

Electronic Health Record Usability

Interface Design Considerations

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540 Gaither Road
Rockville, Maryland 20850
<http://www.ahrq.gov>

Prepared by:

James Bell Associates
The Altarum Institute

Writers:

Dan Armijo
Cheryl McDonnell
Kristen Werner

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HEALTH IT

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Preface

To support research and policy formation in the area of Electronic Health Record (EHR) usability, the Agency for Healthcare Research and Quality (AHRQ) commissioned the “Use of Dense Display and Information Design Principles in Primary Care Health IT Systems” study. This study establishes a foundation of EHR interface design considerations and proposes an action-agenda for the application of information design principles to the use of health information technology (health IT) in primary care settings. The following activities were conducted to further these goals:

- Existing research and evidence on information design, usability, and interface design was assessed. Where available, literature on specific EHR functions and the linkage between usability and the safety, quality, efficiency, and effectiveness of primary care delivery was summarized.
- A multidisciplinary expert panel was identified and convened to discuss design principles and evaluation criteria and to propose an action-agenda to foster improvements in EHR usability. The members of that panel are detailed below.
- The information gained through the above activities was used to develop two companion reports: *Electronic Health Record Usability: Interface Design Considerations* (this report); and *Electronic Health Record Usability: Evaluation and Use Case Framework*.

This study was conducted for AHRQ by James Bell Associates and the Altarum Institute. We would like to thank the expert panel members for their many contributions to this report. Many disciplines, including medicine, information science, usability engineering, cognitive sciences, psychology, human factors, and others, offer insight into design improvements possible in EHRs. Effective exploration of this field requires expert input from multiple areas and the complete range of stakeholders. As such, a 2-day innovation meeting was held at AHRQ offices on February 26-27, 2009, with the purpose of evaluating the many perspectives and disciplines involved and bringing them together to develop a coordinated and comprehensive policy strategy for AHRQ. A distinguished panel of experts from academia, government, and the provider and vendor communities was assembled for this effort. Participants are listed in the following table.

Expert Panel Members	
Name	Affiliation
Mark Ackerman, PhD (Presenter)	Associate Professor, School of Information; Associate Professor, Department of Electrical Engineering and Computer Science, University of Michigan
Daniel Armijo, MHSA (Presenter)	Practice Area Leader, Information & Technology Strategies, Altarum Institute
Clifford Goldsmith, MD	Health Plan Strategist, Microsoft, Eastern U.S.

Expert Panel Members	
Name	Affiliation
Lee Green, MD, MPH (Presenter)	Professor & Associate Chair of Information Management, Department of Family Medicine, University of Michigan; Director, Great Lakes Research Into Practice Network; Co-Director, Clinical Translation Science Program in the Michigan Institute for Clinical and Health Research (MICHHR)
Michael Klinkman, MD, MS (Presenter)	Associate Professor, Department of Family Medicine, University of Michigan; Director of Primary Care Programs, University of Michigan Depression Center
Ross Koppel, PhD	Professor, University of Pennsylvania Sociology Department; Affiliate Faculty Member, University of Pennsylvania School of Medicine; President, Social Research Corporation
David Kreda	Independent Computer Software Consultant
Donald T. Mon, PhD	Vice President of Practice Leadership, American Health Information Management Association; Co-chair, Health Level Seven (HL7) EHR Technical Committee
Catherine Plaisant, PhD (Presenter)	Associate Director, Human Computer Interaction Laboratory; Institute for Advanced Computer Studies, University of Maryland
Ben Shneiderman, PhD (Panel Chair)	Professor, Department of Computer Science; Founding Director, Human-Computer Interaction Laboratory, Institute for Advanced Computer Studies, University of Maryland
Andrew Ury, MD	Chief Medical Officer, McKesson Provider Technologies
James Walker, MD	Chief Health Information Officer, Geisinger Health System
Andrew M. Wiesenthal, MD	Associate Executive Director for Clinical Information Support, Permanente Federation
Kai Zheng, PhD (Presenter)	Assistant Professor, University of Michigan School of Public Health; Assistant Professor, University of Michigan School of Information; Medical School's Center for Computational Medicine and Biology (CCMB); Michigan Institute for Clinical and Health Research (MICHHR)
Michael Zaroukian MD, PhD	Professor and Chief Medical Information Officer, Michigan State University; Director of Clinical Informatics and Care Transformation, Sparrow Health System; Medical Director, EMR Project

