# The wave has finally broken: now what?

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**ABSTRACT**
In 2005, the authors published a paper, 'Will the wave finally break? A brief view of the adoption of electronic medical records in the United States', which predicted that rapid adoption of electronic health records (EHR) would occur in the next 5 years given appropriate incentives. The wave has finally broken with the stimulus of the health information technology for economic and clinical health legislation in 2009, and there have been both positive and negative developments in the ensuing years. The positive developments, among others described, are increased adoption of EHR, the emergence of a national network infrastructure and the recognition of clinical informatics as a medical specialty. Problems that still exist include, among others described, continued user interface problems, distrust of EHR-generated notes and an increased potential for fraud and abuse. It is anticipated that in the next 5 years there will be near universal EHR adoption, greater emphasis on standards and interoperability, greater involvement of Congress in health information technology (IT), breakthroughs in user interfaces, compelling online medical and IT education, both increased use of data analytics for personalized healthcare and a realization of the difficulties of this approach, a blurring of the distinction between EHR and telemedicine, a resurgence of computer-assisted diagnosis and the emergence of a 'continuously learning' healthcare system.

In the 1991 Institute of Medicine (IOM) report, the Computer-based Patient Record,[1] the committee suggested that computer-based records would become the standard record for healthcare in 10 years. Discussion among the committee at that time included a debate between targets of 10 or 20 years. (One of the authors (DED) chaired the 1991 report and was centrally engaged with this discussion. Ultimately, a decade was seen as unrealistically short but 20 years seemed so far into the distance that there was concern that little interest in the report might result.) By the time of the 1997 edition of the same report, the 10-year estimate was seen as clearly beyond achievement. Yet confidence for ultimate adoption was still strong. In a 2004 presentation at a meeting of the American College of Medical Informatics at a time when electronic health record (EHR) adoption was less than 10%, one of the authors (DWS) referred to the periodic incorrect prediction over the decades of an imminent rapid increase in EHR adoption as 'the wave that never breaks'. Following on that theme, the authors published an article in 2005 entitled: 'Will the wave finally break? A brief view of the adoption of electronic medical records in the United States'.[2] It is now 8 years later and we believe that the wave has finally broken. EHR adoption has increased rapidly and now exceeds 70% for office-based physicians.[3] It is timely now to examine the current consequences both intended and unintended, because waves can leave a lot in their wake, and while at this, we wish to project some perspectives for the next 5 years.

In our 2005 article, we reviewed the factors that had inhibited the widespread use of health information technology (IT) and anticipated what the next 5 years would bring. In particular, we noted the need to align financial incentives for EHR adoption, which, in the interim, has occurred.

While we might say the wave was building from the time of the establishment of the Office of the National Coordinator for Health Information Technology (ONC) in 2004, the passage of the Health Information Technology for Economic and Clinical Health (HITECH) Act, a provision of the American Recovery and Reinvestment Act of 2009,[4] brought the crest of the wave to the breaking point. ONC was made permanent and over US$19 billion were allocated to ONC and Centers for Medicare and Medicaid Services (CMS) to promote the meaningful use (MU) of health IT. The HITECH provisions address many of the barriers to adoption including the lack of financial incentives for providers and provider institutions, a lack of a trained workforce, and additional privacy and security concerns among others.[5] Among the MU mandates are requirements for e-prescribing, clinical decision support, health information exchange (HIE), patient engagement, and reporting of clinical quality measures. These enhancements are to be phased in over a number of years with rewards being replaced by penalties in the out years if the adoption and MU requirements are not met. The program's MU incentives have shown an impact in several areas. Below are some positive developments that have occurred subsequent to the HITECH legislation:

1. Increased adoption of EHR: The pace of adoption and, more importantly, active use of EHR is increasing. According to the Center for Disease Control and Prevention's National Center for Health Statistics, overall 72% of office-based physicians use EHR.[3] A survey conducted by CapSite, a health IT research firm, found that 69% of group practices had installed an EHR and 20% more were planning to do so.[6] Community health centers, which once had the lowest rate of adoption of EHR now have a 74% adoption rate.[7]
2. A national infrastructure is slowly emerging: At the time of the 2005 paper, the concept of what we now call the nationwide health information network (NwHIN) was emerging. Rather than being a formal entity under a central control as was being developed in the UK, the NwHIN was conceived as a set of standards, services and policies that enable

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secure HIE over the internet among a less formal network of mostly regional networks under state or local control—then identified as regional health information organizations. These organizations are now called HIE or health information exchange organizations. Since 2009, a group of federal and non-federal entities, including provider organizations, HIE and other entities began exchanging information over the NwHIN and adopted certain standards and governance procedures. This group, initially called the NwHIN-Exchange is now called eHealth Exchange. The governance group of eHealth Exchange, a public–private collaboration, is called Healtheway. Federal support from the HITECH legislation is not only financial, but through the CONNECT open-source software and DIRECT PROJECT, standards for interconnectivity for the NwHIN are being facilitated.[8] The MU requirement for inter-provider communication is another inducement for participation in an HIE and the NwHIN. A recent survey of hospitals by CapSite indicates that 71% of them plan to purchase HIE technology in order to meet this requirement.[9]

