The Evolution of Health Information Technology for Enhanced Patient-Centric Care in the United States: A comprehensive look at enhanced interoperability, electronic prescribing, public health reporting, and patient access to health information

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Abstract

Background: Health information technology has revolutionized health care in the United States. Interoperable clinical care data exchange, e-prescribing, electronic public health reporting, and electronic patient access to health information have improved care and outcomes.

Objective: This objective of this analysis is to examine progress and the Office of the National Coordinator for Health IT's (ONC's) mission to enhance health care through data access and exchange.

Methods: This analysis leverages data on end-users of health IT to capture trends in engagement in interoperable clinical care data exchange (ability to find, send, receive, and integrate information from outside organizations), e-prescribing, electronic public health reporting, and capabilities to enable patient access to electronic health information. Data were primarily sourced from the American Hospital Association Annual Survey Information Technology Supplement (2008 to 2023), Surescripts e-prescribing utilization data (2008 to 2023), the National Cancer Institute's Health Information National Trends Survey (2014 to 2022), and the National Center for Health Statistics' National Electronic Health Records Survey (2009 to 2023).

Results: Since 2009, there has been a remarkable 10-fold increase in EHR use among hospitals and 5-fold increase among physicians. This rapid digitization enabled the interoperable exchange of electronic health information, electronic prescribing, electronic public health data exchange, and the means for patients and their caregivers to access crucial personal health information digitally. Now, 70% of hospitals are interoperable, with many providers seamlessly integrated within EHR systems. Notably, nearly all pharmacies and 92% of prescribers possess e-prescribing capabilities, marking an 85-percentage point increase since 2008. In 2013, 40% of hospitals and a third of physicians allowed patients to view their online medical records. Patient empowerment has increased, with 97% of hospitals and 65% of physicians possessing EHRs that enable patients to access their online medical records. As of 2022, three-quarters of individuals report being offered online access to portals, and over half (57%) report actively engaging with their health information through their patient portal. Electronic public health reporting has also had an uptick, with most hospitals and physicians actively engaged in key reporting types.

Conclusions: Federal incentives have served as catalysts for the widespread adoption of electronic health records (EHRs) and the rapid digitization in health care. We found tremendous growth in health IT capabilities. Interoperability initiatives have gained considerable momentum and have fostered collaboration across health care entities. However, challenges persist in achieving nationwide interoperability, stemming from technical, organizational, and policy challenges and optimizing the benefits of these technologies. Enhanced data standardization, governance structures, and the establishment of robust health information exchange networks are crucial steps forward. Interoperable clinical care data exchange, e-prescribing, electronic public health reporting, and patient access to health information have grown substantially over the past quarter-century and have

been shown to improve health care outcomes. However, interoperability hurdles, usability issues, data security, and equitable patient access persist. Addressing these demands will require collaborative efforts among stakeholders, refining standards, and enhancing policy frameworks.

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Conclusion:
Interoperable clinical care data exchange, e-prescribing, electronic public health reporting, and patient access to health information have grown substantially over the past quarter-century and have been shown to improve health care outcomes. However, interoperability hurdles, usability issues, data security, and equitable patient access persist. Addressing these demands will require collaborative efforts among stakeholders, refining standards, and enhancing policy frameworks.

Keywords

Interoperability, e-prescribing, electronic public health reporting, patient access to health information, electronic health records, health information technology

Introduction

The growth of health information technology (health IT) adoption and use over the years has led to better health care delivery, improved health outcomes, and enhanced patient engagement, therefore supporting patient-centric care.[1] This growth in adoption and use of health IT has been supported by numerous regulations and initiatives, including federal initiatives and legislation as well as quality improvement efforts centering around value-based care. The Health Information Technology for Economic and Clinical Health (HITECH) Act in 2009 spurred increases in the use of certified electronic health record (EHR) technology by hospitals and healthcare professionals[2], reflecting a collaborative effort involving public-private partnerships and various grant programs to enhance the technological foundation of health care facilities nationwide.[3] The HITECH Act authorized the Office of the National Coordinator for Health IT (ONC) to develop the ONC Health IT Certification Program as well as the establishment of the Medicare and Medicaid EHR Incentive Programs. The Centers for Medicaid and Medicare Services (CMS) used [4] this program to measure performance related to data capture and sharing for Stage 1 in 2011-2014 and performance related to advanced clinical processes for Stage 2 in 2014.[5]
The enactment of the 21st Century Cures Act,[6] built upon this momentum and introduced specific provisions to increase the exchange and availability of health information. This Act emphasized the critical importance of interoperability and set forth measures to combat information blocking, ensuring that health care data could be exchanged and utilized more freely and effectively. The ONC Cures Act Final Rule finalized further requirements to help mitigate information blocking and support health information exchange[6]. Authorized by the Cures Act, the Trusted Exchange Framework and Common Agreement (TEFCA)[7] was published in 2022, with a go-live that initiated qualified health information network (QHIN) applications and then designations in 2023. TEFCA established governance, policy and technical requirements for interoperability, connectivity to safely exchange information to improve patient care, and support for patient access to health care information. These efforts collectively focus on resolving persistent challenges for interoperability as the health care sector continues to encounter obstacles, underscoring the complexities and challenges in health IT implementation and use.[8] In 2023, the Health Data, Technology, and Interoperability: Certification Program Updates, Algorithm Transparency, and Information Sharing (HTI-1) Rule[9] continued to implement provisions of the Cures Act to make further headway in the advancement of

patient access, interoperability, and standards. Spurred on by these efforts, the advancement of health IT has brought about transformation across the US health care system.

The evolution of health IT for enhanced patient-centric care in the US is a complex and ongoing process. The goal of this analysis is to shed light on the developments that have occurred in health care delivery through advanced technology and data exchange. This paper examines the successes and challenges faced in health IT implementation, focusing on interoperable clinical care data exchange, electronic prescribing, public health reporting, and patient access to health information. These key developments have paved the way for a more efficient, safe, and patient-centric health care environment, where health care providers can share patient information in real-time, leading to improved patient outcomes and ultimately improving health outcomes for all.