Representing AHRQ and the project team were **Matthew Quinn**, AHRQ Task Order Officer; **Cheryl McDonnell**, PhD, director, James Bell Associates; **Daniel Armijo**, Director of Information and Technology Strategies at the Altarum Institute; **Kristen Werner**, health informatics analyst, Altarum; and **Stanley Chin**, Practice Development Director, Altarum.

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Executive Summary

Health IT holds great promise in supporting the transformation and improvement of health care in America. The American Recovery and Reinvestment Act (ARRA) of 2009 has made available billions of dollars for health care providers to adopt and “meaningfully use” certified electronic health records (EHRs).

An oft-cited limitation in the use of health information technology (health IT) is the “usability” or more broadly, information design, of EHRs. Information design represents the art and science of preparing and conveying information so that it can be used by human beings with efficiency and effectiveness.¹ Recent articles in peer-reviewed and popular literature have identified shortcomings in usability and information design as both contributing to the poor uptake of EHRs in the market as well as new categories of errors in care delivery.²⁻⁴

The usability of EHR systems, while recognized as critical for successful adoption and meaningful use, has not historically received the same level of attention as software features, functions, and technical requirements (e.g., interoperability specifications). Recognizing the importance of usability, the Certification Commission for Health Information Technology (CCHIT) recently formed a Usability Workgroup; however, current CCHIT criteria do not assess EHR product usability.⁵

At the time of this report, very little systematic evidence has been gathered on the usability of EHRs in practice and the implications of their design on cognitive task flow, continuity of care, and efficiency of workflows. Further, the role of EHRs in patient care is evolving significantly as adoption is incentivized, health information exchanges operationalized, and new forms of comparative effectiveness codified and made available for clinical decision support. Given the significant Federal investment in EHR adoption, promoting improvements in EHR usability through fostering deliberations on the subject and furthering an action-based research agenda and policy recommendations are timely activities for the Agency for Healthcare Research and Quality (AHRQ).

Based on recommendations from the AHRQ-commissioned report from the Institute for Healthcare Improvement,⁶ insight from the field, and the need for Federal leadership in this area, the Agency identified the adoption of information design principles as an opportunity for innovation in health IT. Improving the usability of EHRs will support care of the “whole patient” and improve the quality, safety, efficiency, and effectiveness of care delivered in the primary care setting.

To begin exploration of improving EHR usability through the application of information design principles, AHRQ contracted with James Bell Associates and the Altarum Institute to:

- Assess existing research and evidence in this area and its linkage to the safe, efficient, effective, patient-centered, equitable, and timely delivery of care.
- Synthesize the information gained into recommendations for ongoing research, implementation, and policy work in this field.
- Develop applicable “use cases” to evaluate how well information design in primary care health IT systems support care delivery processes and clinical decisionmaking.

To support these objectives, the project identified and convened a multidisciplinary panel including experts from the fields of health care delivery, health IT, information science, usability engineering, cognitive sciences, and human factors. Members of the expert panel included practicing clinicians, researchers, and leadership of care delivery organizations, health IT vendors, broader IT vendors, and health care member organizations. Multiple members of the expert panel serve or have served on the CCHIT.

