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# Toward Health Information Liquidity:

## Realization of Better, More Efficient Care From the Free Flow of Health Information

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### Executive Summary

Recognizing the challenges presented by the current state of our economy and national discussions about healthcare reform, Booz Allen Hamilton and the Federation of American Hospitals have collaborated to examine the ways that health information technology, in combination with communications technology (hereafter referred to simply as health IT), can accelerate progress toward the goal of a patient-centered healthcare system.

We engaged thought leaders from across the different segments of the healthcare industry to discuss ways to accelerate progress toward the free flow of essential electronic health information. This group of invested stakeholders from the provider community, academia, the technology industry, and government concluded that consumers, clinicians, and providers all derive greater benefits when health information flows faster and more freely, or becomes more "liquid." Growing evidence indicates that liquid health information can facilitate improvements in healthcare access, quality, safety, efficiency, convenience, and outcomes. At the same time, it can open the door to innovation and provide a foundation for a new standard of patient-centered care through enhanced use of healthcare teams and informatics.

We conducted a series of interviews with these thought leaders and convened them to discuss the benefits of liquid electronic health information, as well as the barriers that inhibit the conversion from paper-based record systems to robust electronic health information and that discourage the sharing of appropriate data that is already electronic. Published reports, white papers, websites, policy blogs, trade newsletters, and other sources of information on early adopters of electronic health information informed the results of the discussions and our conclusions.

Health IT alone will not dramatically improve care and reduce costs. Even when information is electronic, it is not automatically shared outside of organizational or network firewalls, or across organizational boundaries. In the course of our inquiry, two accelerators emerged that combine policy and market changes to change healthcare delivery and improve the flow of information. First, focus on enhancing the flow of health information and communications among patients and providers, rather than focusing only on adoption of electronic health records (EHR). Second, take bold new steps toward realizing a consumer-centered healthcare system.

We believe several levers are within reach to fuel these two accelerators.

**Accelerator 1: Intensify the Focus on Information Flow and Communication**

1.1 Get out of paper—continue to adopt electronic health information to increase electronic data exchange but focus additional energy to eliminate use of paper-based medical practice in critical areas such as prescriptions, lab results, and medical imaging

1.2 Reform payment to align incentives with desired outcomes and processes known to affect outcomes, including decision support and process redesign

1.3 Define and implement a national health information exchange and knowledge management architecture—make sure critical history data, such as pharmacy, lab, and imaging data, flow securely across organizational boundaries

1.4 Create and maintain standards for information exchange: the Certification Commission for Health IT (CCHIT) could certify any system's ability to meet health information exchange requirements

1.5 Fast-track implementation of a nationwide e-prescribing network with decision support at the time and place of care

1.6 Assure availability of pharmacy, lab, and imaging histories at the point of care and increase reliable and valid reporting for quality and safety

**Accelerator 2: Take Bold Steps Toward a Patient-Centered Healthcare System**

2.1 Grant patients consistent, secure, and timely access to their personal health information and the ability to communicate securely with clinicians about it

2.2 Define professional responsibilities and good stewardship policies and practices for health information workflow—better define how health information is to be received, used, enhanced or processed, and passed along to others

2.3 Refine policies with respect to health information privacy, confidentiality, and security breaches—assure patients and clinicians that health information is transmitted securely

2.4 Create a voluntary authentication system whereby individuals can choose a unique personal identifier for purposes of care and research—facilitating secure and convenient patient and clinician access to health information and facilitating health record matching

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## The Potential of Health Information Technology to Improve Quality and Safety of Healthcare

Although opinions vary widely on how healthcare should be organized and funded in the United States, there is clear consensus on what Americans want from their healthcare system. We want access to healthcare services that meet the Institute of Medicine (IOM) definition of quality: care that is safe, timely, efficient, effective, equitable, and patient-centered.

Consumers, clinicians, and providers all will derive greater benefits when health information flows faster and more freely, or becomes more "liquid."

We agree that health information will help us achieve our goals and that technology is required to make health information portable so it can follow patients from setting to setting and provider to provider. To drive improvements in the effectiveness and efficiency of healthcare, the IOM envisions a transition to a "learning healthcare system" that takes full advantage of developments in information and communications technology and evidence-based advice in changing healthcare delivery at the point of care. [1], [2] This transition will require a new perspective that places the patient at the center of an interdisciplinary team whose members employ evidence-based practice and informatics for quality improvement.

So what can healthcare delivery look like when health information is accessible at any point of care? Picture a future where some health information and timely, evidence-based advice is consistently and securely flowing or being exchanged among the patient, healthcare providers, and ancillary service providers (e.g., pharmacy, lab, medical imaging). As a starting point, imagine that three streams of patient information are flowing and up-to-date patient history related to these services can be easily accessed from any point of care:

- Pharmacy data—prescription and prescription fill information, including medication history and medication allergies
- Laboratory data—lab test order, result, and interpretation information
- Medical imaging data—imaging test order, result, and interpretation information.

These three streams of "liquid" or widely exchanged health information can show how we can meet the goal of a patient-centered healthcare system across several dimensions:

**Safety:**

- Adverse drug events can be reduced in frequency and severity with review of drug history, allergy history, and drug-to-drug interactions and by avoiding mistakes caused by illegible scripts and missing or incomplete information
- Availability of timely and accurate lab and radiology results ensure rapid and effective treatment
- Care coordination errors and iatrogenic injuries through duplication of costly and risky tests can be avoided through information sharing across different settings of care and associated clinicians. For example, lab results that become available after a patient is discharged from a hospital could easily be accessed by the patient and other clinicians performing follow-up consultations

**Timeliness:**

- Prescriptions and prescription refills can be filled immediately, remotely, and in many cases, without an office visit
- Lab and imaging results can be reviewed by the patient and the clinician immediately after they are processed
- Patients can be more easily identified for targeted prevention outreach (e.g., patients due for a mammogram), even if they see multiple clinicians

[1] Institute of Medicine, Roundtable on Evidence-Based Medicine. The Learning Healthcare System: Workshop Summary, 2007 and Learning Healthcare System Concepts v. 2008. Washington, DC: National Academy Press, 2007 and 2008 (respectively). Available at http://www.iom.edu.

[2] Institute of Medicine, Committee on Quality of Health Care in America. *Crossing the Quality Chasm: A New Health System for the 21st Century.* Washington, DC: National Academy Press, March 2001.