Methods

This analysis describes end-user adoption and use of health IT, focusing on interoperable clinical care data exchange capabilities, e-prescribing practices, electronic public health reporting, and patient access to electronic health information. To provide a comprehensive view of the evolving health IT landscape for enhanced patient-centric care, we extracted and analyzed data from 2008 to 2023 from various sources to get a comprehensive view of the evolving health IT landscape for enhanced patient-centric care.

The data for assessing interoperability and EHR adoption among hospitals were derived from the American Hospital Association (AHA) Information Technology (IT) Supplement[10] to the AHA Annual Survey. Respondents from hospitals were the Chief Information Officer or the person most knowledgeable about their hospitals' health IT capabilities. The AHA and ONC have collaborated to monitor the adoption and utilization of health IT in U.S. hospitals since 2008.

The data for assessing interoperability and EHR adoption among physicians were derived from the Centers for Disease Control and Prevention's (CDC) National Center for Health Statistics' (NCHS) National Electronic Health Records Survey (NEHRS).[11,12] These data span from 2009 to 2021 and track trends among office-based physicians in adopting and utilizing EHRs for direct patient care. This survey excludes non-direct care providers such as radiologists and pathologists and provides valuable insights into the EHR functionalities employed in outpatient settings.

For e-prescribing trends, Surescripts transactional data from 2008 to 2023,[13-15] a prominent e-prescription network in the U.S., were used. This network captures data across a wide array of pharmacies.[16]

The National Cancer Institute's (NCI) Health Information National Trends Survey (HINTS)[16] were used to measure engagement with health information technology, tracking how people access and use health information, their use of information technology for health management, and their engagement level in health-related behaviors. This nationally representative survey offers insights into public engagement with health information technology and the evolving trends in this domain.

The National Physician Health IT Survey, a nationally representative survey of office-based physicians is conducted in partnership with the University of California San Francisco, ONC, and the American Board of Family Medicine. These data were collected in 2022 and surveyed outpatient physicians across primary care specialties[17] regarding health IT capabilities.

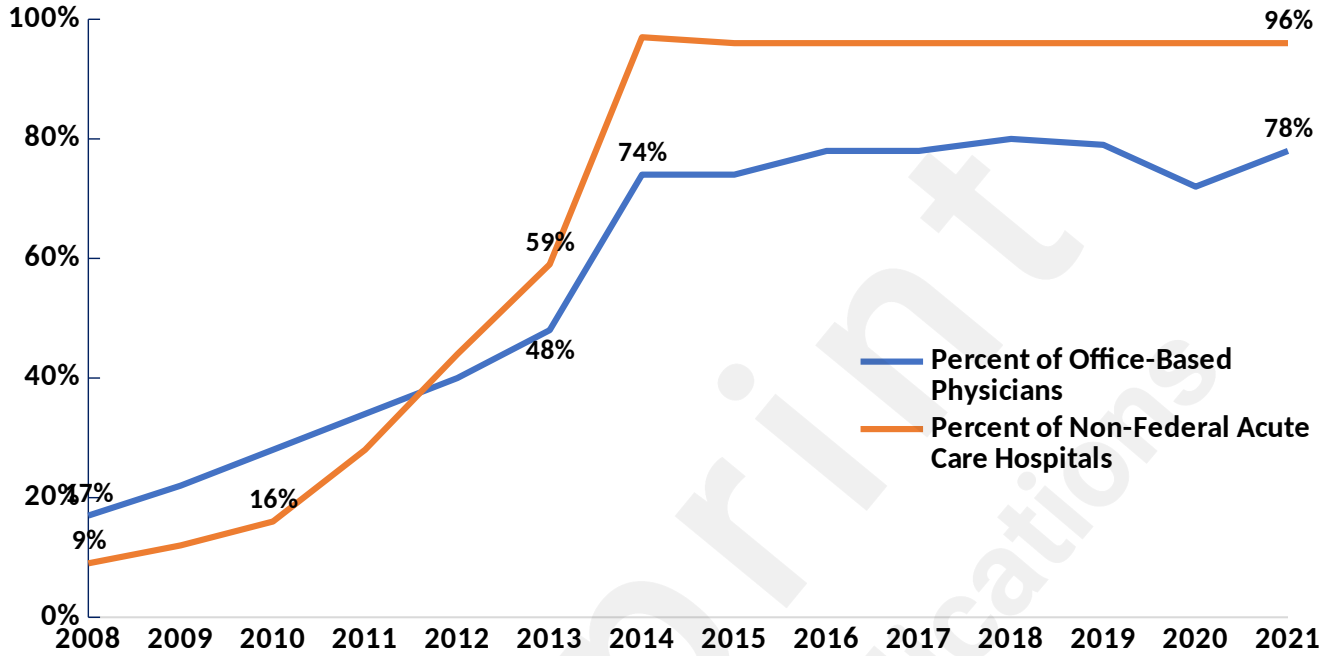
Medicare Meaningful Use (MU) Program data was used to estimate hospital and physician adoption of electronic capabilities to submit of immunizations, syndromic surveillance, and laboratory reports to public health jurisdictions.

Results

Many physicians and hospitals benefitted from federal incentive payments, authorized by the HITECH Act, to implement and use certified health IT, shown by the surge in certified health IT

adoption among office-based physicians and non-federal acute care. EHR adoption and use, underpinning interoperable clinical care data exchange, e-prescribing, electronic public health reporting, and patient access to health information increased over the past two decades. Since 2008 there was an 87-percentage point increase in EHR use among hospitals and a 61-percentage point increase among physicians (Figure 1). hospitals.

