Health Information Exchange

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Synonyms

[Health information sharing](#)

Definition

Health information exchange (HIE) is the reliable, interoperable, and secure electronic sharing of patients' health information among doctors, nurses, pharmacists, and other healthcare providers across organizational boundaries (Abramson et al. 2014; Alexander et al. 2016; Hersh et al. 2015). It may also refer to the organizations that coordinate HIE among healthcare providers (Vest and Menachemi 2017).

Overview

To improve the quality, safety, efficiency, and continuum of care, HIE is created to meet the need of healthcare providers to access current,

accurate, and complete information. In order to realize HIE, a suite of standards for HIE, including standardized clinical terminologies, information exchange modes, and technical architectures are developed. Health information organizations are also established to coordinate the realization of HIE among healthcare providers (Vest and Menachemi 2017). Patients have their choice of participation in HIE either through an opt-in or an opt-out approach (Menachemi et al. 2018).

Although the use of HIE has increased since the early 2000s, it is still limited (Devine et al. 2017) due to barriers such as a lack of funding and privacy concern (Kruse et al. 2018). Despite of these barriers, research has identified potential benefits of HIE including improved healthcare utilization, reduced costs, improved care quality, and improved disease surveillance and public health (Menachemi et al. 2018).

Health information exchange has great potential to improve the care of older people. The number of older people aged 60 years and over is estimated to increase from 11% to 22% between 2000 and 2050 (Global Elderly Care in Crisis 2014). Older people generally have more chronic health conditions and more complex needs. The workload and complexity of caring for these people will be a big challenge. The complex needs usually can only be met by a multidisciplinary team of health professionals such as doctors, nurses, pharmacists, and other health professionals (Tariq et al. 2012). To achieve the optimal care outcome for the older people, it is vital for

this multidisciplinary care team to share current, accurate, and complete information. Therefore, harnessing the benefits of HIE may help residential aged care homes and other healthcare providers involved in the care of older people to tackle this challenge.

Health Information Exchange Organizations

There are three types of HIE organizations – community, enterprise, and vendor – which coordinate the HIE among healthcare providers (Vest and Menachemi 2017). Community HIE is built by third-party health information organizations which engage and provide HIE services to a broad community of healthcare providers (Mello et al. 2018; Vest and Menachemi 2017). Enterprise HIE is built and operated by health systems to share information within a narrowly defined trusted network of healthcare providers (Harris Healthcare Solutions 2012). Vendor-mediated HIE is provided by vendors of electronic health record (EHR) (See ► [“Electronic Health Record”](#)) which have provided internal interoperability within their own user base (Mello et al. 2018; Vest and Menachemi 2017). A literature review study found that compare to community HIE, enterprise HIE and vendor-mediated HIE face lower barriers to formation and sustainability because of the network that is already in place (Everson 2017). To realize the benefits of HIE for older people, aged care providers may utilize their existing relationships with the enterprise or vendor-mediated HIE organizations or join the community HIE organization.

Standards for Health Information Exchange

The implementation of HIE in aged care is low. A US national survey in 2010 showed that the proportion of residential aged care homes, which had the HIE capabilities, was less than 15% (Towne Jr et al. 2016). One of the major barriers to the successful implementation of HIE is the lack of interoperability among a variety of health information systems which use different terminologies and store data in different ways (Benson and Grieve 2016). Interoperability refers to “the ability of two or more systems or components to exchange information and to use the information

that has been exchanged” (IEEE 1990). Without it, information cannot be exchanged among disparate information systems. To solve this problem, standards have been developed, including Health Level 7 (HL7), ISO 13606-5:2010 Health Informatics – EHR Communication and Digital Imaging and Communications in Medicine (DICOM), to name a few (See ► [“Health Information Standard”](#)).

Health level 7. The HL7 is a family of standards for the exchange, integration, and retrieval of electronic health information ([HL7 International](#)). These standards are grouped into seven reference categories: (1) primary standards – the most frequently used standards for system integration, interoperability, and compliance; (2) foundational standards – the tools, building blocks, and technology infrastructure that implementers of HL7 must understand and manage; (3) clinical and administrative domains – the clinical messaging and document standards; (4) EHR profiles – the models and profiles for management of EHR; (5) implementation guides – the supplementary guides to be used with an existing standard; (6) rules and references – technical standards for software development; and (7) education and awareness – the standards for trial use with resources to supplement the understanding of HL7 standards. The HL7 Fast Healthcare Interoperability Resources, published in 2014, is currently a hot research topic.