**Cost Efficiency:**

- Generic medications can be recommended where appropriate
- Duplicate lab and imaging tests can be avoided
- Costly rework can be avoided through a better understanding of patient history
- Patients can access services at the lowest cost location, which may now include telemedicine and online options, without sacrificing loss of critical personal history

**Effectiveness:**

- Clinical decision support can be enhanced through a more complete view of the patient's prior treatments and application of current evidence-based medicine
- Prescription pickups can be tracked, and patients can be sent messages to help improve patient adherence to prescribed treatment plans
- Pharmacy, lab, and imaging data can be used to improve patient-level outcomes and provide information feedback to improve practice

**Equity:**

- Patients can expect to receive access to their lab, pharmacy, and imaging data based on their clinical needs, regardless of personal characteristics such as gender, age, ethnicity, disabilities, geographic location, and socioeconomic status
- Healthcare professionals share patients' lab, pharmacy, and imaging data in a culturally sensitive way that is conducive to meeting the patients' cultural, language, literacy, and learning needs
- Patient–provider relationships are based on a partnership model with shared responsibility for clinical decision-making, thereby reducing information asymmetry

**Patient-Centeredness:**

- Patient health information is available at the point of care if approved by the patient, regardless of location, clinician, or insurance plan (e.g., images will no longer need to be "sent ahead to the hospital" before surgery)
- Patients can access and direct others' access to their information according to clearer laws and protocols that provide greater consistency and transparency
- Patients' burdens are reduced as we make it easier for them to locate and forward medical history when they change providers

The potential benefits that could be gained from just three streams of liquid health information are clear and compelling. Consumers will have greater assurance that their clinicians will have the right information to make informed decisions about them at the point of care. Clinicians will be able to provide better care more efficiently and communicate more easily with care teams to coordinate care. The challenge now is to build on lessons learned to date and begin realizing the benefits of interoperability on a broader level. In short, we need to implement the national health IT strategy that drives us to the outcomes we desire.

## Where Have We Been?

Our national health IT strategy grew from two main principles:

1. Health information that is in paper form today must be available in electronic form tomorrow so that it can flow and be transferred electronically to the right people at the right time.
2. Health information should be patient-centric such that healthcare stakeholders use that information to provide better care more efficiently, communicate and coordinate with care teams, and contribute to evidence on clinical effectiveness.

Liquid health information can facilitate improvements in healthcare quality, efficiency, convenience, and outcomes while encouraging innovation and providing a foundation for a new standard of patient-centered, team-oriented care.

The goal of achieving a paperless healthcare system is global and has existed for decades in the United States. A physician named Lawrence Weed [3]

[3] Weed LL. Technology Is a Link, Not a Barrier, for Doctor and Patient. February 1970. *Modern Hospital,* Vol. 114(2):80–83.

described a system to organize patient records back in the 1960s and helped to form the Problem-Oriented Medical Information System (PROMIS) project at the University of Vermont, one of the earliest attempts to design an electronic medical record. Also in the 1960s, the Mayo Clinic began development of its electronic medical record system. Today, a few leading care providers have succeeded in going nearly paperless but despite enormous advances in technology, adoption remains low in the United States, particularly in small practice settings where most people receive routine healthcare.

The U.S. Department of Defense (DoD) and Department of Veterans Affairs (VA) have both made significant contributions in the past three decades as early adopters of robust, comprehensive electronic health record (EHR) systems. In contrast to most private sector provider organizations, DoD and VA are among the most advanced users of EHR systems in the nation and have large beneficiary populations which, taken together, span the continuum from young, healthy active duty service members and their families, to elderly veterans receiving domiciliary care. [4]

The focus on data exchange, or interoperability, is newer. In 2001, the National Committee on Vital and Health Statistics envisioned a national health information infrastructure that "is fundamentally about bringing timely information to, and aiding communication among, those making health decisions for themselves, their families, their patients, and their communities." [5] In 2003, interoperability was the focus of a congressionally mandated national commission, [6] and it moved forward significantly in 2004 when the Office of the National Coordinator for Health IT (ONC) was created by Executive Order. The Executive Order specifically charged ONC with executing a vision of implementing a nationwide interoperable health information technology infrastructure that—

- Ensures that appropriate information to guide medical decisions is available at the time and place of care
- Improves healthcare quality and safety, reduces medical errors, and advances the delivery of appropriate, evidence-based medical care
- Reduces healthcare costs resulting from inefficiency, medical errors, inappropriate care, and incomplete information
- Promotes a more effective marketplace, greater competition, and increased choice through the wider availability of accurate information on healthcare costs, quality, and outcomes

Improves the coordination of care and information among hospitals, laboratories, physician offices, and other ambulatory care providers through an effective infrastructure for the secure and authorized exchange of healthcare information

Ensures that patients' individually identifiable health information is secure and protected.

ONC's first National Coordinator, David Brailer, MD, stressed that the "portability" and usability of health information were critical to realizing the nation's cost and quality goals. ONC created the Health Information Technology Standards Panel (HITSP) to begin harmonizing standards so systems could "talk" to each other, a necessity for information to flow. ONC leadership also recognized that the movement toward adoption of health IT could be slowed by the need for change in the underlying data structures and the evolution in the requirements for technology. ONC supported the creation of the Certification Commission for Health IT (CCHIT) as an independent nongovernmental organization to help improve standards and performance, thereby also reducing clinicians' fears that any technology they bought today would not become obsolete tomorrow as the requirements and standards evolved.

Finally, ONC started a process of discovering how to implement information exchange at a community level. The original National Health Information Network (NHIN) procurements challenged communities and

[4] Evans DC, Nichol P, Perlin JB. Effect of the implementation of an enterprise-wide Electronic Health Record on Productivity in the Veterans Health Administration. Health Economics, Policy and Law (2006), 0:1-7. Also see Perlin JB. Transformation of the U.S. Veterans Health Administration. Guest Editorial. Health Economics, Policy and Law (2006) 0:1-7.

[5] National Committee on Vital and Health Statistics. *Information for Health: A Strategy for Building the National Health Information Infrastructure*. Washington, DC: U.S. Department of Health and Human Services, November 2001. p. 10. Available at http://aspe.hhs.gov/sp/NHII/Documents/NHIIReport2001/default.htm.

[6] Commission on Systemic Interoperability, mandated by the Medicare Modernization Act of 2003. See http://endingthedocumentgame.gov.

industry players to essentially build the requirements for health information exchange through experiments, or trial implementations. These and other public–private initiatives that are creating health information exchanges (HIE) are identifying and clearing policy and privacy hurdles and piloting organizational and governance structures. They are, in fact, identifying critical requirements for liquid information flow.

Implementation support and technical guidance for clinicians and clinical organizations adopting health IT have also been provided by other U.S. Department of Health and Human Services (HHS) agencies for more than a decade. The Agency for Healthcare Research and Quality (AHRQ) has funded more than 100 demonstration projects to test different tools, applications, and implementation strategies in different organizational settings and to learn what works to promote health IT adoption. The Health Resources and Services Administration (HRSA), through its Office on Health Information Technology (OHIT), recently published an adoption toolbox for ambulatory care and safety net providers to help them to plan, roll out, and evaluate health IT initiatives to improve safety and effectiveness (http://healthit.ahrq.gov/toolbox).