Figure 1. Electronic Health Record Adoption Among Hospitals and Physicians



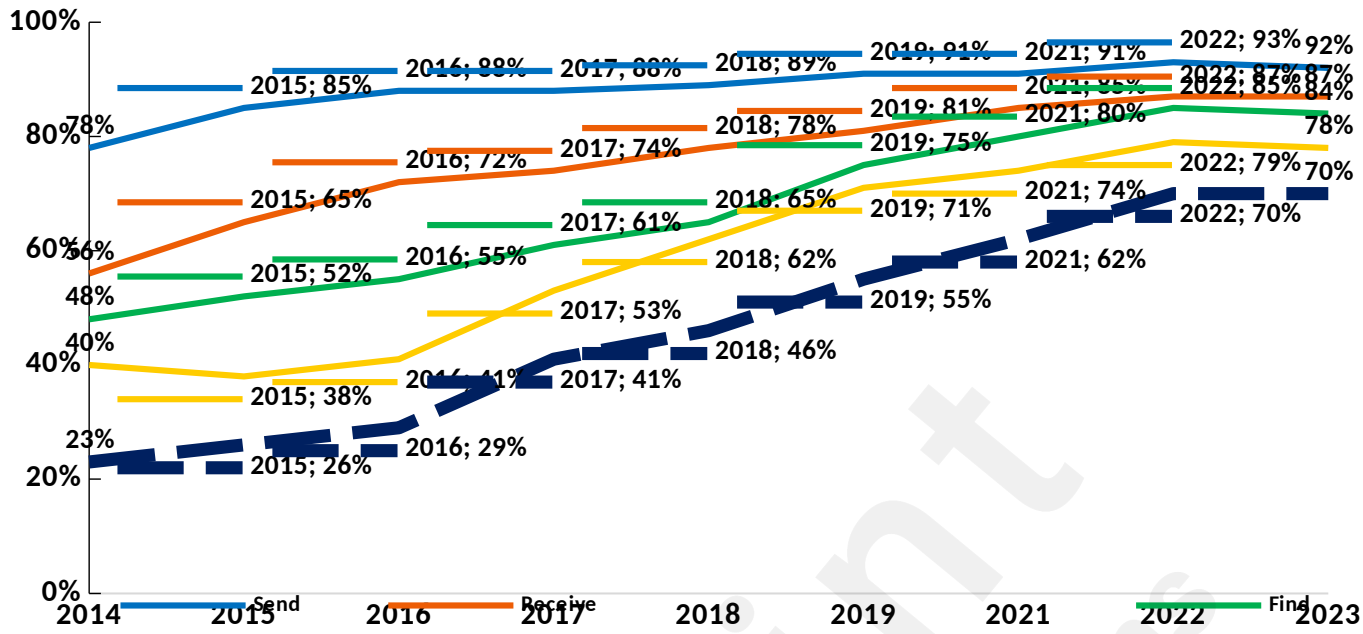
Notes: 2008-2013 includes hospitals and physicians that have adopted an EHR system that integrates patient data, medication tracking, clinician notes, and diagnostic results. 2014 to 2021 includes hospitals and physicians that have adopted a certified EHR system that meets the capability, functionality, and security requirements adopted by the US Department of Health and Human Services. This graph represents data collected from office-based physicians and non-federal acute care hospitals.

Sources: American Hospital Association Information Technology Supplement (2008-2021) and National Center for Health Statistics Ambulatory Care Survey (2008-2011) and National Electronic Health Record Survey (2012-2021)

Interoperable Clinical Care Data Exchange:

Following this period of rapid digitization, there has been progress related to interoperable data exchange among hospitals (Figure 2). From 2014 to 2023, the engagement in all four interoperability domains (find, send, receive, and integrate patient health information electronically) increased. During this decade, the ability to find information increased by 75%, the ability to send information increased by 18%, the ability to receive information increased by 55%, and the ability to integrate information increased by 95%. In 2014, 23% of hospitals were interoperable, and therefore were engaged in all four interoperability domains (find, send, receive, and integrate patient health information electronically) either routinely or sometimes. By 2023, 70% of hospitals sometimes or routinely engaged in all four interoperability domains. Notably, while over half of hospitals were not fully interoperable in 2018, by 2023, this declined to 30%, indicating a downward trend in the lack of complete interoperability.

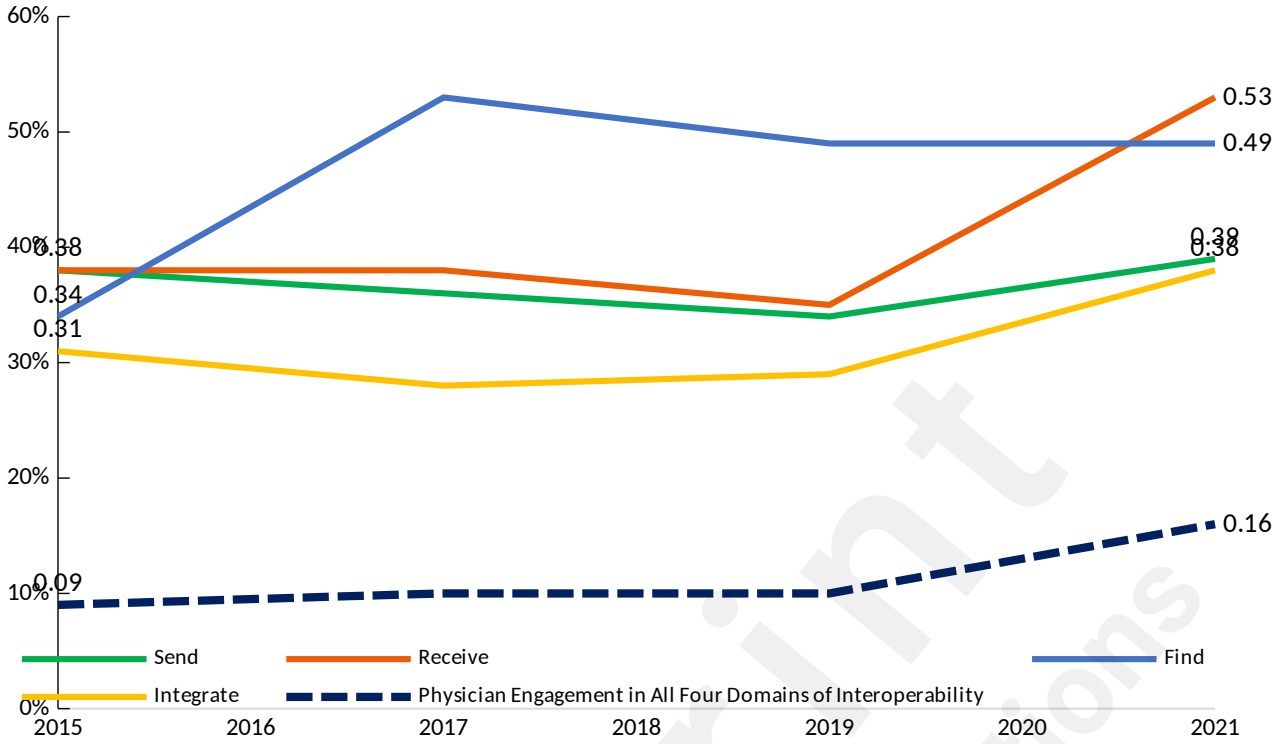
Figure 2. Hospitals Engaging in Interoperable Exchange of Electronic Health Information



