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Eight Rights of Safe Electronic Health Record Use

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COMPUTERS CAN IMPROVE THE SAFETY, QUALITY, AND efficiency of health care.¹ The pressure on hospitals and physicians to adopt electronic health records (EHRs) has never been greater. However, concerns have been raised about the safety of EHRs in light of the limitations of currently available software, the inexperience of clinicians and information technologists in implementation and use, and potential adverse outcomes associated with clinician order entry and other clinical applications.²⁻⁴

President Obama has referred to EHRs as a solution to reduce medical errors. To avoid medical errors resulting from EHR use and to achieve the promise of EHRs, this Commentary proposes 8 rights of safe EHR use. These rights are grounded in Carayon's Systems Engineering Initiative for Patient Safety,⁵ a human factors engineering model that addresses work-system design for patient safety.

Right Hardware or Software

An EHR system must be capable of supporting required clinical activities. If hardware or software is inadequately sized, configured, or maintained, the EHR will function poorly. Anything that slows or disrupts the clinician's workflow could negatively affect patient safety.⁶ For example, an EHR should be able to calculate a medication dose, transmit the order to the appropriate department, and notify the nurse of a placed order. A medication error could easily follow a breakdown in any of these functions.

Local software oversight committees are a way to help ensure proper and safe functioning.⁷ Another solution may be cloud computing, reliable computing services that are accessible from remote locations via the Internet. Although the cloud may reduce hardware procurement, configuration, and maintenance burdens for health care organizations, its benefits hinge on the improvement of Internet speed, reliability, and access.

See also p 1109.

Right Content

Right content includes standard medical vocabularies to encode clinical findings and knowledge used to create specialty-specific features (eg, posttransplant orders) and functions (eg, health maintenance reminders). Content must be evidence-based, carefully constructed, monitored, complete, and error free.

The federal government has taken a significant step toward advancing a controlled vocabulary with its support of Systematized Nomenclature of Medicine—Clinical Terms, the most comprehensive, multilingual clinical health care terminology in the world. The National Library of Medicine distributes it for free through an agreement with the International Health Terminology Standards Development Organization. Adoption of a standard vocabulary is prerequisite to implementing advanced clinical decision support (CDS). To increase access to a standards-based set of validated, evidence-based CDS, an open-access clinical knowledge base of interventions should be developed, focusing on helping clinicians achieve the quality and safety targets for meaningful EHR use.

Right User Interface

The right user interface allows clinicians to quickly grasp a complex system safely and efficiently. The interface should present all the relevant patient data in a format allowing clinicians to rapidly perceive problems, formulate responses, and document their actions. A key design consideration is the trade-off between clinicians' desire to see everything on 1 screen and limited screen space. Errors may follow when clinicians miss crucial information in applications that include too much information on 1 screen. Yet, systems with too many nested menu options or redundant pathways can be difficult to learn and time consuming to use. The physi-

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cal aspects of the interface (eg, keyboard, mouse, or touch screen) may also contribute to error in the input or selection of information.

Another difficult problem facing clinicians is the requirement to navigate different interfaces safely and efficiently at different practice sites. Although remedying this problem is a complex undertaking, the federal government and EHR vendors should develop common user interface standards for health care applications.

Right Personnel

Trained and knowledgeable personnel are essential for safe use as are software designers, developers, trainers, and implementation and maintenance staff. System developers should have software engineering skills, be able to design effective user interfaces, use existing standardized clinical vocabularies, and have a sound understanding of clinical medicine. Trainers, implementers, and maintenance staff should have clinical experience, understanding of system capabilities and limitations, and excellent project management skills.⁶ Clinicians should understand how to integrate the system into their workflows and how to function when it is unavailable. Close interaction among informatics experts, clinical application coordinators, and end users is essential for safe design and use.

In an attempt to create the right individuals, the American Medical Informatics Association has created the “10 × 10 Training Programs” and has identified the knowledge and skills necessary for clinical informatics subspecialty fellowship programs. Such programs need to be implemented nationwide.

Right Workflow and Communication

Any disruption in workflow or information transfer is fertile ground for error. Prior to system implementation, a careful workflow analysis that accounts for EHR use could lead to identification of potential breakdown points. For example, vulnerabilities in hand-offs could be exposed in such an analysis, and communication tasks deemed critical could be required to have a traceable electronic receipt acknowledgment.

