Review

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Interoperability in Radiography Data: The Impossible Dream

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ABSTRACT

Background: Technology in healthcare is changing at a very rapid pace. To ensure that technology is used efficiently to combat rising healthcare costs and new federal policies and laws, all technology must be able to communicate with each other. Therefore, interoperability must be obtained. Radiography is no exception considering all the different types of equipment manufactured routinely used today. Some barriers need to be overcome to achieve interoperability within radiography departments.

Purpose: To review the literature on the interoperability of healthcare data to determine the barriers that Radiography departments would have to overcome to improve interoperability of their healthcare data.

Methods: The methodology of this literature review follows the fundamental principles of a systematic search, conducted in separate stages, but is not a comprehensive systematic review, which was not reasonable due to resource constraints. The stages of the literature search included defining the search strategy, identifying the inclusion criteria, assessing the relevance and validity of the studies retrieved, and data extraction and synthesis.

Results: There were attempts to ensure interoperability, such as the use of the Nationwide Health Information Network (NwHIN), but roadblocks such as financial incentives for physicians and costs of implantation have hindered the adoption of the NwHIN. Other barriers that limit interoperability exist. These obstacles included inconsistency of the Digital Imaging and Communication in Medicine (DICOM) standard for medical imaging departments and a complete lack of norms for certain data points such as the exposure index between different vendors.

Discussion: Multiple viable options for the improvement of interoperability are prevalent in radiography departments. One such option is cloud computing, which uses multiple various types of hardware and software as resources to help interoperability of healthcare data. Agent-based technologies, which can be used to distribute management of different standards, can also be utilized to communicate between standards. The largest need to ensure interoperability is standards that are well defined and stringent with an infrastructure to map different terminologies across different standards.

Conclusion: Various technological advances can be used to improve interoperability such as agent-based technology and cloud computing. However, until a standardization of terms within the DICOM protocol and a standard across vendors, and all data points standardized, it will be impossible to obtain true interoperability.

BACKGROUND

The technology used to communicate information in a healthcare setting is evolving at a rapid pace. In a typical radiology department, there are many different types of equipment. The same company does not manufacture equipment. To ensure that equipment can effectively communicate information to each other, interoperability must be obtained. Interoperability is the ability of one machine to identify and understand the information from another machine. In a typical radiology department, there is a variety of different software utilized to gather healthcare data. These include Electronic Health Records (EHR), Hospital Informa-

tion Systems (HIS), Radiology Information Systems (RIS), and Picture Archiving and Communication Systems (PACS).[1] Different types of software need to communicate to ensure that no information is lost. If they do not communicate, the institution would have to invest in an interface which will cost money, time, and manpower. An interface is a software that is created to convert data from one system to a format that another system can understand. If interoperability is achieved, the investment in an interface is unnecessary. Savings in costs are critical to the field of healthcare, where expenses have increased in recent years. At the end of the second quarter of 2014, the healthcare spending for the federal government increased at 4 percent annual rate.[2] Currently, the cost of health care has ballooned to an astounding $1.9 trillion.[3] With the total healthcare costs for the United States (U.S.) rising, constitutional laws now mandate health care providers use technology in meaningful ways. It is important for technology to benefit radiology departments by lowering costs and improving the efficiency of workflows. The significance of the research will be exploring and describing barriers to interoperability to help medical imaging departments reduce costs and timeliness of care.

President Obama has stated that the adoption of healthcare Information Technology (IT) will reduce errors, cut costs, ensure privacy and save lives.[4] Interoperability of the healthcare data is the only way any of the results listed by the president will happen. The goal of interoperability is sharing of healthcare information not only within any radiography department but across the continuum of care. One attempt to ensure interoperability across this continuum of care is the Nationwide Health Information Network (NwHIN). According to www.healthit. gov, the NwHIN website, the network is "a set of standards, services, and policies that enable the secure exchange of health information over the Internet."[5] NwHIN is a pathway to transmit data from one computer system to another. There are barriers to the adoption of the NwHIN. One such barrier is the cost of the implementation of the network. Estimations say that it would take one hundred and fifty-six billion dollars in capital costs to launch the NwHIN system. The largest issue to limit adoption of the NwHIN, however, is the lack of financial incentives for providers and institutions and the lack of national standards for data transmission.[6]

There have been many laws that addressed healthcare, and in turn, interoperability. The most recent law that influenced interoperability of healthcare data was the Affordable Care Act of 2010. This law instituted what was termed "meaningful use" of healthcare IT. Meaningful use is a program in Center for Medicare and Medicaid that gives guidelines to incentivize providers and organizations to use certified electronic health care records to improve care. There are three stages involved. The first phase started in 2011 and involved promoting adoption of EHR. The second stage focused on the coordination of care and exchanging patient data. The last step, to be rolled out in 2016, involves a focus on improving quality, safety, and efficiency of healthcare IT.[7] It would be impossible for this to happen without interoperability of different systems in the healthcare setting.