Source: 2014-2023 American Hospital Association Information Technology Supplement. These data were collected from non-federal acute care hospitals.

For office-based physicians, there has been a modest progress related to interoperability (Figure 3). From 2015 to 2021, like hospitals, the engagement in all four interoperability domains increased, most notably, the abilities to find and receive electronic information. During this seven-year period, the ability to find information increased by 44%, the ability to receive information increased by 39%, the ability to send information increased by 3%, and the ability to integrate information increased by 23% among office-based physicians. By 2021, 16% of office-based physicians were engaged in all four interoperability domains, with a 78% increase in engagement from 2015 to 2021.

Figure 3. Physicians Engaging in Interoperable Exchange of Electronic Health Information

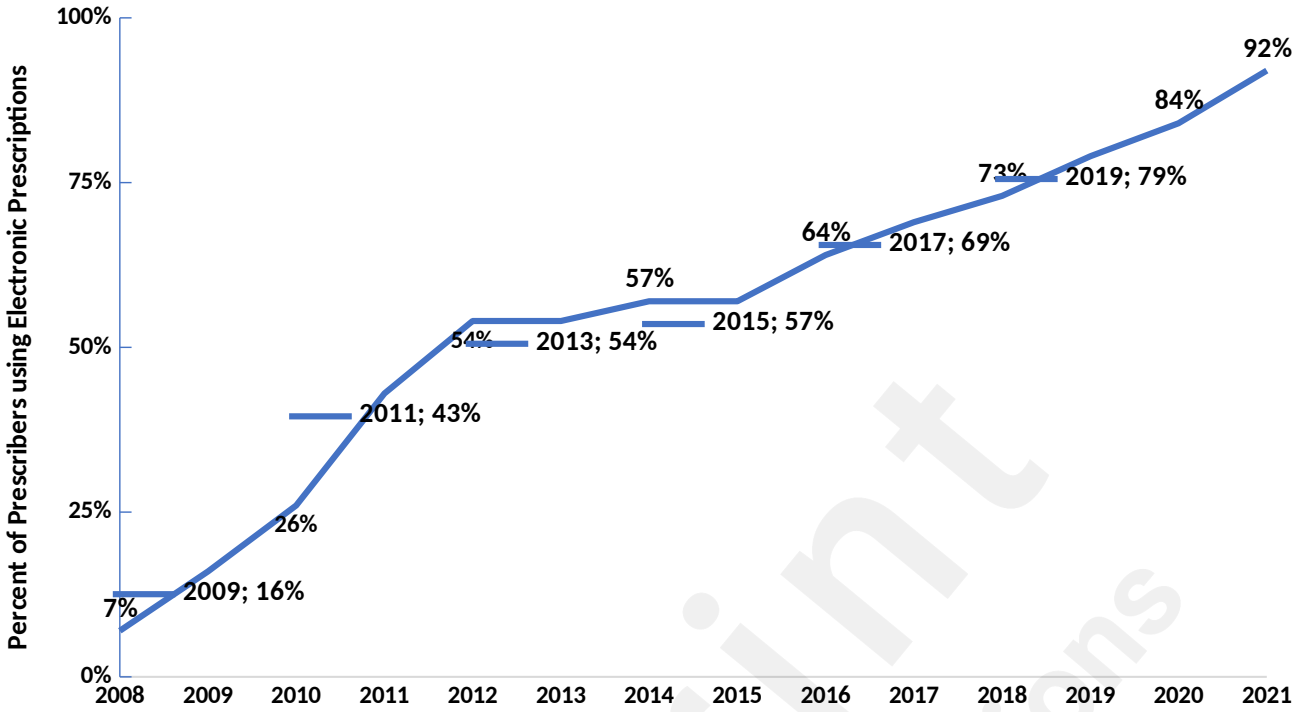


Source: 2015-2021 National Electronic Health Record Survey. These data are collected from office-based physicians.

Electronic Prescribing:

The percentage of prescribers who e-prescribe has grown from 7% in 2008 to 92% in 2021, an 85-percentage point increase. Now, there is near-universal adoption among pharmacies, and 92% of prescribers are enabled for e-prescribing (Figure 4). In addition, the electronic prescribing of controlled substances (EPCS) has increased since first allowed in 2010 (Figure 5). Early on, uptake of EPCS was slow, from 0.05% in 2012 to just over 4% in 2015. By 2017, about a third of office-based physicians who prescribe were using EPCS, and as of 2021, nearly three-quarters were using EPCS.

