight: 67kg

Enter <*> to order suggested antibiotics, press <Enter> to continue. . .

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ANTIBIOTIC HISTORY

07/27/98.15:49-07/27/98.19:51 IMIPENEM/CILASTATIN (PRIMAXIN), VIAL 500.
AS D
07/27/98.19:51-07/27/98.19:43 IMIPENEM/CILASTATIN (PRIMAXIN), VIAL 500.
Q 6
07/28/98.09:45-08/01/98.10:38 FLUCONAZOLE IN NS (DIFLUCAN), IVPB 400.
Q 24
07/28/98.19:43-07/29/98.16:07 IMIPENEM/CILASTATIN (PRIMAXIN), VIAL 500.
Q 8
07/29/98.15:53- TROVAFLOXACIN (TROVAN), VIAL 500.Q 24
08/01/98.10:09-08/03/98.07:26 VANCOMYCIN (VANCOCIN), VIAL 1000. Q
08/01/98.10:38-08/01/98.12:37 AMPHOTERICIN B (FUNGIZONE),VIAL 35 Q
08/01/98.12:37- AMPHOTERICIN B (FUNGIZONE), VIAL 35. Q 24
08/03/98.07:26-08/03/98.07:29 VANCOMYCIN (VANCOCIN), VIAL 1000. Q
08/03/98.07:29- VANCOMYCIN (VANCOCIN), VIAL 1000.Q 24
K= 3.6mg/dl 08/03/98 MAG= 2.5mg/dl 08/03/98

Press <Enter> to return

THE UNIVERSITY OF UTAH

PATIENT NAME Pt. # E605 I 07/26/98 C 22Y M

07/29/98.22:38 -RESPC (ROUTINE CULTURES) -Complete/Final/Verified-

Source: Sputum Suctioned
Stain: Gram. 2+ PMNs, Rare Gram Positive Cocci, Rare Gram Positive Baci
Findings: Mixed Oral Flora
Result: 2+ Staphylococcus aureus
S: Cefazolin, Cefotaxime, Ceftriaxone, Cefuroxime, Clindamycin
Levofloxacin, Nagcillin, Tetracycline, Trimethoprim/Sulfa
R: Ampicillin, Penicillin
Method: MIC
Result: 2+ Neisseria species
Result: 2+ Hemophilus species
Findings: Beta Lactamase Negative
Result: 2+ Streptococcus alpha hemolytic
Result: 1+ Yeast
Result: 1+ Streptococcus beta hemolytic, Not Group A
Result: 1+ Diphtheroids Bacilli

07/29/98.22:26 -BLDC (BLD CULTURE) -Complete/Final/Verified-

Source: Blood Right ARM
Findings: No Growth in 5da

-Press <Enter> to continue, <Esc> to quit, <Page Up>, <Page Down> or Arrow keys

IHC ANTIBIOTIC MONOGRAPH

1. ANTIBIOTIC: IMIPENEM
2. DOSAGE: 500mg IV q6h (infuse over 1hr)
3. ADMINISTRATION: Drug should be diluted in at least 100ml of compatible fluid and infused over 40-60 minutes.
4. PATIENT IV COST/24hr: $75.92 500mg IV q6h (infuse over 1hr)
5. AVERAGE PO COST/24hr: IV Drug Only
6. INDICATIONS: Extremely broad spectrum of activity including, gram-positive, gram negative, and anaerobic organisms. In addition to its broad spectrum of activity, the drug is extremely beta-lactamase stable. Imipenem is often active against P. aeruginosa that is resistant to other antimicrobials. It is the DRUG OF FIRST CHOICE for Acinetobacter. Its use in meningitis is currently not recommended.
7. PROPHYLAXIS: Not indicated.
8. PHARMACOLOGY: Peak serum conc.= 30-40mcg/ml (500mg); Protein binding= 20%; Half-life= 0.9hrs; Vd= 0.15 L/kg; 70% excreted unchanged in the urine. Renal Failure: CLcr= 80-50 ml/min: 0.5g q6-8h; 50-10 ml/min: 0.5g q8-12h; <10 ml/min: 0.25-0.5g q12h. Hemodialysis: 0.25-0.5g dose after dialysis.

Press the ‘Enter’ key for next screen. . .

Reasons for Antibiotic Disagreement

ANTIBIOTICS NEEDED . . .

1. **Patient has infection that is not identified by computer program.**
2. **Computer suggested antibiotics are not adequate for patient's therapy.**
3. **Patient has positive cultures collected before admission to this hospital.**
4. **Patient has positive Xray taken before admission to this hospital.**
5. **Patient's Xrays suggest antibiotic therapy is needed.**
6. **Patient's admit diagnosis warrants the use of antibiotic therapy.**
7. **Patient needs antibiotic(s) for surgical prophylaxis.**
8. **Patient needs antibiotic(s) due to contaminated or dirty surgery.**
9. **Do not agree with dosage suggested by computer program.**

ANTIBIOTICS NOT NEEDED . . .

10. **Computer identified pathogens are incorrect.**
11. **Do not believe computer identified respiratory infection is correct.**
12. **Patient's Xrays do not warrant antibiotic therapy.**
13. **Other**

Please select the main reason why you do not agree with the computer suggested antibiotic therapy for this patient.

Questions?