Meaningful Use IT reduces hospital-caused adverse drug events even at challenged hospitals ☆

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ABSTRACT

Background: many Meaningful Use (MU) requirements involve medication management. Little is known about what impact these will have on adverse drug events (ADEs) at challenged hospitals.
Methods: we use the Florida State Inpatient Database (HCUP, AHRQ), the AHA IT Supplement, and Hospital Compare. Controlling for non-response selection bias, we use multi-level GLLAMM regression analysis to examine the impact of the 5 core MU medication elements on hospital-caused ADEs.
Results: adopting all 5 core MU elements was associated with a reduction in ADEs. Hospitals reporting costs as the main barrier to MU reduced their ADE rates by 35%; low quality hospitals reduced ADEs by 29%, compared to 27% at high quality hospitals. Among hospitals reporting these medication elements among their top MU challenges, ADEs were reduced by 69%, compared to 45% for hospitals with no drug functions as their top MU challenges. However, ADEs increased by 14% at hospitals with physician resistance to MU, compared to a 52% ADE reduction without physician resistance.
Conclusions: the bundling all five medication functions in MU is associated with large reductions in ADEs.
Implications: without physician buy-in at the hospital, MU will have no impact on ADEs.

Published by Elsevier Inc.

1. Introduction

Prior to the implementation of the Health Information Technology for Economic and Clinical Health (HITECH) Act in 2011, Meaningful Use (MU) adoption of EMR (electronic medical records) was relatively low. Only 1.6% of hospitals in 2009 had EMRs that satisfied the HITECH rules for MU.[13] As of November, 2013, 4610 hospitals had received a HITECH incentive payment, at a total of $6.8 billion paid out to hospitals. Thus, HITECH is working as planned in terms of encouraging adoption. To now assess the impact of MU on patient outcomes, one must consider the fact that five of the fourteen core Stage 1 MU requirements involve medication management. This emphasis on medication management is rightly placed. We estimate that adverse drug events composed close to 40% of all adverse events in hospitals in the 2010 Medicare Patient Safety Monitoring System (authors' computations, and MPSMS[17]). Overall, from the MPSMS data, 888,000 adverse drug events are experienced among Medicare

patients in U.S. hospitals each year.[4] And, it is likely that MU EMR can help reduce this large occurrence of adverse drug events, according to many reports, ranging from the IOM Reports, *Key Capabilities of an Electronic Health Record System*[10] and *Health IT and Patient Safety*: *Building Safer Systems for Better Care*,[11] to the recent AHRQ Evidence-Based Report, *Enabling Medication Management Through Health Information Technology*,[16,19] and the federal *Health Information Technology Patient Safety Action* & *Surveillance Plan*.[18]

In this paper, we assess the impact of the five core Stage 1 MU medication functions on adverse drug events among early MU adopters in 2010 as reported by the American Hospital Association before the official roll out of the HITECH MU invective program in 2011. We address this major issue by developing one of the first measures of hospital-caused adverse drug events that can be used on large scale administrative datasets. We then use the measure on all 2.4 million hospitalizations in Florida to measure the impact of the five Meaningful Use core medication management components on the prevention of adverse medication events across the full spectrum of hospitals. We include all hospitals in Florida, and present some sub-analyses of low quality hospitals versus high quality hospitals, hospitals with physician resistance to EMR adoption, hospitals with major cost barriers to EMR adoption, and hospitals that admit that meaningful use implementation will be a challenge.

2. Methods

2.1. Data

We use three data sets. Firstly, we use the 2010 Florida State Inpatient Database from the Agency for Healthcare Research and Quality's Healthcare Cost and Utilization Project,[7] containing all 2.64 million inpatient hospitalizations in Florida. We selected Florida since it has very accurately coded "present on admission" diagnosis data, especially for ICD-9 E-codes (injury codes). Secondly, our electronic medical record data is the Information Technology (IT) Supplement to the American Hospital Association's[1] 2010 Annual Survey. (See Jha et al.[12] for a description of this survey.) 2010 was the first year that this survey asked questions about Meaningful Use. Thirdly, we use the 2010 Medicare Hospital Compare data in order to use Medicare's hospital quality measures.

