Levels of Adoption of Electronic Health Records and Patient Safety: Effectiveness and Efficiency

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Background
- Patient safety, including hospital acquired infections has become one of the major concerns in healthcare delivery in recent years.
- Electronic health records are becoming an integral aspect of the health care delivery system.
- Health policies have been looking to improve quality / patient safety and efficiency of healthcare through the adoption of electronic health record (EHR) systems.

Research Questions & Hypotheses

- Can EHR adoption improve patient safety?
- Can EHR adoption reduce costs?
- H1: Patients treated at hospitals with a higher level of EHR adoption are less likely to incur poorer patient safety indicators.
- H2: Patients treated at hospitals with a higher level of EHR adoption are more likely to incur lower costs for their respective patient safety indicators.

Methods

Design and Data
- Study design: Cross-sectional
- Unit of analysis: Hospital discharge
- Data: Mainly the 2009 National Inpatient Sample (NIS) and the 2009 American Hospital Association (AHA) electronic health record (EHR) implementation survey
- Plus the AHA annual survey data and the Agency for Healthcare Research and Quality (AHRQ) cost-charge ratio file.

Measures
- Dependent variable set I: 9 AHRQ patient safety indicators
  - Pressure ulcer
  - Death among surgeries
  - Postoperative pulmonary embolism or deep vein thrombosis
  - Postoperative hemorrhage or hematoma
  - Postoperative wound dehiscence
  - Postoperative physiologic metabolism derangement
  - Accidental puncture/laceration
  - Postoperative respiratory failure
- Dependent variable set II: costs for the 9 patient safety indicators, respectively
- Independent variable: Level of EHR adoption
  - Comprehensive EHR system (the highest level): 24 electronic functions present in all major clinical units
  - Electronic clinical documentation (e.g., patient demographics, MD notes, discharge summaries)
  - Results viewing (e.g., lab reports, diagnostic test images)
  - Computerized provider order entry (CPOE)
  - Decision support (e.g., clinical guidelines, drug allergy alerts)
  - Bar coding (e.g., tracking pharmaceuticals)
  - Others (e.g., telemedicine)
- Basic EHR system
  - No electronic functions present in all major clinical units
- Below basic EHR system or no “real” EHR systems
- Neither comprehensive EHR nor basic EHR

Analyses

Risk adjustment
- Patient demographics: age, sex, race
- The AHRQ’s 29 comorbidities, as well as AMI, cancer, diabetes, obesity, paralysis, and weight loss.

Control variables
- Patient level: Health insurance status
- Hospital level:
  - Structure: Bed size, ownership type, teaching affiliation, system membership, and network participation
  - Operation: FTE nurses per 1,000 adjusted patient days and average daily census per staffed bed
  - Environment: Percentage of Medicare patients, percentage of Medicaid patients, capitation based reimbursement, market competitiveness, rural or urban hospital, and hospital region

Results

9 Patient Safety Indicators
- 7 had no differences across the level of EHR adoption and the remaining 2 showed mixed results.
- Pressure ulcer
  - As compared to those who went to hospitals without EHR adoption, patients who stayed in hospitals with both full EHR and basic EHR were less likely to experience pressure ulcers (0.66 [0.56, 0.78] and 0.74 [0.68, 0.79]).
- Postoperative hemorrhage or hematoma (PHH)
  - As compared to those who went to hospitals without EHR adoption, patients who stayed in hospitals with full EHR were more likely to experience PHH (1.41 [1.19, 1.66]) while patients who stayed in hospitals with basic EHR had comparable outcomes.

9 Costs
- As compared to patients who went to hospitals without EHR, patients who were treated in hospitals with comprehensive EHR incurred lower costs of care for all 9 costs of care.
- Ranging from $834 lower in the case of postoperative physiological metabolism derangement to $4,007 lower in the case of death among surgeries.
- As compared to patients who went to hospitals without EHR, patients who were treated in hospitals with basic EHR incurred lower costs of care in 6 indicators but higher costs in 3 indicators.

Conclusions
- Our study did not detect many differences in patient safety indicators across levels of EHR adoption.
- They, however, showed consistent patterns that patients in hospitals with comprehensive EHR systems incurred lower costs than those in hospitals without a comprehensive or basic EHR system.
- EHR adoption is likely to reduce the cost of patient care before improving quality indicators.
- Hospitals may not be using their EHR systems to improve quality, because they have not incorporated meaningful use criteria into their hospital EHR systems yet.

Limitations
- Our study did not detect many differences in patient safety indicators across levels of EHR adoption.
- They, however, showed consistent patterns that patients in hospitals with comprehensive EHR systems incurred lower costs than those in hospitals without a comprehensive or basic EHR system.
- EHR adoption is likely to reduce the cost of patient care before improving quality indicators.
- Hospitals may not be using their EHR systems to improve quality, because they have not incorporated meaningful use criteria into their hospital EHR systems yet.
- Lost several hospitals due to the multiple data sets merge, which compromised the generalizability of our findings.
- Costs were not directly estimated, but rather they were converted from total charges using an average rate for the entire hospital provider by CMS.
- The cross-sectional design cannot be used to establish causality between EHR adoption and quality and cost. The EHR adoption measures were also cross-sectional and they did not indicate how long hospitals had had the level of adoption attributed to them.

Longitudinal research is needed to further explore this relationship.