These and other efforts have resulted in a number of accomplishments, including—

- HITSP's harmonization of more than 200 standards across 13 use cases [7]
- CCHIT's seven certification programs certifying more than 150 products, including 75 percent of the EHR market [8]
- Forty-two operational community health information exchanges [9]
- Twenty-three organizations demonstrating exchange of NHIN core services [10]

There is simply no question that we have learned much about the technical, governance, policy, and legal opportunities and challenges surrounding information exchange. Nonetheless, the efforts of ONC and others have been largely under-funded relative to the scope of the challenge. Much work remains to be done beyond pilots and demonstration projects to bring full interoperability.

[7] Halamka J, Health Information Technology Standards Panel (HITSP). Update on HITSP. Presentation to American Health Information Community (AHIC), November 12, 2008. Available at http://www.hhs.gov/healthit/community/meetings/m20081112.html.

[8] Leavitt M, Certification Commission for Health IT (CCHIT). Update on CCHIT. Presentation to AHIC, November 12, 2008. Available at http://www.hhs.gov/healthit/community/meetings/m20081112.html.

[9] Marchibroda J, e-Health Initiative. An Overview of Results of 2007 Survey on Health Information Exchange. Presentation to AHIC, February 26, 2008. Available at http://www.hhs.gov/healthit/documents/m20080226/marchibroda_HIE_files/800x600/index.html E-.

[10] Office of the National Coordinator for Health IT (ONC), NHIN Core Services September Presentation Description, September, 2008. Available at http://www.hhs.gov/healthit/documents/m20080923/05a_nhin_summary.html.

## Some Key Events in Policy and Implementation Guidance for Health IT

| | |
|---|---|
| April 2001 | Department of Health and Human Services (HHS) Office of Civil Rights (OCR) issues federal standards for privacy of health information [1] |
| November 2001 | National Committee on Vital and Health Statistics/HHS announces national strategy for health information infrastructure (NHII) [2] |
| May 2002 | Congress commits $4 billion to information and communications infrastructure for emergency preparedness [3] |
| February 2003 | HIPAA Security Rule defines safeguards to protect health information from inappropriate uses and disclosures [4] |
| December 2003 | Medicare Modernization Act (MMA) requires pharmacies and health plans to participate in future e-prescribing [5] |
| April 2004 | Office of the National Coordinator for Health IT (ONC) is established at HHS; 90 days later strategic plan for Health IT is released [6] |
| October 2004 | HHS Agency for Healthcare Research and Quality (AHRQ) funds $139 million in Health IT projects [7] |
| November 2004 | HHS public comment period generates more than 500 responses on how to develop a nationwide health information exchange [8] |
| July 2005 | American Health Information Community (AHIC) is chartered by HHS Secretary to provide public—private policy and implementation advice [9] |
| October 2005 | Congressionally mandated Commission calls for a connected, interoperable system of health information [10] |
| October 2005 | ONC invests $17.5 million in three organizations to accelerate health IT adoption through harmonizing standards (HITSP), certifying HIT products (CCHIT), and addressing variations in privacy and security practices (HISPC) [11] |
| November 2005 | HHS provides support for regional electronic health record (EHR) adoption in Gulf States, but state legal barriers later prevent implementation [12] |

**Footnotes**

[1] Center for Medicare and Medicaid Services (CMS), HHS. *Privacy Standards*. (http://www.cms.hhs.gov/HIPAAGenInfo/04_PrivacyStandards.asp#TopOfPage.

[2] National Committee on Vital and Health Statistics (NCVHS). *Information for Health: A Strategy for Building the National Health Information Infrastructure (NHII).* November 15, 2001. http://aspe.hhs.gov/sp/NHII/Documents/NHIIReport2001/default.htm.

[3] CNN.com, June 12, 2002. Bush Signs Bioterror Law, Pushes Homeland Security. http://archives.cnn.com/2002/ALLPOLITICS/06/12/bush.terror/index.html. Also see *Public Health Security and Bioterrorism Preparedness and Response Act (P.L. 107-188); Provisions and Changes to Preexisting Law*. https://www.policyarchive.org/handle/10207/1337.

4 Centers for Medicare and Medicaid Services (CMS). Security Standard Overview. http://www.cms.hhs.gov/SecurityStandard. Also see U.S. Government Accountability Office (GAO), *Health Information Technology: HHS Has Taken Important Steps to Address Privacy Principles and Challenges, Although More Work Remains*, GAO-08-1138, Washington, DC. September 2008, p. 7.

[5] AHRQ. *Findings from the Evaluation of e-Prescribing Pilot Sites*. Rockville, MD: AHRQ Publication No. 07-0047-EF, April 2007.

6HHS. *The Decade of Health information Technology: Delivering Consumer-centric and Information-rich Health Care—Framework for Strategic Action*. Washington, DC: July 21, 2004. http://www.hhs.gov/healthit/frameworkchapters.html.

[7] HHS Press Office, October 13, 2004. *HHS Awards $139 Million to Drive Adoption of Health Information Technology*. http://www.hhs.gov/news/press/2004pres/20041013.html.

[8] HHS, *Summary of National Health Information Network Request for Information*. http://www.hhs.gov/healthit/rfisummaryreport.pdf.

[9] HHS, American Health Information Community, Background. http://www.hhs.gov/healthit/community/background/.

[10] HHS Press Office. Commission on Systemic Interoperability. *Federal Commission Urges Immediate Action on Development of National Health Information Technology Infrastructure*. October 25, 2005. http://endingthedocumentgame.gov/.

[11] HHS Press Office. *HHS Awards Contracts to Advance Nationwide Interoperable Health Information Technology*. October 6, 2005. http://www.hhs.gov/news/press/2005pres/20051006a.html.