The expert panel recommended the following actions to support the development of an objective usability evidence-base, incorporate lessons learned from other industries, and systematically improve the usability of EHRs made available to practicing physicians and their staff. The panel's recommendations were categorized into research-based activities and policy actions:

Research

The panel recommended funding research on:

- Documenting patterns of clinician information use in EHR systems.
- Developing and evaluating “use cases” and tools for evaluating EHR implementations for adherence to usability principles and best practices.
- Developing an understanding of, and ways to measure the impact of usability and information design on ergonomic (navigating, documenting) and cognitive (reading, thinking, deciding) workload, data awareness and comprehension, patient safety, clinician decisionmaking, and efficiency of care delivery.
- The effectiveness of adaptive displays, defined as those data displays that change the nature or format of information presented for viewing on specific patient characteristics or physician preferences.
- Assessing current vendor and health care organization practices with regard to information design in EHR product development lifecycle and implementation.
- Identifying and evaluating existing evidence-based style sheets and guidelines for EHRs.
- Identifying and evaluating innovative ways to display complex information in EHRs.
- Identifying best practices in the use of shared (patient-clinician) EHR views, including applicable privacy and confidentiality issues.
- Promoting fellowships in the area of EHR usability and information design.

Policy

The panel recommended the following policy actions:

- Establishing certification requirements for EHRs, based on a practical and fair process of usability evaluation:
 - Include usability/information design as an essential part of the certification process.

- Require/strongly recommend that vendors establish and document their programs for testing the usability of their systems (people and processes), including evaluating potential impacts on quality and safety.
- Include EHR design and functionality in standards and guidelines.
- Developing a National EHR usability laboratory to:
 - Support public-private collaboration and sharing of best practices in this area.
 - Develop tools and processes to support evaluation of products and implementations.
 - Assist health IT vendors in product development and health care organizations in effective implementation of EHRs.

Chapter 1. Introduction

Widespread adoption of health information technologies holds the promise of transformational change in the way health care is delivered—improving quality, enhancing safety, and reducing costs. The increased availability of patient information and decision support at the point of care has tremendous potential for reducing errors and increasing evidence-based care delivery. In pursuit of these goals, various initiatives have sought to foster the adoption of technology including the Institute of Medicine (IOM) which in 1991 called for paperless records in 10 years,⁷ the establishment of the Office of the National Coordinator for Health Information Technology with the goal of nationwide Electronic Health Record (EHR) use by 2014⁸ and, more recently, EHR-related incentives and penalties introduced through ARRA.⁹ Despite these initiatives and the many successes achieved through EHR implementations,¹⁰⁻¹² physician adoption of clinical EHR systems is still estimated at less than 10 percent nationally.¹³

While much attention is paid to the financial and technical reasons for limited EHR use in this country, the usability of these systems and their ability to effectively integrate with clinical decisionmaking and workflow has not been adequately explored to date.^{14, 15} Information design, the art and science of preparing information so that it can be used by human beings efficiently and effectively,¹⁶ is central to system usability and implementation success.¹⁷ As such, the further exploration of EHR information design has been identified by AHRQ as an opportunity for innovation in health IT that will improve the safe, efficient, effective, patient-centered, equitable, and timely delivery of care.

Insights gained from this report, and its companion (*Electronic Health Record Usability: Evaluation and Use Case Framework*) are intended to foster research and policy development to inform the next generation of EHR products and the clinical communities that use them.

Chapter 2. Current State of Research and Design

As background to this report an extensive literature review was conducted to determine past and current research and trends in the areas of information design; EHR functions and use; and usability considerations. The research was organized around EHR use in primary care settings and topic selection based on the understanding that diagnostic and treatment decisions in those settings demonstrate the most variability in environment, workflows, patient populations, and information requirements among outpatient care delivery. The primary care environment is also often cooperative (involving patient, physician[s] and staff) as well as time and resource constrained, which makes barrier reduction and ease of use essential components of any strategy to effect process improvement. Only through a full understanding of workflow, practice patterns, and physician information needs will it be possible to develop technologies that truly integrate with and enhance the practice of medicine.

Usability

The National Institute of Standards and Technology (NIST) defines usability as the “...effectiveness, efficiency and satisfaction with which the intended users can achieve their tasks in the intended context of product use.”¹⁸ This concept is critically important in promoting both the widespread adoption and “meaningful use” of EHRs prescribed in ARRA. Usability has been cited as a major factor in both the acceptance^{19, 20} and effectiveness^{21, 22} of EHRs in the clinical setting. Examples describing potential negative impacts of EHRs on efficiency,²³ cognitive load,²⁴ team collaboration,²⁵ and medical errors²⁶ can all be linked, at least in part, to issues directly related to usability and design.