2.2. Hospital-caused adverse drug events

To identify adverse drug events, we use the algorithm developed by Lucado et al.[15] However, many of these adverse events identified by the algorithm may have occurred outside of the hospitalization. To identify only those adverse events that occur during that hospitalization, we redesigned the algorithm to flag adverse events that were coded as not being present on admission (POA). The POA codes used in the HCUP data have been validated.[5] Following Houchens et al.[9] and the HCUP Present on Admission Report,[5] we screened out a few hospitals (5% of the hospitalizations) that had either more than 95% of their diagnoses coded as present on admission or more than 20% with present on admission missing. We find that while 6% of hospitalizations had an adverse drug event, only 1.7% of hospitalizations had adverse drug events that occurred in the hospital. We will focus on these latter adverse events occurring in the hospital.

2.3. Meaningful Use

In the 2010 AHA IT supplement, we can identify hospitals that by 2010 had implemented the five DHHS Stage 1 Meaningful Use core measures that pertain to medication management. These five measures and their adoption rates are reported in Table 1:

1. Use computerized ordered entry (CPOE) for medication orders.
2. Implement decision support system for drug–drug and drug–allergy interaction checks.
3. Capability to exchange key clinical information (for example, problem list, medication list, medication allergies, and diagnostic test results) among providers electronically.
4. Maintain active medication list.
5. Maintain active medication allergy list.

Moreover, the 2010 AHA IT supplement allowed hospitals to report their top two expected challenges for implementing Stage 1 Meaningful Use EMR in 2011 out of eight possible challenges. Four of the eight challenges pertain to the five core medication management measures listed above (core measures 4 and 5, medication list and medication allergy list, are subsumed under the challenge "generate problem lists"). In Table 1, we also report what percent of hospitals view each of the five core medication measures as one of the top two challenges in implementing Meaningful Use.

2.4. Regression analyses

We use multivariate logistic regression analyses to examine the relationship between adopting all of the five core Meaningful Use medication management measures and the probability that a hospitalization will have an adverse drug event. Since the regressions are at the patient level and since the Meaningful Use variables are at the

Table 1
The five Meaningful Use medication management components across hospitals.

MU medication management components	Percent of hospitals who say this medication component is among their top 2 MU challenges	Percent of hospitals actually adopting this MU component	Percent of hospitals with physician resistance to MU	Hospital-caused adverse drug event rate
CPOE	38.43%	20.56%	52.68%	1.55%
Exchange medication history with outside providers	25.02%	65.29%	55.16%	1.89%
Decision support on drug–drug interaction alerts	15.41%	79.37%	57.02%	1.94%
Comprehensive list of allergies including medications	16.13%	82.66%	55.84%	1.79%
List of patients' current medications	16.13%	95.52%	53.77%	1.83%
Type of Hospital	Percent of Hospitals with any medication component as one of their top 2 MU challenges	Percent of Hospitals Of this type	Percent of Hospitals with physician resistance to MU	Hospital-Caused Adverse Drug Event Rate
Their top two MU challenges are among these 5 components	–	37.94%	62.91%	2.25%
Adopted all 5 components	28.52%	9.90%	55.91%	1.36%
Adopted none of the 5 components	44.47%	3.00%	100.00%	1.72%
Physician resistance to MU	43.39%	55.01%	–	1.61%
High Quality Hospital	22.16%	13.26%	69.40%	1.37%
Low Quality Hospital	41.09%	13.48%	25.18%	1.65%
Costs as the Main Barrier to MU	45.26%	15.66%	85.20%	1.39%
All Hospitals	37.94%	–	55.01%	1.83%

Notes: hospital-level rates. N = 74. 2010 AHA IT Survey, Florida hospitals. Adverse drug event rates computed from 2010 the Florida Inpatient Database. MU—Meaningful Use. A hospital is high quality if its risk adjusted mortality rates for either heart attack, heart failure, or pneumonia were rated as "better than the U.S. national rate" in Hospital Compare. Hospital were rated low quality if they were not high quality and their rates for either heart attack, heart failure, or pneumonia were rated "worse than the U.S. national rate."