Errors may result from CDS interventions (ie, alerts and reminders) that are not well focused or not judiciously delivered at the point in the workflow that best supports the clinician's decision making or data entry.⁸ Clinical decision support interventions should be streamlined with clinicians' electronically enabled workflow through a standard set of functions (eg, pop-up alerts, pick lists, or order sets).

Right Organizational Characteristics

As with other safety models, a culture of innovation, exploration, and continual improvement are key organizational factors for safe EHR use. Organizations should actively facilitate reporting of errors or barriers to care resulting from EHR use, even if the findings are used only locally. Organizations must also carefully review their existing poli-

cies and procedures before implementation. For instance, although EHR systems can improve transmission of critical information through electronic notifications, this may do more harm than good if there are no policies for appropriate follow-up.⁹ The Veterans Affairs health system exhibits many model organizational features, including a fair amount of central control, standardized procedures for collecting error data and implementing upgrades, and a recent emphasis on studying innovations from end users.

Right State and Federal Rules and Regulations

State and federal regulations may act as barriers or facilitators for achieving safe use.

The American Recovery and Reinvestment Act stipulates that clinicians and health care organizations can receive incentive payments for “meaningful use” of EHRs. Depending on the definition and timeline for meaningful use, this legislation could result in a rush to implement suboptimal systems. Furthermore, the legislation includes patient privacy provisions, such as access to lists of all third-party data disclosures that will require significant modifications to existing systems.

Regulations to safeguard patient privacy are clearly important but may also have the greatest unintended consequence on national EHR implementation. Policies must address the safety and effectiveness of health information exchange across organizational boundaries, which may reopen the debate about unique national patient identifiers. Currently used probabilistic patient matching algorithms, used to link patient information from disparate health care organizations, are prone to error, and many matches are never made. We recommend that state and federal governments should create a regulatory environment compatible with widespread use and interoperability, thereby enabling systems to continue evolving while maintaining appropriate safety and privacy oversight.

Right Monitoring

The creation of the Certification Commission for Health Information Technology is a significant step toward accelerating adoption, but an equally detailed postimplementation usability inspection process is also needed. Several reports have described serious errors related to the use or misuse of EHR systems, many of which were the result of faulty system design, configuration, or implementation processes.¹⁰ Organizations must continually evaluate the usability and performance of their systems after implementation, reliably measure benefits, and assess potential iatrogenic effects. Furthermore, the federal government should mandate use of a vendor-independent hazard reporting database and a national implementation accreditation test to help ensure that the systems are functioning as designed and are safe to use. The LeapFrog clinical decision support functionality test is an example of how such a test could be constructed.

EHR developers have encountered many roadblocks to achieving safe and effective EHRs for all. Success in the next 10 years will require a coordinated multidisciplinary research and development effort, much like the formation of National Aeronautics and Space Administration following President Kennedy's promise of a moon landing, to bring the best scientists, engineers, and clinicians together to address the problems and challenges in ensuring safe and effective use of EHRs. Efforts must move beyond the lone informatics researcher in an isolated laboratory if the complex interaction of organizational, technical, and cognitive factors that affect the safety of EHRs are to be understood and addressed and without this understanding, any solutions are certain to be far from optimal. Without high-quality, well-designed, and carefully implemented EHRs, highly reliable, safe health care may never be achieved.

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Regional Variation and the Affluence-Poverty Nexus

Richard A. Cooper, MD

AS THE NATION EMBARKS ON HEALTH CARE REFORM, concerns have been raised that the United States is training too few physicians for the future.¹ However, progress in responding has been stalemated by a broadly accepted view that there is unexplained geographic variation in both physician supply and health care spending and that correcting it could obviate the need for more physicians—indeed, that less care is a value that should be rewarded.^{2,3}

What explains this "unexplained" variation? The answer lies in economic and social dynamics that operate separately at the communal and individual levels and that influence the use of health care resources and the outcomes they produce. Simply stated, wealthier communities have more resources, use more health care, and achieve better average outcomes—the vectors are linear and direct. Conversely, low-income individuals use the most health care resources, and those who

use the most tend to have the worst outcomes—the vectors are nonlinear and principally inverse.

States as Communal Units of Health Care

Among states, strong and stable relationships have existed among total health care spending, the number of physicians per capita, and economic development for many decades.⁴ This was evident even in the 1920s, when land values rather than per capita income were the economic measure. Wealthier states also spend more on K-12 education and other public services.⁵ In fact, K-12 expenditures per pupil correlate closely with the number of physicians per capita.⁶

These associations have been remarkably durable.⁴ For example, over the last 50 years, the approximately 2-fold differences in both per capita income and physician supply

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