3. Improving quality through MU: The HITECH provisions were designed specifically to help hospitals and physicians address not only financial implications but also to improve quality. The MU requirements include several measures to promote healthcare safety and quality. One of the major ones is the use of clinical decision support systems (CDSS).[5] In 2007, the AMIA board of directors approved as a board white paper the Roadmap for Clinical Decision Support,[10] many aspects of which are embodied in the MU regulations. The past 50 years of informatics research is finally finding its place as commercial systems are developed to meet these requirements. Less certain is the impact that US Food and Drug Administration (FDA) regulation of clinical system software may have. Certainly, the IOM report, 'Health IT and patient safety: building safer systems for better care', that was released in November 2011 expressed substantial concern that current FDA structure could not properly deal with safety considerations of health IT software.[11] Funding has also been a concern, as has anxiety about whether or not FDA regulation would prevent flexibility and needed continued evolution. Having said this, the scale of public monies now consolidating into a few systems makes it unlikely that Congress will continue to allow as much freedom from oversight regulation going forward.
4. Development of patient portals: Improved technological capabilities coupled with an internet-savvy patient population has led to more interest in using the technology for patient engagement. The Optum Institute found that 75% of patients surveyed were interested in going online to access their records, although less than half of physicians said they had systems that would allow such access.[12] However, we are likely to see an increase in the number of sites providing patient portals. As part of the new stage 2 MU regulations, providers will be required to provide at least 50% of their patients online access to their EHR-based personal data through patient portals or similar arrangements.[13] Not only must they provide access, but also to receive incentive payments, patients are required to use the systems for communication with providers. The concept of a patient portal is one mechanism for fulfilling the desire of some patients for a personal health record (PHR). Although under provider control, a patient portal is considered by many to be a more practical form of PHR than independent ('untethered') PHR controlled by the patient.[14] At this time, patient portals are increasing rapidly and are likely to become the dominant method of achieving greater patient involvement.[15]
5. Workforce development: The ONC recognized that successful implementation of EHR does not just 'happen' without knowledgeable individuals to assist clinicians. Supported initially with HITECH funding, ONC's workforce development program[16] and the regional extension program[17] are producing more individuals with the skills to assist clinicians with EHR configuration and implementation. The distance learning curriculum materials developed as part of the ONC curriculum development centers program, which is part of the workforce program, have been downloaded not just by educators throughout the USA but also by individuals all over the world.[18] In addition, the Department of Labor has developed a competency model for individuals who work with EHR.[19] As the use of EHR increases it is being recognized that not only are specialists in health IT needed, but also clinicians with skills in using EHR are now in demand.[20]

The above developments are directly related to the HITECH provisions and MU requirements, but there have been other positive changes during the past 8 years. These include the emergence of 'big data'[21–23] the rapid increase in mobile computing,[24] the use of social media, and the emergence of clinical informatics as a medical subspecialty.[25 26]

As with all waves that break, this one has caused some turbulence. Barriers to achieving the promise of improved quality and reduced cost remain, as well as some unintended negative consequences. These are reviewed below:

1. Poor usability of user interfaces: Both anecdotal and formal survey data continue to indicate that physician unhappiness with EHR remains a problem.[6 27] A HIMSS task force has described 'usability' as 'possibly the most important factor hindering widespread adoption of EMRs'.[28] At a minimum the results are mixed as to the extent of the problem, but physicians continue to complain about the user interface and negative impact on workflow. Part of the problem resides in the peculiar relationship that exists in medicine between the user of the system and the buyer of the system. In the world of consumer electronics that has brought us wildly popular cellular phones, music devices, tablets and PCs, the consumer user is the buyer of the product. The decision to purchase an EHR by a provider organization is at least partly driven by administrative and financial needs. In response, vendors of EHR have focused on improved charge capture, enhancing revenue or functions that qualify for financial incentives of various types. These provide a more visible and immediate return on investment than improvements in clinical processes and decision support. If the purchase decisions are driven by financial considerations and have insufficient physician involvement, usability for clinicians is likely to be an afterthought.
2. Distrust of EHR-produced encounter notes: EHR vendors incorporate a number of tools in their products to speed up the process of recording a clinical encounter. These include problem templates, copy forward, and 'single-click' entry of review of systems and physical examination components. These tools favor the creation of voluminous documents with redundant and sometimes inaccurate notes. There is a growing frustration among clinicians

who feel that clinical documentation quality and accuracy has been subjugated to financial needs for higher levels of documentation for billing purposes.[29] As documented at the 2011 AMIA policy meeting,[30] there is a crying need to reinvent the clinical EHR record to support solely patient-centered clinical care and to move all other essential EHR functions such as the financial and reporting considerations elsewhere.