While the broad issue of usability is often cited in the literature in relation to less than ideal results of EHR use, there is evidence that this issue is often poorly understood and is not adequately addressed by EHR developers and users alike.¹⁵ Even the prevailing body for setting standards and certifying the use of EHRs, the CCHIT, specifically excluded usability requirements in their original certifications⁵ and have only recently formed a usability workgroup to address this issue.

There are many potential reasons for this lack of attention on EHR usability. Unlike the more straightforward identification of desired software features, functions, and interoperability goals, EHR usability can be a more subjective and elusive concept. Effective usability measures involve a combination of heuristics and observations of direct use in clinical settings along with noting unexpected patterns of workarounds and design influenced errors. The complexities of outpatient clinical environments are difficult to replicate in laboratory settings, and ethical and privacy concerns may prevent some types of usability evaluations in clinical settings.²⁷ This is further complicated by an inability or unwillingness of the vendor community to invest heavily in usability constructed user acceptance testing, information design, and usability expert involvement in product development. The market’s inability or unwillingness to consistently pay for the level of implementation support required to appropriately incorporate technology into clinical practice (which can involve a level of process improvement beyond the change capital available in many practices) has also limited the quality of usability “evidence” available. It is uncommon for EHR implementation teams to include usability experts, and EHR end users, so

critical for evaluating usability, typically lack the skills or training required to assist in designing for usability.²⁸ These factors combine to create an environment where usability has not received the required level of attention and investment, despite the best intentions of both EHR vendors and users.

Information Design

EHRs are the tools through which physicians, nurses, and other staff enter, view, and share the information required to deliver high quality care. The presentation of patient information has a direct effect on clinical decisionmaking whether it is in paper or electronic form.²⁹ Clinical decisionmaking is a product of the integration and interpretation of multiple pieces of patient information and clinical knowledge. When incomplete or inconsistent display of information is combined with the variability that inherently exists in physician knowledge, variability in clinical decisions can be expected.³⁰ Intuitively designed displays can provide immediate clinician access to the large variety of information required for patient care without a significant increase in cognitive effort or a reduction in system usability.³¹ However, information density must be increased with careful consideration of the basic principles of cognition, task analysis, interface design, and visualization in order to be effective.³²

Exploration of these basic principles in information design revealed no shortage in theories and principles related to the effective display of information in multiple contexts. Strategies in use of color,³³ numbers,³⁴ graphs,³⁵ visualizations,³⁶ and general principles of information design³⁷⁻⁴⁰ can all be easily referenced at a general level. The difficulty appears to be in applying these principles with specificity within the complex clinical environment. Alignment of information displays (i.e., software interfaces) with physician cognition, workflows, and decisionmaking in particular is an aspect of EHR design often cited as lacking in the current product market.^{24,41-44}

These cognitive considerations have been extensively discussed within the research community. Multiple approaches for cognitively based design and evaluation have been explored for a variety of health care technologies including electronic health records,^{45,46} computerized physician order entry,^{41,44,47,48} medical devices,⁴⁹⁻⁵² and health care information resources on the Internet.⁵³ Vimla Patel, André Kushniruk, James Cimino, and Jiajie Zhang are well cited advocates of applying cognitive approaches to designing and evaluating health care software user interfaces.^{43,54-56} Examples of innovative approaches to the displays of medical information can also be found through efforts to identify and meet unmet physician information needs⁵⁷⁻⁵⁹ or define alternative ways to view or explore patient information.⁶⁰⁻⁶² This research, however, has not resulted in comprehensive standards or guidelines that are accepted or applied across the EHR market.

