

Electronic health records: monitoring the return on large investments

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This special issue of *JAMIA* focuses on Electronic Health Records (EHR) systems. Health systems in many countries have promoted the implementation of EHR systems in the past few decades, and demonstrations of value for public health and research, as well as implications for clinical workflows and care improvement have been previously published. In the USA, however, a substantial government initiative to promote the widespread implementation of EHR systems did not happen until 2009. The HITECH act provided the necessary financial incentives for EHR implementation in different settings, which increased public interest in information about key factors for success or failure, particularly generalizable lessons learned from practical implementations.

The articles in this issue discuss and provide some answers to frequently asked questions related to: (1) EHR usability issues in clinical care and quality improvement; (2) public health implications of EHR and health information exchange systems across institutions; and (3) use of EHR-derived clinical data warehouses for research.

Adoption of EHR systems by clinicians is still highly variable. Commentaries from different stakeholders illustrate fundamental reasons for heterogeneous adoption: Middleton (*see page e2*) reports on AMIA recommendations to improve the usability of EHR systems to increase patient safety and quality of care. Cresswell (*see page e9*) provides an international perspective on successful health IT implementation and adoption, while Saleem (*see page e175*) provides the perspective of the Veterans Affairs in the USA. Ozkaynak (*see page e14*) calls for increased flexibility to accommodate workflow issues in patient-centered care, Bar-Dayan (*see page e17*) reports on positive return on investment for an EHR system, and Simborg (*see page e21*) discusses some potential future directions.

Research articles address the issue of usability: McClellan (*see page e26*) describes a study on successful EHR system adoption by physicians, while Davis (*see page e33*) reports on marked differences in EHR utilization depending on clinical specialty and

office settings. Jariwala (*see page e39*) describes factors that influence physician's use of electronic prescribing (e-prescribing), and Thomas (*see page e44*) reports on adequate adoption of controlled substance e-prescribing in a community setting. Also on this topic, Abramson (*see page e52*) describes the safety of e-prescribing systems. However, EHR systems cannot always be adapted to fit existing workflows. Flanagan (*see page e59*) describes paper- and computer-based workarounds to EHR use in different institutions. De Lusignan (*see page e67*) and Pinnock (*see page e76*) report on studies that utilized multi-channel video recording to analyze clinician's use of EHRs, with the latter article focusing on e-prescribing by primary care clinicians. Rosenbloom (*see page e178*) and Wachs (*see page e183*) developed interfaces that facilitate EHR utilization in practical settings, and Landman (*see page e187*) provides a case report of hazards related to software updates in clinical workstations.

The use of EHR systems has been associated with healthcare quality improvement in several areas. Bates (*see page e85*) reports on decreased rates of adverse medication events with the use of EHR systems, and Flamm (*see page e91*) reports on benefits for pre-operative assessment. Structured data from EHR systems are not always enough: Greenberg (*see page e97*) combines EHR data with other sources to monitor blood pressure control for quality improvement for chronic kidney disease care. Computer-aided diagnosis can also benefit from data derived from EHR systems. Haug (*see page e102*) and Morillo (*see page e111*) propose systems to facilitate pneumonia diagnosis that could potentially interface with EHR systems in the future. Because many clinical decisions are based on life expectancy and current models for predicting five-year survival are problematic, Mathias (*see page e118*) proposes a prognostic index derived from EHR data.

Public health is another potential beneficiary of EHR adoption, particularly through the electronic exchange of health information. Onylle (*see page e125*) reports on the population characteristics of a health information exchange network in

New York City. Merrill (*see page e131*) describes an evaluation model for the impact of health information exchange in public health, and Lee (*see page e139*) proposes a tool to assist with infectious disease control at a regional level.

Finally, the benefits of using EHR for research will increase as the barriers to utilization are removed and proper incentives are devised. Newton (*see page e147*) reports on algorithms and strategies to validate phenotypes for use in cross-institutional research studies, and Weber (*see page e155*) draws attention to issues of duplicate records in clinical data warehouses serving multi-centric studies. While most clinical research is still currently based on data collected by dedicated clinical trial management systems (CTMS), there is increasing interest in integrating CTMS with the information originating from the EHR, and a potential merger of functionalities could be envisioned in the long-term. A historical controls database, such as the one described by Desai (*see page e162*), could be among the first beneficiaries of such integration, as its goal is to accelerate studies and quickly disseminate actionable results by drawing on a larger data set for controls. However, as Huser (*see page e169*) points out, dissemination of clinical trial results is still hampered by poor adherence to mandatory clinical trial registration in national databases.

These articles illustrate that EHR systems present enormous opportunities as well as important challenges. The field of biomedical informatics has helped lay the foundations of EHR system design, implementation, and evaluation, as well as clinical decision support for quality improvement, analytics for public health and research, and the study of human factors in EHR adoption. There will be no backtracking from EHR system use and adoption: much has been accomplished since the boost in utilization of EHR systems that started in 2009, and much more is expected to happen within the next few years. As always, *JAMIA* will continue to be the prime source for information on the impact of EHR systems for clinical care, public health, and research.