Figure 4. Electronic Prescribing Use Among Prescribers



Source: Analysis of Electronic Prescribing Transaction Data

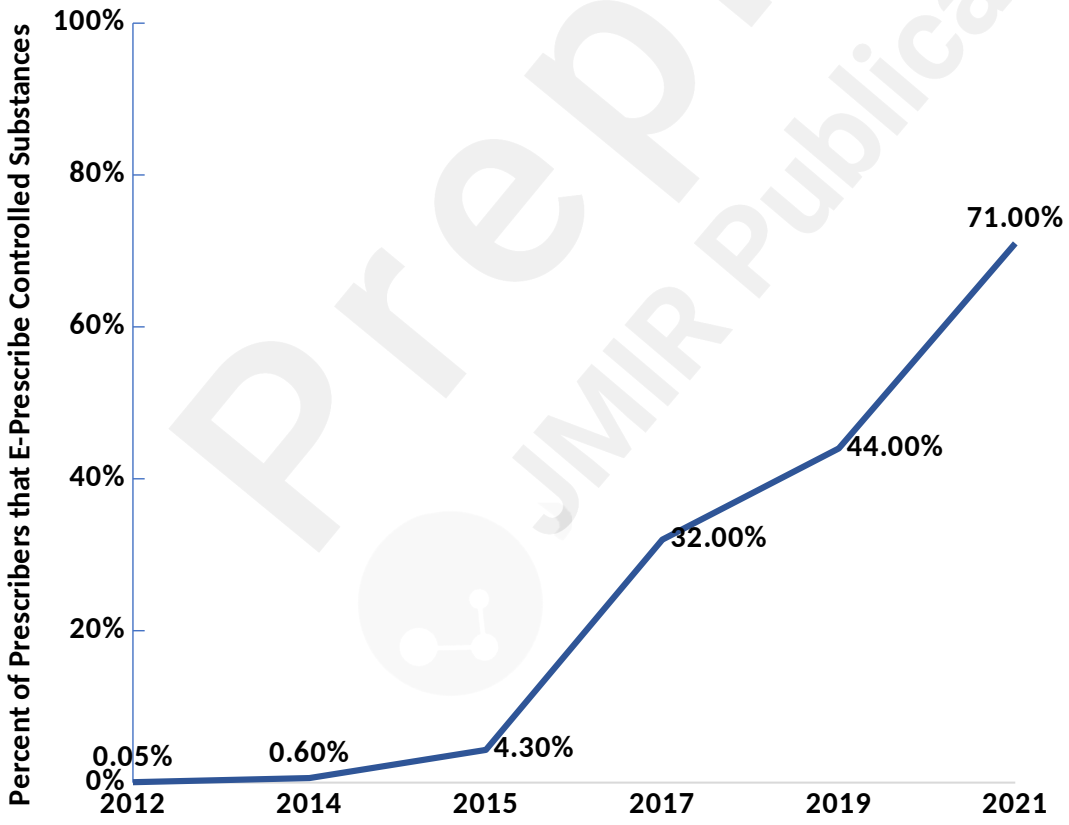


Figure 5. Electronic Prescribing of Controlled Substances Sources: EPCS Transactional Data (2012-2015, prescribers enabled for ECPS) and National Center for Health Statistics Ambulatory Care Survey National Electronic Health Record Survey (2017-2021, percent of office-based physicians using EPCS)

Electronic Public Health Reporting:

Public health reporting capabilities among hospitals and primary care physicians have increased over the past decade (Figure 6). An analysis of Meaningful Use (MU) Program data shows that in 2012,

among eligible hospitals required to use certified health IT to report public health data electronically, 63% could electronically submit immunization data to their state immunization information system (IIS), 57% could electronically report laboratory results, and 55% could electronically report syndromic surveillance data to public health agencies. For primary care physicians participating in the program, over half (57%) were able to electronically submit immunization data to their state IIS.
By 2022, according to the AHA Health IT Supplement, rates of hospitals' electronic reporting increased for syndromic surveillance (86%) and laboratory reporting (85%) and immunization registry reporting (90%). Additionally, as of 2022, about three-quarters of primary care physicians who viewed immunization data in their EHR indicated their primary outpatient EHR reported data to their state IIS.