PURPOSE

The history of the political situation on healthcare IT resulted in the researcher's question of interoperability and the primary barrier that is present in radiography departments. The purpose of this exploratory research was to determine the primary barrier and identify possible solutions to support interoperability among different vendors and other systems used within a healthcare facility.

METHODOLOGY

The methodology of the literature review follows the fundamental principles of a systematic search, conducted in separate stages, but is not a comprehensive systematic review, which was not reasonable due to resource constraints. This limitation resulted in the inability to search 'gray literature' or to translate papers of a language other than English. However, the search did identify published major articles. The stages of the literature search included defining the search strategy, identifying the inclusion criteria, assessing the relevance and validity of the studies retrieved, along with data extraction and synthesis.

The literature review was limited to material from the last ten years to ensure the reliability of the information. Professional peer-reviewed journals, books, and professional websites regarding data transmission, healthcare IT management, or data standards were used during the research to ensure validity. The literature produced information that was then used to analyze data standards and to identify possible solutions to the lack of interoperability in radiography departments.

RESULTS

To realize the goal of achieving interoperability, first it must be possible to exchange healthcare data across different systems. Research completed in 2010 explains that there is a lack of interoperability partially because there are not structured data definitions or enough standards in the US.[8] Radiography departments utilize data from all across their organization from many different types of systems. The healthcare data used for radiological exams is the Digital Imaging and Communication in Medicine (DICOM) standard protocol. Radiography departments use DICOM protocols for viewing and diagnosing by the means of a PACS systems.[9]

DICOM data must be interpreted by other standard formats used in other software systems across the organization. One example is the Health Level 7 (HL7) standard utilized in the most electronic medical record (EMR) systems. The DICOM standard must also recognize data from many different types of vendors supplying equipment to the radiology department. This machine may use various types of data to determine the same

data point.

Although DICOM is the common standard for all imaging departments, the structure of the DICOM standard can vary between vendors. Sets of data are created in formats that are unique to the particular vendor that manufactures the equipment, which leads to some interoperability between imaging devices and PACS systems.[10] One example of this is the exposure index, where value is given to the dose received by a patient. Exposure index is an example of value that is present in all digital equipment, but a lack of standardization of the values between vendors limits the interoperability between different pieces of equipment. Different vendors use different values, and even some of the vendors that use the same values use different principles to calculate the data point.[11] Various data values make interoperability impossible for exposure index.

DISCUSSION

Data must be standard between systems to obtain interoperability. This standard requires constant data values.[12] The largest barrier to this is the lack or inconsistency of data standards used in today's radiography departments. There are many possible solutions to overcome this obstacle. One technology that is accustomed to some extent already that may change interoperability in the healthcare field is cloud computing. Cloud computing is services over the World Wide Web (WWW) where the multiple different types of hardware and software are facilitated in data centers to give the illusion of infinite resources so that data standards can communicate.[13] The use of these multiple data standards can be utilized on multiple data sets to improve interoperability.

Another solution could be in the form of agent-based technology. This type of technology has been proven to increase interoperability by distributing the management of sources of data, allowing remote access to patient data, and adapting font changes within the actual data standard.[14]

The largest need to ensure interoperability is a set infrastructure utilized by all that includes detailed mapping of different standards that can translate and code the terminologies of the various standards to ensure interoperability. This support should also contain input from professional societies, legal framework for accountability, and a way to translate, map, and transcode all of the terminologies involved.[15]

There are limitations evident during this research. One limitation of the study is the lack of common definitions associated with data standard criteria within the U.S. This lack of common definitions limited the resources available to access in regards to criteria for data standards. A second limitation of the research was that there was little available content found concerned the planning and design of technology systems in a digital health-care facility.[16]

CONCLUSION

Interoperability is considerably better among radiography departments than in most other technology fields. The interoperability is better because there are standards that widely accepted. Examples of these rules are DICOM and HL7. Full interoperability is still impossible because of variations in the DICOM standard are still present. A complete lack of standardization involving certain data points among vendor's equipment also presents a barrier to interoperability.

Some solutions will improve interoperability, such as agent-based technology and cloud computing. However, until a clear and standard terminology within DICOM is developed full interoperability will never be achieved. There also must be an avenue for accountability for not complying with this standard language. Cross-mapping of different terminologies of various standards and an infrastructure that supports and enforces that standardization is the only avenue to achieving true interoperability.

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