[12] HHS Press Office. *HHS Enters Into Agreements to Support Digital Health Recovery for the Gulf Coast*. http://www.hhs.gov/news/press/2005pres/20051117.html

## Some Key Events in Policy and Implementation Guidance for Health IT (continued)

| | |
|---|---|
| January 2006 | Center for Medicare and Medicaid Services (CMS) e-prescribing foundation standards go into effect [13] |
| July 2006 | Certification Commission for Healthcare IT (CCHIT) certifies the first 37 ambulatory electronic health records [14] |
| August 2006 | HHS announces final regulations to promote e-prescribing, including exceptions to the Physician Self-Referral Law (Stark) [15] |
| September 2006 | Health IT Standards Panel (HITSP) publishes first set of interoperability specifications recognized by HHS for federal use [16] |
| October 2006 | HHS begins to support e-health alliance to address state-level issues [17] |
| July 2007 | DoD (Military Health System) and VA (Veterans Health Administration) initiate a study to assess the feasibility of a joint DoD-VA Inpatient EHR [18] |
| October 2007 | HHS awards $22.5 million to test implementation of nine prototype state-level health information exchanges [19] |
| November 2007 | Federal Communications Commission commits $400 million to rural broadband to promote telehealth [20] |
| December 2007 | HHS recognizes the first set of interoperability standards for Health IT recommended by the American Health Information Community (AHIC) [21] |
| February 2008 | CMS demonstration project recruits office-based physicians to use personal health records (PHR) [22] |
| June 2008 | HHS releases Federal Health IT Strategic Plan 2008—2012 [23] |
| September 2008 | HHS sponsors successful demonstration of trial prototypes for health information exchange [24] |
| September 2008 | U.S. Government Accountability Office (GAO) advises that HHS could risk losing public trust absent a comprehensive privacy, confidentiality, and security strategy [25] |
| October 2008 | European Union launches 12-country pilot healthcare data exchange [26] |
| December 2008 | ONC and OCR jointly release Health IT privacy and security toolkit [27] |
| January 2009 | CMS e-prescribing incentives go into effect [28] |

**Footnotes**

[13] CMS, *E-Prescribing Overview*. http://www.cms.hhs.gov/eprescribing/.
[14] Certification Commission for Health IT (CCHIT). CCHIT *Certified Ambulatory EHR 2006.* http://www.cchit.org/choose/ambulatory/2006/. Accessed December 27, 2008.
[15] CMS Office of Public Affairs. *New Regulations to Facilitate Adoption of Health Information Technology*. August 1, 2006. http://www.hhs.gov/news/press/2006pres/20060801.html.
[16] HHS. *Data and Technical Standards: Standards and Recognition*. http://www.hhs.gov/healthit/standards/recognition/.
[17] ONC Press Office, HHS, October 19, 2006. *State Alliance for E-Health (E-alliance) Now Underway.* http://www.hhs.gov/healthit/20061019.html.
[18] VA/DOD Health IT Sharing Program. Inpatient EHR Study. http://www1.va.gov/VADoDHealthITSharing/page.cfm?pg=19.
[19] HHS Press Office, October 5, 2007. *HHS Awards Contracts for Trial Implementations of the Nationwide Health Information Network.* http://www.hhs.gov/news/press/2007pres/10/pr20071005a.html.
[20] Federal Communications Commission (FCC). *FCC Launches Initiative to Increase Access to Healthcare in Rural America Through Broadband.* November 19, 2007. See Rural Health Care Pilot Program. http://www.fcc.gov/cgb/rural/rhcp.html
[21] HHS. Data and Technical Standards; Standards and Recognition. http://www.hhs.gov/healthit/standards/recognition/.
[22] HHS Press Office, February 20, 2008. *HHS Secretary Invites Communities to Apply for an Innovative Electronic Health Record Demonstration Project*. http://www.hhs.gov/news/press/2008pres/02/20080220a.html.
[23] HHS, Office of the National Coordinator for Health IT, *The ONC-Coordinated Federal Health IT Strategic Plan: 2008-2012*. Washington, DC: June 3, 2008.
[24] ONC launches first interoperability demo for NHIN, *Government Health IT News*, September 24, 2008. http://www.healthcareitnews.com/story.cms?id=10016. Also see NHIN Goes Live for a Day, Sort of. Government Health IT News, September 23, 2008. http://www.govhealthit.com/online/news/350589-1.html.
[25] U.S. GAO. *Health Information Technology: HHS Has Taken Important Steps to Address Privacy Principles and Challenges, Although More Work Remains.* GAO-08-1138. Washington, DC: September 17, 2008.
[26] Monagain B. Europe launches its healthcare data exchange pilot. *Healthcare IT News*, October 6, 2008. See http://healthcareitnews.eu/content/view/1227/40
[27] HHS. The Nationwide Privacy and Security Framework for Electronic Exchange of Individually Identifiable Health Information. Health IT Privacy and Security Toolkit. http://www.hhs.gov/healthit/privacy/framework.html.
[28] CMS, HHS. E-prescribing Incentive Program. http://www.cms.hhs.gov/PQRI/03_EPrescribingIncentiveProgram.asp#TopOfPage.

## What's Left to Be Done?

Health IT alone will not necessarily improve care and reduce costs. There is an urgent need for concurrent changes in the ways healthcare is delivered.

To achieve our goals, we need to make meaningful and simultaneous progress in several areas. Based on our interviews with the expert panel and our review and analysis of extensive source materials, the following key areas emerged.

- **Getting out of paper:** Health information that is of high value to high quality and efficient care needs to be available in electronic form so that it can flow and be transferred electronically to the right people at the right time
- **Aligning incentives:** Payment systems need to be aligned with desired outcomes. Counter-incentives, such as paying more for volume (e.g., fee-for-service), including duplicative or unnecessary interventions, must be removed. Compelling business models must be present for the stakeholders that are expected to invest in and use health IT to gain efficiencies
- **Ensuring privacy and security:** Acceptable health information stewardship models need to be defined, implemented, governed, and regulated to ensure that health information is exchanged appropriately and reliably while maintaining security and confidentiality of the data. Issues of cross-organizational and interstate exchange must be addressed and reconciled. Patients must have improved access to and shared use of their health information. Patient record matching and personal authentication hurdles must be overcome
- **Improving workflow:** Patients, clinicians, providers, and ancillary service vendors need to adhere to health information workflow processes that are patient-centric. This includes responsibly receiving, using, and contributing to patient health history that is shared among all stakeholders involved with a patient's care. For many providers, this will require a radical change in the way medicine is practiced
- **Defining and implementing the national health information exchange and knowledge management architecture:** A common understanding of how health information applications (EHRs, personal health records [PHR], etc.) and shared services can work together to create an affordable, high-functioning, and secure information transfer platform must be achieved
- **Creating and maintaining protocols for information exchange:** Common information exchange protocols are required so information can be shared over time by multiple stakeholders using a variety of health information applications and devices
- **Clearing policy and regulatory hurdles:** State and federal policies that conflict with national health information goals or with each other need to be harmonized

## Current National Policy Focus

Most proposals promoting the use of health IT aim at increasing investment in EHRs and, to a lesser extent, e-prescribing. While these technologies may be necessary, they are not sufficient to drive the type of change in healthcare delivery that is required to realize the quality improvements and cost savings desired.

Even when health records are electronic, information is not automatically shared outside of the organizational or network firewalls, or across organizational boundaries.