Given the reality that multiple vendor systems, each having unique styles and design constructs, coexist in the current health care environment, creating standard design elements and principles for EHR interfaces is an emerging need. In the user-interface (UI) design community this is partially addressed through the establishment of interactive patterns; a collection of building blocks that represent recurring solutions to common design problems.^{63,64} For example, the U.S. Department of Health and Human Services publishes *The Research-Based Web Design and Usability Guidelines*. These guidelines promote the use of research validated designs for building responsive and easy-to-use Web sites for the public.⁶⁵ The Microsoft Health Common

User Interface is one early attempt to achieve some uniformity among health IT UI by collecting empirically validated designs with descriptions of their qualities and applicable contexts.⁶⁶ Continuing and building on this type of work will allow for the development of intuitive, adaptive displays with the capacity to effectively support the evolving role of EHRs in clinical practice.

Chapter 3. EHR Innovation Meeting and Recommendations

Many disciplines, including medicine, information science, usability engineering, cognitive sciences, psychology, human factors, and others offer insight into possible usability and UI design improvements to EHR products. Each offers particular insight into the design and development of more effective EHRs. Effective exploration of this field requires expert input from multiple areas, the complete range of stakeholders, and incorporation of ideas from other industries. As such, a 2-day innovation meeting was held at AHRQ offices February 26-27, 2009, with the purpose of evaluating the perspectives offered by many disciplines and bringing them together to develop a coherent, comprehensive, and successful policy strategy for AHRQ. A distinguished panel of experts from academia, government, and the provider and vendor communities was assembled for this effort. A full list of meeting participants can be found in the preface to this report.

Discussion Key Points

The group was highly participatory, and the discussions surrounding the presentation topics were engaging and covered a wide range of topics. Several key points were made throughout the discussion; these are summarized below.

There are strong indications that EHRs can dramatically improve quality and lower cost; however, the majority of products in the market require far too much effort and skill to achieve those ends. The resource intensive planning and training necessary for effective EHR implementation has limited the realization of benefits expected from widespread adoption.

While usability as defined by NIST is a broad concept, a particular element of importance to health IT is intuitiveness or “learn-ability without teaching.” As tools offer more features and their relevance to clinical decisions grows, the ability to figure out how to accomplish a novel task without training grows in importance.

There are differences in care complexity that need to be considered in EHR design: new vs. ongoing patients; patients with chronic conditions vs. those with self-limited ones; and those with common presenting symptoms vs. those with complex or undifferentiated ones. EHR design needs to effectively address the breadth of health care encounters.

Existing efforts to evaluate EHR systems are insufficient for broad identification of best practices in information design. Further, the recognition of usability as a critical issue varies across organizations responsible for setting standards and not enough objective evidence exists for specific design considerations drawn from real-world patient care settings. Existing efforts have focused on patient safety issues.

The group was in general agreement that to impact change, AHRQ needs to leverage existing groups that have a current set of engaged participants with practical recommendations that can be utilized immediately (e.g., medical associations, large provider organizations, user groups, certification organizations, etc.).

There are many ways to promote an action-agenda to foster improvements in EHR usability. There is a need to create a community and social structure that promotes usability evaluation and continuous EHR improvement. From workshops and panels at leading conferences to the creation of an annual conference on EHR usability and perhaps even a scientific journal to focus on these topics, there is much that can be done to foster purposeful discussion and stakeholder engagement.

Areas of Recommended Focus

As the primary output of the innovation meeting, participants developed a set of recommendations to identify concrete initiatives which could be promoted or supported by AHRQ to facilitate improved EHR design and usability. Participants agreed there are multiple areas of potential action to foster discussion and improvement. These areas are described below.

Building a Base of Evidence

In order to be effective, efforts to improve EHR design need to be firmly grounded in evidence. Further academic exploration was suggested by meeting participants to enhance our understanding of the clinician/EHR interaction.

During the course of providing care, a physician may consult the EHR or other information sources to review a patient's history or test results, identify appropriate treatment plans, or access knowledge resources. Multiple studies have documented that physicians often do not seek answers to information needs encountered when delivering care, citing difficulty in locating needed information or doubt as to the existence of information which will fit their specific needs.⁶⁷ Evaluating and documenting the information needs of physicians and the rest of the care team is central to ensuring that information displays are effective in promoting quality care. The interchanges between human error and system design are of particular note. Information design considerations can foretell and prevent common points of human error and inattention to them as been shown to introduce new causes of human error.²² Further analysis should be conducted to improve our understanding of clinical information needs and explore proven and effective methods for presenting that information to enhance the delivery of care.