Figure 6. Public Health Reporting: 2012 and 2022

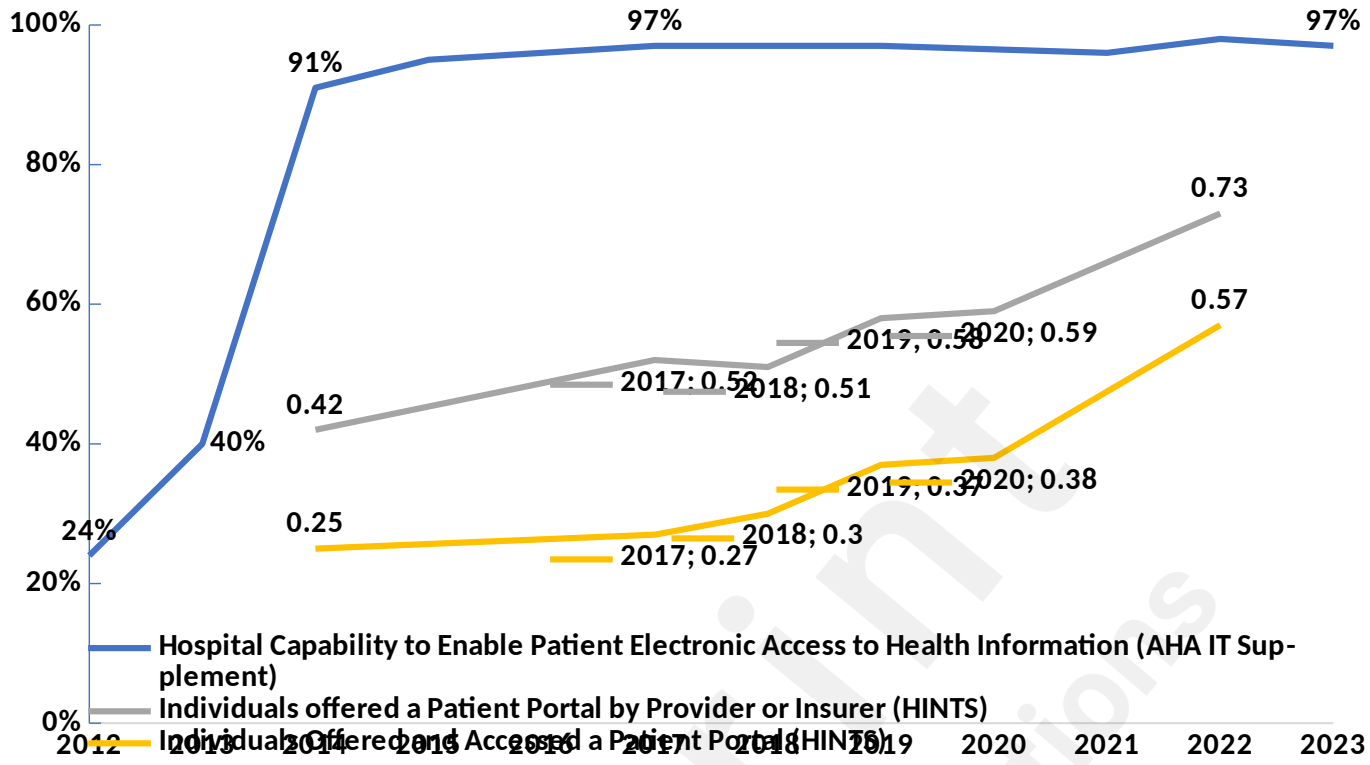
Public Health Reporting Among Hospitals and Physicians	
2012	**2022**
• 63% of participating hospitals enabled to report immunization data to public health agencies • 57% of participating hospitals enabled to report laboratory results to public health agencies • 55% of participating hospitals enabled to report syndromic surveillance data to public health agencies • 57% of participating primary care physicians enabled to report to immunization information services	• 90% of hospitals enabled to report immunization data to public health agencies • 85% of hospitals enabled to report laboratory results to public health agencies • 86% of hospitals enabled to report syndromic surveillance data to public health agencies • 74% of primary care physicians who viewed immunization data in their EHR report data to immunization information services

Sources: 2012 CMS PI Programmatic Data, 2022 National Physician Health IT Survey, & 2022 AHA IT Supplement

Patient Access to Health Information:

Over the past decade, progress has been made in enabling patient access to electronic health information (Figure 7). In 2012, 24% of non-federal acute care hospitals offering inpatient care had health IT capable of enabling patients to view their online medical records. As of 2017, 97% of non-federal acute care hospitals providing inpatient care possessed health IT that enabled patients to view their electronic health information online, predominantly through patient portals or smartphone health apps. This percentage has remained stable throughout the subsequent years, and nearly all (97%) of hospitals offering inpatient care in 2023 enabled patient access to their data.
In 2014, 42% of individuals were offered a patient portal by their provider or insurer. In 2022, 73% of individuals reported being offered online access to their medical records by health care providers or insurers, representing a 74% increase since 2014. Of the individuals offered a patient portal, only a quarter accessed their data in 2014. However, by 2022, the percentage of individuals actively accessing their medical records online rose to 57%, a 128% increase.

Figure 7. Access to Patient Electronic Health Information



Sources: NEHRS, AHA IT Supplement, and HINTS Surveys

Discussion

Our analysis provides insights into the outcomes of ongoing efforts to enhance health care delivery through advanced technology and data exchange. The adoption rates for health information technologies among health care professionals and hospitals underscore the critical role of federal incentives and collaborative efforts.[18,19,20] We also highlight the need for continued efforts to overcome the challenges in health IT implementation and ensure that all patients have access to high-quality, patient-centric care. The rise in the adoption of these functionalities reflects the success of initiatives and programs designed to transition healthcare from mostly paper-based to digitally native. The rise in the adoption of these functionalities reflects a broader trend towards greater patient involvement in their health and care.

Interoperable clinical care data exchange

The growth in interoperable exchange among health care providers signifies a transformative era in health care communication and data exchange.[21] These findings show that both hospitals and office-based physicians alike have made progress in interoperability and the adoption and use of health IT. However, office-based physicians have consistently lagged behind hospitals. With the modest progress in interoperability among physicians, it is important to continually monitor growth for targeted support. Furthermore, prior analyses examining variation in interoperability across both hospitals and physicians show that providers with greater resources outpace those with fewer resources.[22,23]

Prior analyses found that both hospitals and physicians face continue to face challenges related to interoperability that need to be addressed. Despite marked growth in interoperability among hospitals, the majority of hospitals continue to indicate experiencing interoperability challenges and overarchingly, lower-resourced hospitals reported challenges to using application programming interfaces (APIs) for more efficient information exchange.[24] Also, more than half of physicians experienced positive benefits from engaging in electronic exchange of patient health information in areas related to practice quality, care coordination, and efficiencies, yet most physicians also

experienced barriers to exchange.[25] Although a recent survey of family medicine physicians revealed that the majority (91%) find it relatively easy to use external information for patient care, around 8 out of 10 reported facing challenges in locating important information and integrating it into their EHR. These data point to need to explore interventions that support data integration to ensure that accessing and using patient information from external sources becomes seamless.

Despite the investments of the past two decades, more work to enable clinical data exchange remains. Of particular importance is data standardization and the seamless exchange of information across diverse health systems. The continuing evolution of technology and legislative and regulatory support are essential to address these barriers and advance interoperability. Interoperability has been a critical factor in the integration and advancement of health IT, allowing health care providers to share patient information in real-time, leading to improved patient outcomes. [26,27] Additionally, necessary information is not always available at the point of care and hospitals may not always be able to share patient information with external providers including other hospitals, ambulatory care, long-term care providers, or behavioral health, even when they have the capability.[28] This can lead to providers frequently missing patient records, as a recent survey of family medicine providers found that a third faced this issue. [29] Improvements that come with enhanced interoperability will play a role in providing patient information that is needed, when it is needed, at the point of care.