Adoption of EHRs only addresses the first area identified in the previous section—getting out of paper—and it does not go far enough to get to interoperability and shared responsibilities for clinical decision-making. Eliminating paper through health IT requires more than just increasing adoption of EHRs.

An EHR is one specific technology within the health IT portfolio; focusing exclusively on its adoption is problematic for at least three reasons:

1. **EHRs are necessary but not sufficient for interoperability** The e-prescribing industry has demonstrated that there is independent value

to removing paper from a single process—prescribing drugs. For example, RxHub/SureScripts have shown us that it is possible to create a patient-centric medication and allergy history outside of the EHR. Leading health information exchanges, such as the Statewide Health Information of New York, are just beginning to test how building shared services could reduce cost and improve quality. In its approach, shared services would exist outside the EHR but interact with the EHR.

2. **The market is not demanding robust EHRs, as shown by low adoption rates, especially in small office-based practice settings.** As we increase the supply of EHRs, we also need to work on improving the demand for electronic health information by demonstrating the value of liquid health information. Because we do not have a centralized delivery system, we need the "pull" and the "push" to go paperless. Demonstrating benefits, as is being done through e-prescribing and could be done through telemedicine and other solutions, helps to generate the pull.

3. **Even with widespread adoption of interoperable EHRs, we still need to address other gaps and barriers to reach the vision of full interoperability.** Even when information is electronic, it is not automatically shared for systems improvement and research outside of the organizational or network firewalls, or across organizational boundaries, because of technical, legal, and privacy concerns. The experiences of other countries are instructive with regard to interoperability. For example, in the United Kingdom, where more than 90 percent of primary care practices use EHRs, and there is a single national secure broadband network, interoperability is being pursued as a separate initiative. [11]

In summary, the goal is more than full EHR adoption. Free flowing health information, communication among care teams, and all of the benefits of interoperable health information do not come automatically with EHR adoption—and in fact, some benefits of interoperable health information can be realized without EHRs. Therefore, it is critical to rethink our strategy and focus new energy on all of the other components that must be addressed to achieve benefits from liquid health information.

[11] HIMSS. Electronic Health Records; A Global Perspective. August 2008. pp. 36–42.

**Figure 1: Other Countries' Experience Shows That EHR Adoption Does Not Automatically Lead to Interoperability**

### Canada

| | |
|---|---|
| EHR—hospitals | <10% |
| EHR—primary care | 20-23% |
| E-rx—hospitals | <1% |
| E-rx—primary care | 5-11% |
| Lab results online | 27% |
| Universal patient identifier | No |
| Interoperable EHRs | No |

| | |
|---|---|
| Healthcare system model | Universal |
| Top Health IT goals | Nationwide interoperable EHR solutions |
| Who drives | Infoway: independent, not for profit, public sector members |

### Germany

| | |
|---|---|
| EHR—hospitals | <5% |
| EHR—primary care | 42-90% |
| E-rx—hospitals | <5% |
| E-rx—primary care | 60% |
| Lab results online | 34% |
| Universal patient identifier | No |
| Interoperable EHRs | No |

| | |
|---|---|
| Healthcare system model | Statutory; no public financing; covers almost 90% of citizens |
| Top Health IT goals | National E-card for all citizens; national system to link regional networks |
| Who drives | Gematik LLC; controlled by all major stakeholders |

### US

| | |
|---|---|
| EHR—hospitals | 10% |
| EHR—primary care | 24-28% |
| E-rx—hospitals | 5-10% |
| E-rx—primary care | <10% |
| Lab results online | 48% |
| Universal patient identifier | No |
| Interoperable EHRs | No |

| | |
|---|---|
| Healthcare system model | Distributed; multiple payers |
| Top Health IT goals | Nationwide health information network (NHIN) |
| Who drives | ONC and multiple stakeholders |

### Israel

| | |
|---|---|
| EHR—hospitals | >90% |
| EHR—primary care | 99% |
| E-rx—hospitals | <5% |
| E-rx—primary care | 99% |
| Lab results online | 85-90% |
| Universal patient identifier | Yes |
| Interoperable EHRs | No |

| | |
|---|---|
| Healthcare system model | National |
| Top Health IT goals | Nationwide health information exchange |
| Who drives | Central government |

### UK

| | |
|---|---|
| EHR—hospitals | <10% |
| EHR—primary care | 89-99% |
| E-rx—hospitals | <3% |
| E-rx—primary care | >90% |
| Lab results online | 84% |
| Universal patient identifier | Yes |
| Interoperable EHRs | No |

| | |
|---|---|
| Healthcare system model | National Health Service |
| Top Health IT goals | National Programme for IT (NpfIT)—single national network |
| Who drives | UK Dept of Health (DOH) |

### Australia

| | |
|---|---|
| EHR—hospitals | <10% |
| EHR—primary care | 79-90% |
| E-rx—hospitals | <1% |
| E-rx—primary care | 75-81% |
| Lab results online | 76% |
| Universal patient identifier | No |
| Interoperable EHRs | No |

| | |
|---|---|
| Healthcare system model | Universal |
| Top Health IT goals | Develop national strategy to integrate regional networks |
| Who drives | NEHTA (National e-health Transition Authority) |

| | Australia | Canada | Germany | Israel | UK | U.S. |
|---|---|---|---|---|---|---|
| **EHR—hospitals** | <10% | <10% | <5% | >90% | 8% | <10% |
| **EHR—primary care** | 79-90% | 20-23% | 42-90% | 99% | 89-99% | 24-28% |
| **E-rx—hospitals** | <1% | <1% | <5% | NA | <3% | 5-10% |
| **E-rx—primary care** | 75-81% | 5-11% | 60% | 99% | >90% | <10% |
| **Lab results online** | 76% | 27% | 34% | 85-90% | 84% | 48% |
| **Universal patient identifier** | No* | No* | No* | Yes | Yes | No |
| **Interoperable EHRs** | No | No | No | No | No | No |

* Regional identifiers only **Sources for Figure 1:**

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2. Source for EHR in primary care: Table 1, Jha AK, Doolan D, Grandt D, Scott T, Bates D. The use of health information technology in seven nations. International Journal of Medical Informatics (2008), doi:10.1016/j.ijmedinf.2008.06.007. For EHR adoption in Israel, see HIMSS: Electronic Health Records: A Global Perspective. August 2008, p. 101. Germany is pursuing a regional implementation plan, and the adoption rate varies by geographic regions.
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5. Source for laboratory results online: HIMSS: Electronic Health Records; A Global Perspective. August 2008. Available at http://www.himss.ogv/content/files/200808_EHRGlobalPerspective_white-paper.pdf.
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7. Interoperability ratings based on Monegain B. Europe Launches Large-Scale Health Data Exchange Pilot. Healthcare IT News, October 26, 2008. http://www.healthcareitnews.com/story.cms?id=10160; Also see HIMSS, 2008, p. 8 and Australian Health Information Council. eHealth Future Directions Briefing Paper. AHMAC Meeting, October 4, 2007. Available at http://www.achi.org.au/node/20.