As detailed in sections above, EHRs have historically had mixed impacts on physician workflow and cognition. While many have experienced marked improvements in care quality and efficiency after EHR implementation, others provided examples of negative results in the same areas. The lack of adequate consideration of the cognitive needs of computer users has been a significant impediment to the acceptance and routine use of computer-based systems in health care.⁴² Performing the research required to directly link aspects of information design to their effects on clinical practice will create a base of evidence which can directly inform the vendor community and improve EHR design.

Evaluating and Measuring EHRs

The EHR market is broad and is expected to grow significantly over the next several years.⁶⁸ New technologies are always being explored, and existing technologies are being implemented in a variety of different clinical settings. Not all of these features and functions are created equal,

nor are they equally effective in different environments. Clinicians attempting to purchase EHRs are often unfamiliar with the range of technological offerings and trade-offs and thus are at a disadvantage in determining which product will best suit their needs and requirements.⁶⁹ For these reasons, while not necessarily a role for government, a need currently exists for improved EHR evaluation and measurement and the dissemination of these results to EHR researchers, developers, and purchasers.

Medical care is delivered in a highly interruptive environment composed of complex work processes performed by multidisciplinary teams. These teams primarily operate in heavily tailored (site and provider specific) rules-based decisionmaking modes. This environment is difficult to replicate in a laboratory setting, creating challenges for the design of EHR systems required to be effective in varied clinical environments. Even direct involvement of clinicians in EHR product development has failed to consistently produce products which accurately reflect clinician workflow.⁷⁰

Evaluation of EHRs in use in clinical settings presents a potential solution; however, direct observation of EHR use can be disruptive and costly. As it would be inefficient to require each vendor to undertake such field studies of their products in use, alternative strategies should be pursued. These strategies include the creation of a mechanism to support structured observations of mature EHR offerings in use through government-supported efforts like Practice-Based Research Networks (PBRNs) and improving the ability to track and evaluate actual EHR use through expanded use of audit trails and structured analysis of navigation patterns, etc. These would provide valuable information to EHR researchers and developers including deficiencies in design, definition around usability issues, and clinician behavior within the context of interactions with EHRs. Products designed to more closely reflect the desired work patterns of physicians and support staff would reduce EHR implementation difficulties and improve the long term efficiency and effectiveness of the application of technology on clinical practice.

Increased measurement is also needed to more accurately describe user interaction with EHRs and the computing devices they run on. The development of metrics to describe an EHR's impact on ergonomic workload, cognitive workload, and data comprehension would all be useful tools in the evaluation and comparison of currently available EHR products. Measurements specifically focused on usability would provide insight into the ease with which clinicians are able to integrate EHR use into the care setting.

Evaluation of EHR offerings is a complex but necessary undertaking.⁷¹ Once practical metrics have been developed, high performing EHRs (in terms of information design and usability) can be identified and direct comparisons can be made which would help end users make more effective purchasing decisions. New entrants into the market will also be able to be effectively compared to existing programs, increasing the ability for promising technologies to enter into clinician use. While government-funded Regional health IT Extension Centers may serve as a mechanism to support evaluative efforts and disseminate product comparisons, actual product rankings should likely be conducted by the private sector.

Creating Standards and Guidelines

When research, measurement, and evaluation leads to knowledge of design characteristics that are clearly associated with ease of use and improved patient care potential, guidelines and standards should be released to the EHR vendor and user communities. As specific EHR displays

and functions are tested in laboratory and real-world environments, a basis of evidence can be created which should be used in the creation of style sheets and guidelines for EHR design. These style sheets can focus on best practices in commonly used EHR functions and tasks, increasing overall EHR usability and consistency. Dissemination of proposed standards, style sheets, and design guidance should be open and available for comment. One approach would be the development of an online EHR usability library that could be used to disseminate proven design approaches and as a clearinghouse for guidelines under development.