E-Prescribing

The rise in e-prescribing adoption illustrates another shift towards digital health care processes to help improve prescription accuracy, efficiency, and patient safety.[23,30] Research suggests that adherence to early e-prescribing thresholds set forth by the Medicare Promoting Interoperability (PI) Program is associated with reduced rates of adverse drug events (ADEs), indicating the potential of e-prescribing to improve medication accuracy and patient adherence.[31] The integration of e-prescribing into EHRs and the advancement of electronic prescribing of controlled substances (EPCS) have been crucial in this development. The use of e-prescribing is now nearly universal, and the use of EPCS[32] is growing rapidly, and being facilitated by state and federal initiatives[33] and the integration of systems within EHRs.

However, there are still areas for improvement, particularly in ensuring uniform adoption across all health care settings. Future efforts must focus on overcoming these challenges to fully realize the benefits of e-prescribing in enhancing patient care. The use of EPCS has contributed to safer prescribing practices and aiding in combating the opioid crisis. Also, prescription drug monitoring programs[33] (PDMPs) have become integral tools in addressing the opioid epidemic, offering real-time data to aid health care providers in making informed prescribing decisions. While PDMPs have shown promise in reducing inappropriate prescribing, their effectiveness is amplified when integrated with EHRs, highlighting[34,35] the importance of ease of access and use for health care professionals. Recent studies confirmed that physicians frequently use PDMPs[33] and report benefits beyond reduced prescribing, including improved clinical decision-making and overall patient care. The growth of EPCS and other related tools and initiatives, such as PDMPs, have affected improvement on patient-centric care by reducing inappropriate[36] controlled substance prescribing practices and prescription overdoses. While the adoption and use of e-prescribing of medications inclusive of controlled substances have been hailed as a success, there is still room for improvement. Updating the National Council for Prescription Drug Programs (NCPDP) Script standards to align with Medicare and other federal programs would help to ensure a unified approach across our health care system.[37]

Furthermore, to reduce the burden associated with medication prior approvals, the Health Information Technology Advisory Committee (HITAC)[38] Taskforce on Pharmacy Interoperability and Emerging Therapeutics[39] has recommended that electronic prior authorizations be included with Health IT Certification requirements and to support better decision-making during prescribing. The implementation of real-time benefit tools[40] is important as reflected by legislative requirements[41] and will help improve prescription affordability and transparency. To further enhance patient-centric care,

it may be beneficial for providers and pharmacies to include additional data elements, such as the indication or reason why a medication was prescribed, on e-prescriptions.[42] This will improve communication between the pharmacist and patient regarding the intended use of the medication and ensure safe and effective care. These updates and improvements to e-prescribing are set to transform it into a more integrated tool for medication management in support of patient-centric care. It would help to improve bi-directional access between parties, uphold patient privacy and security, and address existing gaps in prescription services.

Electronic Public Health Reporting

The adoption of electronic public health reporting capabilities for both hospitals and physicians has changed the landscape of public health surveillance and response, driven by legislative frameworks such as the HITECH Act and furthered by the CMS PI Programs.[22,43-45] The transition from optional to mandatory reporting[46] on public health measures for providers under these programs has increased electronic public health reporting capabilities, streamlining the submission of public health data, and equipping public health agencies with more timely and accurate data[47] needed for disease surveillance and response efforts.[48]

Despite this progress, providers continue to face challenges to electronic public health reporting due to a lack of data standardization and use of different vocabulary standards, high implementation costs related to interfaces and data submission or transmission, technical complexity of interfaces, and difficulty extracting relevant information from the EHR.[45] Further, many providers cite public health agencies' lack of capacity to electronically receive information as a major barrier to public health information exchange.[22,49] Varying technical complexities of sending and receiving systems across institutions persist, highlighting a need for comprehensive strategies to enhance system uniformity and functionality to achieve interoperable public health data systems. Nevertheless, the ongoing digitization of public health reporting has facilitated a notable improvement in data exchange and real-time monitoring capabilities.

Public health reporting is crucial for rapid response and effective public health management, as evidenced by the increased adoption rates among hospitals for electronic submission of immunization, syndromic surveillance, and laboratory data and among physicians for IIS reporting efforts. A similar trend is seen among physicians, where the early uptake of exchange and rates have remained steady since then.[17,50] Recent data show that around half of primary care physicians exchange information with their state's IIS, but among those who viewed immunization data in their EHR, approximately three quarters were able to access and report data to their IIS[17]. Rates of awareness of their EHR's reporting capabilities and overall satisfaction among primary care physicians varied, and the data show that those physicians that exchanged with their IIS through their primary outpatient EHR have a higher rate of satisfaction than those using an outside portal, paper, or fax, showing the perceived benefits of integrating these capabilities within the EHR[17].

Federal mandates to report public health data electronically and underlying ONC Health IT Certification Program requirements that standardize these processes across disparate health IT have played a role in advancing electronic reporting. The mandates led to an uptake in electronically reporting key public health data, underscoring the influence of federal policy in enhancing public health reporting infrastructures. Despite advancements driven by federal requirements and coordination with state, tribal, local, and territorial health departments, interoperability issues and the integration of reporting functionalities within existing health IT present ongoing challenges.

These challenges underscore the importance of continued support and resource allocation from federal initiatives and coordination to address these barriers effectively. Moreover, the evolution of electronic public health reporting necessitates the need for continued collaboration among health care providers, public health entities, and technology developers to foster a more integrated and efficient public health reporting ecosystem. Though progress has been made in electronic public health reporting, addressing existing challenges remains critical for further developing efficient, standardized, and universally accessible public health reporting systems. Enhancing electronic

reporting capabilities across all health care settings, particularly among office-based physicians, is essential for achieving comprehensive public health surveillance and ensuring a coordinated response to public health emergencies.