## Widening the Focus Beyond EHR Adoption

As described in earlier sections, we feel a shift is needed away from a "big bang" or "magic bullet" strategy that articulates EHR adoption as the only goal. More realistic and more effective may be a strategy that drives delivery system change through an incremental focus on widespread health information exchange. We urge consideration of a strategy that accelerates the exchange of critical consumer health information such as prescription drug information, lab results, and medical imaging.

Two accelerators combine policy and market changes to improve the flow of information: focusing on the information flow, not just on the adoption of EHRs; and taking bold new steps toward realizing a consumer-centered healthcare system.

We have identified two accelerators, illustrated by potential scenarios, that can help us reap the benefits of health information exchange.

### Accelerator 1: Intensify the Focus on Information Flow and Communication

*1.1 Get out of paper—continue to adopt electronic health information to increase electronic data exchange but focus additional energy to eliminate paper-based medical practices in critical areas, such as prescriptions, lab results, and medical imaging*

Starting with widely exchanged streams of information from e-prescribing, lab results, and medical imaging data could lead to the greatest derived benefit. All three sources are of high value and should be available in electronic form at the point of care so that clinicians and providers can reasonably be expected to access and use an individual's history in real time to improve the safety and efficiency of care provided.

A variety of policy mechanisms can encourage stakeholders to capture and share e-prescribing, lab, and medical imaging information in electronic form. The key to generating and maintaining the flow of information and communications is "the belief on the part of stakeholders that uses of the exchange will succeed and be beneficial and that, in rare cases of problems, the stakeholders will be protected and problems solved" through policy and governance. [12]

*1.2 Reform payment to align incentives with desired outcomes and processes known to affect outcomes, including decision support and process redesign*

The current payment system is out of alignment with the nation's goals for safe, timely, efficient, effective, equitable, and patient-centered care. Significant reforms to public and private payment will help remove counter-incentives and conflicts from the healthcare system while encouraging the appropriate technology investments required to make health information and communications flow. CMS, TRICARE, and various private payors have expressed interest in value-based purchasing, or a shift in focus from volume to results. Under the umbrella of value-based purchasing, payors could create the expectation that care providers will access, use, and contribute to patient-centered history. A substantial change in philosophy and mechanism regarding care coordination is required to achieve desired outcomes, with a much greater emphasis on communications among care team members who may

[12] New York State Office of Health Information Technology Transformation. Technical Discussion Document: Architectural Framework for New York's Health Information Infrastructure. HEAL NY Phase 5 Health IT RGA, Section 7.2, March 2008. p. 6. Available at www.health.state.ny.us/technology/projects

practice in different organizational settings. The public payors are positioned to lead this change.

*1.3 Define and implement a national health information exchange and knowledge management architecture—make sure critical history data, such as pharmacy, lab, and imaging data, flow securely across organizational boundaries*

Multiple regional health information organizations and health information exchanges have identified, and in some cases overcome, the hurdles of multi-organization health information exchange and governance. At the same time, SureScripts-RxHub has operationalized a working exchange for pharmacy information. Finally, other sectors (banking, defense) have provided models for secure exchange of information.

We now have enough experience to define a health information exchange architecture for some services and implement it. The architecture can provide a common understanding of how health information applications (EHRs, PHRs, etc.) and shared services can work together to create an affordable, high-functioning, and secure information transfer platform. This could be scoped conservatively at first to deal only with exchange of pharmacy, lab, and imaging data.

*1.4 Create and maintain standards for information exchange: the Certification Commission for Healthcare Information Technology (CCHIT) could certify any system's ability to meet health information exchange requirements*

Common information exchange protocols are required so multiple stakeholders can share information using a variety of health information applications and devices. As such, the CCHIT could focus on the ability of health IT to meet interoperability requirements, regardless of the form their products and services may take.

The process under the ONC has included creation of use cases by the AHIC, selection and harmonization of standards by the HITSP, and development of criteria and certification by the CCHIT. [13]

Many types of applications can perform the functions and meet the standards and requirements developed through the ONC process, including freestanding "clipboards," PHRs, freestanding ER applications, EHRs, lab information systems, radiology information systems, freestanding e-prescribing systems, and so on. The CCHIT is now focused on certifying certain forms of applications rather than on certifying innovations that meet the CCHIT set of functional requirements.

We believe there are some missed opportunities in this approach. First, the focus on EHR as the single best solution to all healthcare problems is leading to design of the "big EHR" through the certification process. This means that small vendors, wanting only to create products and services to address specific market needs, may not be able to complete certification and could be pushed out of the market. Second, creating an increasingly big EHR could drive costs up for health information products and push them out of reach for many healthcare providers.

Solutions that achieve safe, secure, standardized transfer of health information should be supported. For example, CCHIT could begin to certify discrete sets of functions—such as the ability to send and receive a secure lab order—regardless of the technology's form. At the same time, implementation of freestanding applications as alternatives to a big EHR could bring new challenges, including a need for improved communications.

*1.5 Fast-track implementation of a nationwide e-prescribing network with decision support at the time and place of care*

The nation could support a single, standards-based network for e-prescribing and decision support (e.g., drug–drug interactions) that encompasses all prescription drugs and includes controlled substances. If existing policies and standards at HHS and the Drug Enforcement Administration (DEA) were harmonized, an affordable, phased-in, clinician-driven e-prescribing system could be fast-tracked.

E-prescribing can open up the flow of e-health information. Beginning in 2009, providers who use e-prescribing with Medicare patients will receive a two-

[13] Loonsk, J and Halamka, J. Standards Timeline and HITSP Interoperability Specification V 2.0. Presentation to AHIC June 12, 2007; HIT Implementation Testing and Support, for the NHIN Initiative, http://xreg2.nist.gov/hit-testing; US Dept of Health and Human Services website, http://www.hhs.gov/healthit/usecases/.

percent bonus and those who do not will have their fees reduced, according to provisions of the Medicare Modernization Act of 2003. There is a conflicting policy currently in place, however, through the DEA, which excludes controlled substances from e-prescribing to help prevent drug diversion. This exclusion policy persists in part because of the perception that paper-based systems with personal signatures in ink are more secure than e-signatures. By early 2009, DEA will be issuing new rules on e-prescribing of controlled substances after reviewing comments submitted during a recent public comment period that ended in September 2008.