Standards can also be used to encourage best practices in EHR development (i.e., encouraging reliable incorporation of usability metrics into the development cycle). At minimum, requesting that all EHR vendors actively test for usability and supporting the posting of processes and personnel devoted to this effort would help promote putting appropriate structures in place to encourage quality in the EHR design process.

The creation of standards and certification for EHR products is currently performed through the CCHIT. This commission is developing standards and certification criteria in the areas of EHR functionality and interoperability. The recently formed CCHIT Usability Workgroup should begin by defining the appropriate level of government involvement in usability standard setting and evaluation. The work of multidisciplinary committees such as CCHIT will enhance the acceptance of standards in EHR design, thus promoting usability considerations market-wide.

Encouraging Innovation

EHR product offerings are constantly evolving, improving functionality and design to better meet end user needs. Encouraging and broadening this innovation will serve to more quickly identify and incorporate new technologies and strategies into EHR design. Chief among the ideas for encouraging innovation was the idea of a usability competition for both new and existing EHR products. Competing EHRs could be loaded with de-identified real world data sets and evaluated by trained physicians on their performance of specific clinical tasks. This type of forum could be utilized to bring together vendors, researchers, and users and publicly showcase the performance of both new and existing EHR technologies.

Regardless of the forum, innovation meeting participants stressed the need for increased coordination between EHR developers, visualization experts, health informaticists, and users to encourage innovation in the field of EHR design. Whether through the development of a national usability laboratory and corresponding library or encouraging cross-field collaboration through fellowships and conference discourse, participants agreed that innovation could be promoted through the combined efforts of a variety of fields of study.

Targeted Recommendations

The above discussions can be summarized through a set of targeted research and policy initiatives which can serve to both improve our understanding of and spur innovation in EHR usability and information design. A condensed set of high-priority recommendations developed by the expert panel follows.

Research

The panel recommended funding research on:

- Documenting patterns of clinician information use in EHR systems.
- Developing and evaluating “use cases” and tools for evaluating EHR implementations for adherence to usability principles and best practices.
- Developing an understanding of, and ways to measure the impact of usability and information design on ergonomic and cognitive workload, data comprehension, usability, patient safety, clinician decisionmaking, and clinical outcomes.
- Research the effectiveness of adaptive displays, defined as those data displays that change the nature or format of information presented for viewing on specific patient characteristics or physician preferences.
- Assessing current vendor and health care organization practices with regard to information design in EHR product development and implementation.
- Identifying and evaluating existing evidence-based style sheets and guidelines for EHRs.
- Identifying and evaluating innovative ways to display information in EHRs.
- Identifying best practices in the use of shared (patient-clinician) EHR views, including applicable privacy and confidentiality issues.
- Promoting fellowships in the area of EHR usability and information design.

Policy

The panel recommended the following policy actions:

- Establishing certification requirements for EHRs that:
 - Include usability/information design as an essential part of the certification process.
 - Require/strongly recommend that vendors establish and document their programs for testing the usability of their systems (people and processes), including evaluating potential impacts on quality and safety.
 - Include EHR design and functionality in standards and guidelines.
- Developing a national EHR usability laboratory to:
 - Support public-private collaboration and sharing of best practices in this area.
 - Develop tools and processes to support evaluation of products and implementations.
 - Assist health IT vendors in product development and health care organizations in effective implementation of EHRs.

Chapter 4. Concluding Thoughts

This document provides recommended actions to support the development of an objective EHR usability evidence base and formative policies to systematically improve the usability of EHR systems. In a companion document, *Electronic Health Record Usability: Evaluation and Use Case Framework*, the evolving role of EHRs and the need for a practical, common evaluation framework is discussed. Information design principles tailored to EHR considerations along with initial approaches to heuristic usability evaluation and representative use cases are also provided. These two companion documents on EHR usability are intended to foster discussion on the importance of usability and guide federally funded research activities as well as inform policy development in this area. Through collaborative efforts between physicians, researchers, and vendors these recommendations and frameworks can be further refined to promote the necessary industry focus on EHR design and its significance to consistently delivering desired improvements in care quality and efficiency.

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