ISO 13606 health informatics – EHR communication. This standard defines the information architecture to support the interoperability of systems that require access, transfer, add, or modification of EHR data (International Organisation for Standardisation 2008). It includes five parts: (1) reference model; (2) archetype interchange specification; (3) reference archetypes and term lists; (4) technical specification on security; and (5) interface specification. This standard does not specify the design of internal architecture or database of an EHR system.

Digital imaging and communications in medicine. The DICOM is a standard specifically defined for handling, storage, printing, and transferring of diagnostic and therapeutic information, images and related data (Mildenberger et al.

2002). It includes four parts: (1) transfer syntaxes – a set of encoding rules that clearly define the syntaxes for file transfer; (2) modality – the file type (e.g., the type CT represents computed tomography); (3) service-object pairs – the service (e.g., store, get, and find) acted upon the information object (e.g., a CT image); and (4) storage space – it defines the matrix, the bit per pixel, and the size of each type of files (National Electrical Manufacturers Association 2019).

Standardization of Terminologies

Standardized terminologies are the building block of HIE. In fact, HL7 uses standardized terminologies to achieve semantic interoperability, i.e., no ambiguity in the interpretation of the information exchanged (Ojeda-Carreño et al. 2017). There are many standardized terminologies that have been developed, such as the Systematised Nomenclature of Medicine Clinical Terms (SNOMED CT) and the Logical Observation Identifiers Names and Codes (LOINC).

Systematised nomenclature of medicine. The SNOMED CT is a comprehensive, multilingual clinical terminology that enables consistent representation of clinical content in EHR (SNOMED International 2018). Its core components are concept, description, and relationship. The concept represents a unique clinical meaning. The description includes the fully specified name which describes the unambiguous meaning of a concept and the synonym of this concept. The relationship represents the association between two concepts. As of July 2018, it contains 340,659 active concepts.

Logical observation identifiers names and codes. The LOINC is a set of unique identifiers, structured names, and universal codes for identifying health measurements, observations, and documents (What LOINC is). It also contains concepts with details such as synonyms, units of measure, and descriptions. It is the code set used by HL7 for laboratory test names.

Information Exchange Modes

The US Office of the National Coordinator for Health Information Technology defined three modes of HIE: directed exchange, query-based

exchange, and consumer-mediated exchange (Williams et al. 2012). Directed exchange refers to the secure sending and receiving electronic health information between healthcare providers. This mode is also known as “push” because the providers send or “push” the information to other providers (Campion et al. 2012). Query-based exchange refers to the provider-initiated requests for a patient’s information from other providers. This mode is also known as “pull” because the provider actively seeks or “pulls” the person’s information (Campion et al. 2012). Consumer-mediated exchange refers to the patients’ aggregation and control of their information among the healthcare providers.

Technical Architectures

There are three main types of HIE architectures – centralized, decentralized, and hybrid (HIMSS HIE Guide Work Group 2009). In the centralized architecture, all patient data are replicated and stored in a single central database. All local providers send and retrieve data from this central database. This architecture allows local providers to maintain autonomy while operating to share data at the local level. In the decentralized architecture, each healthcare provider stores patient data in their own databases. These databases are interconnected by a record locator which processes the query, points to the required data in other databases, and returns this data to the person requested the data. This architecture allows healthcare providers, perhaps widely distributed across regions, to exchange information. In the hybrid architecture, only some of the data are replicated in the central database and the record locator is used to locate other data stored in each health provider’s database.

Key Research Findings

Why the Need of Health Information Exchange?

The health care system is “a dark, lumpy archipelago composed of tens of thousands of isolated corporate islands that, at least in terms of information, chop up patients into cloistered parcels”

(de Brantes et al. 2007, p. 70). These information silos, often a variety of electronic systems used in different healthcare organizations, create barriers for healthcare providers to access accurate and complete patient information to make informed decisions on patient care. Due to chronic health conditions and complex needs, older people often receive various healthcare services such as primary care, hospital, and residential aged care from different healthcare organizations, causing their care information scattered among these organizations. In order to improve the quality, safety, efficiency, and continuum of care, these information silos need to be linked. Health information exchange aims to meet this need through electronic sharing of health information across organizational boundaries in a reliable, interoperable, and secure manner (Abramson et al. 2014; Alexander et al. 2016; Hersh et al. 2015).

Patient Consent Approach

There are two approaches for patients to consent to include their data in HIE – opt-in and opt-out (Menachemi et al. 2018). Using an opt-in approach, patients explicitly give their consent for participation. Using an opt-out approach, all patients are enrolled in HIE unless a person explicitly objects and is thus excluded. Older people who have difficulties to provide consent for themselves may delegate this task to their family members or representatives (Crotty et al. 2015).