It is important to understand that e-prescribing is much more than a prescriber initiating a prescription. It is a process that involves communications among the prescriber, the dispensing pharmacist, and the patient and his or her family members and caretakers. Properly designed and supported, the emphasis would shift from initial prescriptions to the ongoing management of medications as the patient's clinical condition changes over time.

Rather than being viewed only as instruments of efficiency or cost-containment, effective e-prescribing systems should be seen as essential tools in ensuring that those individuals who need regular medications to manage chronic conditions adhere to their medication regimens, a significant ongoing problem in disease management.

*1.6 Assure pharmacy, lab, and imaging histories to improve quality at the point of care and increase reliable and valid reporting for quality and safety*

The complexity of healthcare requires a deepened commitment to improving care by integrating clinical expertise with the best available evidence on what works.[14] Health information and communications technologies can assist in the development and application of evidence that supports clinical decision-making at the point of care and that contributes to a culture of knowledge generation and continual improvement in healthcare. This cultural shift in care delivery has been described as a "learning healthcare system." Quality measurement is another important part of quality improvement. Today's quality measures rely on clinical data that are either manually collected from EHRs or based on claims data. The AHRQ has funded the National Quality Forum to specify the prioritized set of clinical data types and elements that would be used for future quality measurement. Pharmacy, lab, and imaging data are very likely to be considered high priority. If we could assume that full patient history related to pharmaceuticals, lab tests, and medical imaging would be available electronically, the quality of performance measures could be enhanced. For example, we could begin to introduce reliable measures of overuse to complement existing measures.

### Accelerator 2: Take Bold Steps Toward a Patient-Centered Healthcare System

*2.1 Grant patients consistent, secure, and timely access to their personal health information and the ability to communicate securely with clinicians about it*

We must strengthen an individual's right to access his or her health information and share access to this information with healthcare providers. The government could require that stewards of health information (clinicians, laboratories, etc.) provide such information in electronic form to individuals or their designated agents for purposes of collaborative decision-making with clinicians. For example, when a lab transmits a test result to a clinician, an electronic copy of that result could travel securely, in a standard format and using a standard protocol, to a destination of the patient's choosing such as a PHR or health record bank.

Under current legislation, individuals have rights to information but they must make formal requests (sometimes in writing) to access health information, wait up to 30 days for it to arrive, and then work with printouts or faxes. [15] Despite good intentions, it seems that the Health Insurance Portability and Accountability Act (HIPAA) and the ensuing security and privacy provisions do not make it easy for patients

[14] Institute of Medicine Roundtable on Evidence-Based Medicine. *The Learning Healthcare System*. 2007, Executive Summary.

[15] Title 45—Public Welfare And Human Services, Part 164—Security and Privacy, Subpart E—Privacy of Individually Identifiable Health Information. Code of Federal Regulations, Title 45, Volume 1, Revised as of October 1, 2002, U.S. Government Printing Office via GPO Access, CITE: 45CFR164.524, pp. 728–731.

or their authorized agents to access the information to which they have rights. These access barriers discourage the use of health information by stakeholders as well as by private sector innovations that can convert raw patient information into useful products and services, including patient record storage, interpretation, treatment plan adherence tracking, and so on. While abuse of personal health information for commercial gain should be prohibited, patients should be able to authorize third parties to access and use their data in ways that are in the patients' best interests.

*2.2 Define professional responsibilities for health information workflow—better define how health information is to be received, used, enhanced or processed, and passed along to others*

The healthcare delivery system needs to focus on the care of individuals and should enable healthcare professionals and organizations to provide better care to these individuals and their families as they move from setting to setting across the continuum of care. Aggregation of health data for research can help to expand knowledge about diseases, effective treatments, and ways to improve the effectiveness and efficiency of healthcare delivery at the point of care. [16] To realize the full benefits of health information, that information needs to be viewed as a shared resource that is under the stewardship of the patient and the practitioners involved with the patient's care and available across organizational boundaries. In such a model, patients, clinicians, providers, and ancillary service vendors all would adhere to health information workflow and communication processes that were patient-centric, including responsibly receiving, using, and contributing to a shared patient health history.

Government intervention might be required to implement this dramatic shift in the way Americans view health information, and clinician and provider concerns about competition and litigation would need to be addressed. For many clinicians and providers, this recommendation will require a significant change in workflow, including improved coordination with the patient and other caregivers, use of newly available information in diagnosis and care decisions, and shared stewardship of information.

*2.3 Refine policies with respect to health information privacy, confidentiality, and security breaches—assure patients and clinicians that health information is transmitted securely*

Consumers need assurance that their clinicians will have the right information to make informed decisions about them at the point of care and that the confidentiality, privacy, and security of their medical information will be protected. Surveys show that the American public supports having its personal health information digitized and shared for research to inform public policy and practice, as long as appropriate privacy protections are in place. [17] However, the risk of high-profile privacy breaches creates fears that consumer protections are not adequate.

To maintain a high level of consumer and clinician trust in electronic records, a meaningful national remedy for privacy breaches is necessary. It must address the need for audit logs, error handling procedures, and language that includes a substantial threshold for harm as a trigger for notifying patients about breaches. [18] It also will need to address concerns about the consequences of data breaches, including whether penalties are needed as deterrents.

The Common Framework for Networked Personal Health Information, developed by Connecting for Health and sponsored by the Markle Foundation, is a potential source for additional guidance on privacy principles. [19] Another resource is the Nationwide Privacy and Security Framework released by the ONC in December 2008. [20] The goal of these and other

[16] Bloomrosen M, Detmer DE. Advancing the Framework: Use of Health Data. American Medical Informatics Association, 2008.

[17] Kaiser Permanente. More Americans Aware of Digital Health Options; Use of Health IT Increases. June 12, 2008. Available at http://xnet.kp.org/newscenter/pressreleases/nat/nat_080612_healthit.html. Forrester Research. National Consumer Health Privacy Survey, November 2005. California Healthcare Foundation. http://www.chcf.org/topics/view.cfm?itemID=115694. Center for Democracy and Technology, Comprehensive Privacy and Security: Critical for Health Information Technology. May 2008. http://www.cdt.org/healthprivacy/20080514HPframe.pdf.

[18] U.S. Government Accountability Office. *Privacy: Lessons Learned About Data Breach Notification.* GAO-07-657. April 2007.

[19] Connecting for Health, Markle Foundation. *Connecting Consumers: Common Framework for Networked Personal Health Information.* New York: Markle Foundation, 2008. Available at http://www.connectingforhealth.org/phti/

[20] Office of the National Coordinator, U.S. Department of Health and Human Services. Nationwide Privacy and Security Framework For Electronic Exchange of Personal Health Information. Washington, DC: HHS, December 2008. Available at http://www.hhs.gov/healthit/privacy/framework.html.

efforts is to mobilize information sharing by fostering public trust and stabilizing market risk.