Patient Access to Electronic Health Information

In recent years, advancements in health IT have notably enhanced patient access to electronic health information, underpinned by provisions from the 21st Century Cures Act to reduce the effort for patients to electronically access their health information and increased demand due to the COVID-19 pandemic's impact on health care delivery. The transition to EHRs facilitated by federal mandates fostered an informed and engaged patient population. The adoption of certified health IT has not only streamlined patient engagement but also enhanced the quality of health care delivery. The surge in telehealth and patient portal usage from 2020 to 2022[51] exemplifies the role that external factors, such as the COVID-19 pandemic, have played in accelerating the demand for electronic access to health information. As of 2022, most individuals who accessed their data did so to view test results, view clinical notes, or download health information.[51] This period underscored the utility of patient portals and health applications in providing crucial health care services and information, thereby contributing[52] to an increase in their adoption and use.

These developments signify a pivot towards more patient-centric health care, with increased patient engagement and demand for transparent, accessible health information.[53] Data indicate that nearly all hospitals report the ability to enable patients to access their information online, while fewer office-based physicians do so. It is important to note that the lower reported rates among physicians may further exacerbate the differences in access as individuals are more likely to have outpatient encounters. Expanded health IT adoption, however, illuminates persistent access and usage differences across different patient groups, accentuated by varying levels of education, income, and ethnicity. These differences highlight the critical need[54] for targeted interventions to bridge gaps and ensure that advancements in health IT benefit all sections of the population equitably. Recent data show that family physicians who practiced in rural areas, that did not have staff and linkages to community programs to address patients' social needs, and that treated a large proportion of vulnerable patients were less likely to be satisfied with access to patient information from external providers[55]. Therefore, the ability to access and use information from external sources creates friction and barriers to patient-centric care.

The shift towards app-based access to health information introduces new dimensions to the health IT landscape, offering increased convenience and patient engagement.[51] However, this shift[56] also concerns data privacy, security, and interoperability. As mandated by the Cures Act Final Rule,[6] implementing standards-based APIs represents a step forward in addressing these challenges, promoting safer and more efficient access to health information. Addressing these multifaceted challenges and opportunities is imperative for advancing a more inclusive, effective, and patient-centric health care system.

Raising the Bar to Support Patient-Centric Care

Ultimately, health IT has contributed to more patient-centric care in the US, but more work remains. Rates of patient engagement and electronic public health reporting have improved, and further advancements to interoperability and transparency through standards and policies that support the access, use, and exchange of patient information will help to move the needle forward. Additionally, as technology advances, it is essential to update and standardize the way health IT applications launch and interact. A specific focus on security, data accessibility, and interoperability will help to ensure that patients can access their electronic health information. For example, data standards, such as the United States Core Data for Interoperability (USCDI),[57] which was established in the ONC Cures Act Final Rule,[58] includes data elements, classes, and standard code set versions that are continuously and transparently updated through an annual, public process. The implementation of these updated standards and frameworks are integral to support seamless exchange of data elements needed for patient-centric care.

Since the start of this new decade, federal policymakers have focused on initiatives and policies to address persistent interoperability challenges. The implementation of provisions of The 21st Century Cures Act,[59] such as defining information blocking and establishing activities that do not constitute information blocking,[58,60] establishing TEFCA, and adopting standardized APIs that can be accessed and used 'without special effort' will help to facilitate and support necessary data sharing to promote patient-centric care. The HTI-1 Final Rule continues to support provisions from the Cures Act and sets first of its kind governance for artificial intelligence in health care.[9] These efforts are meant to broaden the playing field, inviting innovators and new models for data sharing, clinical decision-making, and patient access to their electronic health information. The rapid digitization of the past two decades has created new opportunities in health care technology and delivery. The lessons of the COVID-19 pandemic tell us that interoperability has not been fully achieved, but also that without the efforts to adopt and implement health IT, new digital health and virtual care models that were vital during the pandemic would not have been possible.

This analysis provides a high-level overview of the advanced in health IT that have revolutionized patient centric care in the United States. Continuous measurement and evaluation of health IT policy and program implementation have been vital to identify barriers and help formulate ways to address these challenges. Due to the complex nature and inherent difficulties in quantifying physician interoperability it is important to explore methods for accurate measurement and to address these challenges. This will enable more comprehensive evaluations of interoperability. Furthermore, advancement of indices or tools to holistically measure interoperability and related capabilities could be used to assess the impacts of policies, inform future policy opportunities, and identify areas for targeted support, including performance gaps and health equity concerns. As we move forward into the next quarter-century- it is now the time to 'be bold' and help support tools and processes to ensure patient-centric care.[61]

Conclusion

The US has experienced growth in enhanced interoperability, e-prescribing, electronic public health reporting, and patient access to health information, which have transformed health care delivery and improved patient outcomes. While these achievements are noteworthy, it is essential to continue the collaborative efforts, policy support, and technological innovation to overcome the persistent obstacles, such as non-standardized health IT systems and financial burdens. Legislation such as the HITECH Act and 21st Century Cures Act, have played a vital role in addressing these challenges. However, it is important to continue to focus on enhancing interoperability, data standardization, and security while reducing inequities to ensure all patients benefit from health IT advancements.

Addressing social determinants and ensuring equitable technology access remain central to bridging the digital divide and achieving a comprehensive health care transformation. In the next 25 years, we should shift our focus from health IT adoption to infrastructure improvements necessary for patient-centric care. It is crucial to establish a system where patient data can flow safely and seamlessly. The commitment to advancing health IT will be indispensable in overcoming existing challenges and harnessing the full potential of technological innovations in health care as we transition towards a more integrated and patient-centric health care framework. The ongoing evolution of health IT offers a future where health care delivery is efficient, accessible, and tailored to the needs of every patient, creating another quarter-century of improvements in public health and patient care.

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