3. Lack of interoperability: Despite the increased adoption of EHR and the efforts at HIE, physicians continue to express frustration that exchange of information is still not as seamless as it should be, even within a single hospital[31] and especially between entities.[32] Consequently the improvement in quality of care that EHR could bring is not being fully realized. Part of the difficulty is technical. Data-level standards remain a problematic area. Although LOINC (logical observation identifiers names and codes) has widespread use among EHR and laboratory systems, broader data-level standards have not had similar success, although it is encouraging that the 2014 edition EHR certification criteria require SNOMED (systemitized nomenclature of medicine) coding for many components of the record.[33] The standards issue is only part of the problem. HIE continue to struggle to find the right economic model for viability.[34] The issues are complex in that multiple studies have shown that many times, even when there is enthusiasm for HIE and the information is easily available, it is not accessed or used.[35–37] As others have indicated, the technical interoperability issues may be the least of the issues that need addressing for HIE to be truly seamless and to realize its potential of improving healthcare quality. Other issues such as competition between hospitals with regard to information exchange and getting clinicians to use the data to improve quality may pose bigger problems than actually exchanging the data.[38 39]
4. Slow adoption of CDSS: Although MU is increasing the implementation of decision support rules, barriers to their use remain.[40] These include the lack of a single oversight entity to coordinate CDSS issues to allow provider organizations, vendors, and CDSS developers to have a common source for information on existing CDSS efforts, lack of a common terminology and standards for CDSS, and insufficient funding for research on how to optimize CDSS effectiveness.
5. Market barriers: There is concern that the EHR market, itself, represents a barrier to innovation. Although there are hundreds of EHR vendors, only five account for over 50% market share.[6] Mergers and acquisitions activity during 2012 in healthcare IT showed significant increases over previous years.[41] Such a difficult market environment clearly inhibits the entry of new approaches to EHR. Mandl and Kohane[42] point to a lack of modern infrastructure in EHR systems compared to other industries, which can potentially stifle innovation, interoperability and user friendliness.
6. Potential for fraud and abuse: In 2005, a group of industry experts warned ONC of the potential for increased fraud in an electronic environment and recommended that anti-fraud measures be proactively required of EHR.[43] ONC's focus was on encouraging adoption, which could potentially be affected negatively if ONC was also perceived to take on a policing role. ONC did not implement a set of specific recommendations made by a subsequent expert panel.[44 45] In September 2012, this issue bubbled over into the public media with articles by the Center for Public Integrity, a non-profit investigative news organization, and the New York Times both reporting an increase in billing associated with the adoption of EHR. This led to considerable public debate regarding whether this increase was legitimate or fraudulent. Although the jury is still out on this issue, there are clearly features and functions of EHR that are questionable and invite fraud and should be eliminated or more narrowly used, unless other safeguards against fraud are instituted. These features include 'decision support' aimed solely at increasing the billing codes, record 'cloning', default histories and physical exams, and other practices.
7. Insufficient numbers of trained clinical informaticians: Despite the recent funding and more interest in informatics training, there are still insufficient individuals to meet the demand. Since passage of the HITECH legislation in 2009, the number of online postings for health IT jobs has tripled, far exceeding the increase in demand for all types of healthcare jobs as well as non-healthcare jobs.[46] When AMIA started its 10×10 program years ago they anticipated that 10 000 individuals with clinical informatics training would be needed by 2010.[47] The ONC community college workforce programs aimed to train 10 000 individuals a year. The number of online postings for health IT jobs in February 2012 was 14 512.[20] Neither the 10×10 nor the ONC workforce programs have been able to meet the demand. Some of the other workforce programs are intentionally longer programs, so that although they are successfully recruiting students, these programs are smaller programs and the output will take longer to make a difference in the marketplace. In addition, while these newly trained individuals are clearly needed, it will take a longer time for them to meet the demand that is still there for experienced health IT professionals.[48]

Although the HITECH legislation has focused on clinical use of health IT, there are other areas where insufficient progress has been made that are useful for clinical care, but are especially important in terms of using the clinical data for research. These problematic areas include the fact that there is still no universal health identifier for either clinical care or research[49] and that many current policies have made access to the clinical data for research more difficult.[50–52]

As in our 2005 paper, we predict a number of major changes in the next 5 years. These are listed below.

1. Near universal adoption will be achieved.[53]
2. There will be greater emphasis and progress on standards and interoperability.
3. Congress will become involved in health IT to a greater level of detail than ever.[54]
4. We will see new breakthroughs in user interfaces.[55]
5. There will be a move toward on-line education regarding IT.[56]
6. CDSS will emphasize genetics and personalized medicine.[57–59]
7. A 'learning healthcare system' will emerge.[60]
8. Better delineated limitations to and strengths of 'big data' will become apparent.
9. The distinction between telemedicine and EHR will blur.
10. There will be a resurgence of computer-assisted diagnosis.[61 62]

## CONCLUSION

Over the next few years we shall know whether or not the leading recommendation included in the 2012 IOM report 'Best

care at lower cost: the path to continuously learning health care in America'[12] will become manifest. The initial recommendation is for a digital infrastructure capable of both improving care as well as the management of the healthcare system while also improving the capacity to utilize data already existent within the system. It says a great deal that after so many years at sea, with the waves now crashing about us, a clear call has been made by the IOM not to lose sight of essentials. We are optimistic that despite substantial turbulence among clinicians and political leaders with respect to EHR and EHR systems, the progress outlined in this paper will continue and a more sustainable, safer and higher quality healthcare system will result.

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