*2.4 Create a voluntary authentication system whereby individuals can choose a unique personal identifier for purposes of care and research—facilitating secure and convenient patient and clinician access to health information and facilitating health record matching*

A method of authentication and record matching is required in a system that draws information from multiple sources. Although a unique patient identifier is broadly viewed as untenable as a national policy option today, we believe it is much more dangerous to patient safety and privacy to not have a reliable authentication and record matching scheme. For example, multiple records for individuals with the same names (e.g., Mary Robinson, Jose Rodriguez) could be mismatched, potentially resulting in dangerous medical errors as well as breaches of privacy.

It seems appropriate for consumers to choose whether or not to use a voluntary unique identifier for the purposes of authentication and records matching. A non-government organization could set up a service whereby individuals could voluntarily register a unique identifier and the authentication protocols of their choice. The role of government could be to limit access to these unique identifiers and to create potential deterrents, such as stiff penalties for misuse and abuse. System vendors could further be required to use voluntary identifiers when provided. This approach requires that health information stewards and vendors be able to use the consumer unique identifier for authentication and records matching and that the registration process is affordable and highly secure.

Authentication, record matching, and privacy methods are improving rapidly in the banking and telecommunications sectors and may provide additional models for consideration in the health sector.

## Conclusion

Health IT has tremendous potential to make the healthcare delivery system more consumer-centered. Technology can make health information portable so it can follow patients from setting to setting and provider to provider. In an interoperable healthcare system, the flow of health information will support shared clinical decision-making among patients, clinicians, and care teams and improve quality of care as well as efficiency at the point of care.

Consumers, clinicians, and provider organizations will all derive real benefits when health information flows faster and more freely, or becomes liquid. Consumers will know that their clinicians will have the right information to make informed decisions about them at the point of care and that the confidentiality, privacy, and security of their medical information will be protected. For clinicians and provider organizations, the free flow of information will mean the ability to make better diagnoses, administer better care and preventive interventions, reduce errors and adverse drug events, conduct clinical and population-based research, and improve overall health outcomes for their patients and communities.

But health IT alone cannot improve the quality and efficiency of healthcare. Even when information is electronic, it is not automatically shared outside of organizational or network firewalls, or across organizational boundaries. Technical challenges, privacy concerns, legal liability issues, and the organizational culture of healthcare combine to slow the adoption of electronic health records, e-prescribing, and other health IT policy and market initiatives.

Our national health IT strategy can build on the current infrastructure and successes to bring full interoperability. By focusing on information flow and the needs of patients, we have the opportunity to accelerate progress toward the goal of a consumer-centered system of care.

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## Our Approach

The development of this paper followed an iterative process to identify potential accelerators of health information liquidity and develop potential approaches that can make these accelerators work.

First, we identified thought leaders from the provider community, academia, the technology industry, and government who have experience with interoperability and with the barriers and solutions to health IT implementation and adoption.

These thought leaders were invited to participate in an in-person discussion in Washington, DC, in early August 2008, where we presented our ideas about the value of free flowing health information for different stakeholders, focusing on consumers, clinicians, and providers. This initial discussion spurred an exciting period of dialogue throughout the fall of 2008 with an ever-growing group of thought leaders who participated in telephone interviews.

To supplement the interviews, published reports, white papers, websites, blogs, industry newsletters, and extensive source materials were reviewed to provide an understanding of the current state of adoption and the views of experts on the topics surrounding health information flow.

Next, we summarized and analyzed the results. Key themes were identified to help clarify what worked, what did not, and what might be the best path forward to achieve true liquid health information for the United States.

In particular, we examined—

- Experiences of early adopters in promoting the timely exchange of health information
- Barriers to interoperability
- Ways to accelerate the free flow of health information, including human capital, successful incentive structures, and innovations from other industries that can be applied to healthcare

This process allowed us, in turn, to identify and refine the top accelerators of information flow and present them to the thought leaders for review and comment.

Based on their comments, advice, and guidance, and on our own discussions, we developed the scenarios and approaches presented in What's Left to be Done Section.

*Developed by:*

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We would like to thank the following individuals for their advice and guidance as we developed this paper. The opinions expressed in this final product, however, are solely the responsibility of Booz Allen Hamilton.

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## Glossary of Working Definitions

**Architecture:** A set of principles, structures, and processes used to guide the design and construction of software systems based on a set of assumptions about the user and technical environment (HEAL NY). Open architecture allows free access to developers and potential users to add, upgrade, revise, and share software components, as compared to closed or proprietary software, which is not freely accessible to developers and users. Service-oriented architecture unifies large applications and business processes by structuring them as smaller modules called services (e.g., messaging, scheduling, billing, etc.)

**Authentication:** Act of verifying the identity of an individual, originator, terminal, or workstation to determine the entity's right to access certain information (HITSP)

**Electronic Health Record (EHR):** Information, assembled and maintained in an electronic format, that pertains to the health status of an individual and health services delivered to an individual (HITSP). The Institute of Medicine defined eight core functions of EHR systems as follows: health information and data; result management; order management; decision support; electronic communication and connectivity; patient support; administrative processes and reporting; and reporting and population health

**e-prescribing:** A prescriber's ability to electronically send an accurate, error-free, and understandable prescription directly to a pharmacy from the point-of-care (Center for Medicare and Medicaid Services)

**Harmonization:** A process of comparing different standards or components, resolving differences, and agreeing on a common or standardized version

**Health Information Exchange:** Mobilization of healthcare information electronically across organizations within a region or community (HITSP); also used more broadly to refer to any other information exchange, including paper-based, conversations, faxes, etc. (HEAL NY)

**Informatics:** Knowledge and skills in the management and use of health information and communications technology (health IT) and the organizational, social, and training issues that relate to health IT

**Infrastructure:** In information technology, the technical and software structures that organize and support a system, such as an organization or a community

**Interoperability:** The ability of health information systems to exchange meaningful patient health information within and across organizational boundaries in order to advance the effective delivery of healthcare for individuals and communities (HITSP, HEAL NY). Semantic interoperability refers to information provided in a format that can be understood by humans and computers

**Liquid health information:** The exchange of health information in which the information flows freely and the right information reaches the intended person at the right time

**Open Source:** An approach to software design in which the source code (programming) is freely accessible for sharing, adapting, and upgrading

**Personal Health Record:** A paper-based or electronic health record that is initiated and maintained by a consumer/patient, family member, or other caregiver

**Workflow:** A sequence or pattern of activities or operations by an individual or group working together; also used to refer to the sequential processing of information by computers

**Sources:**

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