Use of Health Information Exchange

A systematic review on the global use of HIE between 1990 and 2015 found that although the use of HIE varied among countries, the common theme was that the use increased since the early 2000s (Devine et al. 2017). The review found that in the USA, 82% of nonfederal hospitals had HIE in use in 2015 and 38% of physician practices used HIE in 2013. Among 27 European countries, Denmark was the highest HIE user in 2014. In ten countries including Australia, Canada, France, Germany, Netherlands, New Zealand, Norway, Switzerland, the UK and the USA, the HIE use in primary care ranged from 14% (Canada) to 55% (New Zealand). Out of the 58 studies included in this systematic review, only four

studies investigated HIE between residential aged care homes and other healthcare providers.

The extent of HIE use in residential aged care homes is low. A study reported the findings from the US national survey 2010 showed that only 14% of the residential aged care homes had the capability to electronically exchange health information with pharmacists and only 13% could do so with physicians (Towne Jr et al. 2016).

Benefits

Despite the slow adoption of HIE, research has identified potential benefits of HIE. A systematic review of 24 studies on the impact of HIE published between May 2014 and June 2017 found that the use of HIE was associated with improved healthcare utilization, reduced healthcare costs, improved care quality, and improved disease surveillance and public health (Menachemi et al. 2018). Specifically, there were reductions in the 30-day hospital readmission rate, the number of repeated imaging and therapeutic medical procedures and the total number of orders. Healthcare costs including lab test costs and imaging test costs were also reduced. Improvements in care quality included improved medication reconciliation, immunization, and health record completeness and reduced care disparities. This review also found a link between HIE and improved population level immunization rates, timeliness of reporting, identification of drug seeking behaviors, and surveillance of frequent emergency department attenders. None of the reviewed studies reported adverse effect (Menachemi et al. 2018). The benefit of HIE in enabling highly-coordinated, real-time monitoring of the spread of a virus was observed during the outbreak of coronavirus disease 2019 (Jason 2020).

Facilitators and Barriers

Research has identified a number of facilitators and barriers to HIE adoption and implementation. A systematic literature review on HIE for older people transfer between residential aged care homes and other healthcare providers found that the facilitators included a supportive organization culture, a workflow integration approach that

considers user needs, adoption of EHR, and proper funding (Kruse et al. 2018). The perceived benefits of HIE such as improved quality of care, better coordination of care, increased care effectiveness, improved communication, ease of data transfer, efficiency gain, and reduction in cost also facilitated the adoption and implementation of HIE (Dimitropoulos et al. 2011; Kruse et al. 2018).

The barriers to HIE adoption include organizational issues (e.g., high staff turnover), cost of implementation, concern about technological maturity, concern about data privacy and security, inaccurate or incomplete data transferred by HIE, lack of data standards, and lack of training (Kruse et al. 2018). The barriers also include lack of funding, interoperability among systems, and willingness to change (Vest and Gamm 2010). Among these, the most frequently cited barriers are the privacy concern, the concern about the accuracy of linking patient data and the complexity of patient consent for information disclosure (Dimitropoulos et al. 2011; Mathematica Policy Research and Harvard School of Public Health 2015), all traceable to the legal barrier (Mello et al. 2018).

Future Directions of Research

Aged care providers such as residential aged care homes, community-based care services, and home-based care services look after a large number of older people. As such, a substantial amount of information is exchanged between aged care providers and a variety of other healthcare providers such as pharmacies and primary care every day. However, the aged care providers have not been able to systematically exchange this information in an electronic format with other health providers (Alexander et al. 2016; Towne Jr et al. 2016) and research on this topic is scarce (Devine et al. 2017). More research is needed to investigate the adoption, implementation, and impact of HIE in residential aged care homes.

Summary

Health information exchange is the electronic sharing of health information across organizational boundaries in a reliable, interoperable, and secure manner. To coordinate HIE among healthcare providers, HIE organizations, i.e., community, enterprise, and vendor, have been established. Relevant HIE standards, standardized terminologies, information exchange mode, technical architectures, and patient consent approaches have also been developed to facilitate the realization of HIE. Research has also identified benefits, facilitators, and barriers to HIE adoption and implementation. Despite the large attention gained by HIE, the adoption of HIE in healthcare still has a long way to go. In particular, residential aged care homes are laggards in the health industry to adopt this technology (Kruse et al. 2018). Therefore, more research on HIE in residential aged care homes is also needed.

Cross-References

- [Electronic Health Record](#)
- [Health Information Standard](#)

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