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The Need for Research on Record Keeping Metadata Standardization of Electronic Health Records System Integration

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ABSTRACT

The implemented system still has limited integration and interoperability for supporting clinical operations among other Ministry of Health Malaysia (MOHM) hospitals, health centres, and clinics. The adoption of EHR system is happening very slowly to become fully integrated in both primary care and within hospital settings. Therefore, the objectives of this paper are to discuss about the challenges in EHR integration and the consideration towards metadata standardization. It is also to analyse the current status of such research topics in it relevancy, the dominant countries involve and the subject areas that contributed the most. Method being used in this is paper is literature review analysis and Scopus analyse tools. This papers begin with the explanation of general metadata that is required in system integration. Then the discussion highlighted the importance of metadata in electronic document management. Furthermore, the discussion reveals the challenges or barriers includes interoperability, security and privacy and preservation regarding electronic health records system integration. The important part of this paper is the analysis of related research. It is important in recognizing the relevancy of research topic and the area that has been explored by previous researchers. The findings conclude that the topics is demanded to be explore further and there is more to reveals especially in the management areas.

Keywords: Electronic Health Records; record keeping metadata; integration; interoperability; security.

1.0 INTRODUCTION

The adoption electronic health records (EHR) in medical system setting is not something new anymore. The demand towards electronic records is said to be beneficial to the organization. According to Palabindala, Pamarthy, & Jonnalagadda (2016), EHRs are beneficial in improving patient care, promoting safe practice, as well as enhancing patients and multiple providers communication and risk error reduction. More than that, physicians reported high levels of satisfaction and confidence in the reliability of the system by adopting EHRs. However, despite the potential advantages, it seems that the adoption of EHR system is happening very slow to become fully integrated in both primary care and within hospital settings

This scenario requires further discussion on the challenges or barriers that may hindered the development and advancement of EHR in the future. In the realistic views of EHR, Ekblaw et al. (2016) stated that EHR were not ever intended to serve multi-institutional, life time medical records. The nature of life events leave patient's data scattered across several organizations with the involvement of separated provider's data silo into one another. Records are provided for patients in a fractured manner that replicates the nature of how records being managed. This is the reality of how medical records is being created in real world. Yet the medical records are vital evidence which is demand to be complete and reliable.

In that matters, the objectives of this paper are to discuss about the challenges in EHR integration and the consideration towards metadata standard establishment. It is also to analyse the current status of such research topics in it relevancy, the dominant countries involve and the subject areas that contributed the most.

2.0 METHODOLOGY

The methods used in this paper are literature review analysis and analysis by using Scopus analyze tool. The literature review begins with the importance of metadata in electronic documents management system and it demand towards standardization. The range of years of selected literature are from twelve (12) years back until 2017. This is to ensure that the topic is significant until to date. Then, the literature reviews are organized into three main challenges found in various publication. The three main themes include interoperability and data exchange, security, privacy and data ownership and preservation. Next, the Scopus analyse tool is used to generate the statistics of publication which then illustrated in graph that explain the current status of related publication available in Scopus. The purpose of this process is to visualize the results into some structured manners that will give betters understanding to the researcher. The tool is available in Scopus search engine website which assist users further in finding relevant resources. The researcher used combination of relevant keywords related to the topics. Further details of keyword combination used are explained in the findings. The reason of choosing Scopus analyze tools is because every IPTA all over Malaysia are required to publish in Scopus to gain merit for further improvement in works or education or others similar.

3.0 LITERATURE REVIEW

3.1 The importance of metadata in electronic documents management system

Franks & Kunde (2006) describes metadata needed for the integration of electronic document management systems and electronic records management systems. Metadata are the glue that binds the various components of a record together and relate the record to other records that are relevant to their understanding and use (International Records Management Trust, 2016). Recordkeeping metadata it not a static profile of a document or other information asset. This is a key feature that distinguishes recordkeeping metadata from other types of metadata. (Department of Education LINC Tasmania, 2015)

Literatures have outline various metadata types. Recordkeeping metadata includes registration and classification metadata, content, structure and context metadata and recordkeeping process metadata (Government of South Australia, 2014; International Records Management Trust, 2016). Meanwhile, Franks & Kunde (2006) & International Records Management Trust (2016) stated that metadata types falls into three common categories which is descriptive, structural and administrative. On the contrary, Griffin, Keakopa, Mansfield, Millar, & Nordland (2009) outlines several other types of metadata which includes technical or structural, administrative, descriptive, preservation and use. Even though the types of metadata differ from one setting to another, it serves the main purpose of controlling the interoperability of the systems.

The types of metadata serve different purposes that is well function when the complete relation of records process is clearly identified. According to Riley (2017) the effective exchange of content between systems or interoperability relies on metadata describing the content where the systems involved can effectively profile incoming material and match it to their internal structures. Although different environment would manipulate different purposes of metadata uses, the key of success is to thoroughly identified the relationship of records for the whole structures. The examples of metadata types are as the following table.

Metadata Type	Example Properties	Primary Uses
Descriptive metadata	Title Author Subject Genre Publication date	Discovery Display Interoperability
Technical metadata	File type File size Creation date/time Compression scheme	Interoperability Digital object management Preservation
Preservation metadata	Checksum Preservation event	Interoperability Digital object management Preservation
Rights metadata	Copyright status License terms Rights holder	Interoperability Digital object management
Structural metadata	Sequence Place in hierarchy	Navigation
Markup languages	Paragraph Heading List Name Date	Navigation Interoperability

Figure 1 Types of metadata *Riley (2017)*

As the used of metadata is clearly mentioned from the literatures, there is a significant relation between the importance of metadata and the demand towards it standardization. System integration in organization requires system standardization practices. According to Sixto Ortiz Jr. (2011), it is too difficult for any organization to mandate standards which usually occurs in mature technologies cause by lacking standardization. Moreover, based on Gepp et.al (2015) cited from Philbin (2008) stated that, neglecting integration aspects in standardization programs is considered to be a reason why such approaches have is difficult to thrive with enduring effect. In health environment, it includes the involvement which poses a unique set of problems for data exchange including a large number of stakeholders, workflows that routinely cross institutional boarders, and a lack of data or information standardization. This implies that in order to ensure correct and safe data transport between stakeholders, Health Information Exchange (HIE) solution first has to overcome technical communication barriers between the participating systems, which can be only achieved by the establishment of nationally recognized standards for the transfer of medical data from both syntactic and semantic perspectives (Demurjian, S. A., Ziminski, T. B., Sanzi, E. B., & Agresta, 2016). Due to the respective literatures, metadata standardization is considered beneficial to be explored in future research works as one of the solution for issues being mentioned. Hence, the integration of patient information from disparate sources using health information systems may improve both the delivery and quality of patient care (Follen, Castaneda, Mikelson, Johnson, Wilson, & Higuchi, 2007, as cited in Glodosky, 2014).

4.2. Challenges in health records system integration

According to Hammami, Bellaaj, & Kacem (2014), inconsistent and badly documented standards are identified as the challenges that hinder the progress towards achieving truly beneficial semantic interoperability medical information systems (MISs). Interoperability problems often result from a lack of standards, ambiguous standards, or standards being misinterpreted (Kovac, 2014). Moreover, there is evidence that necessities for interoperability must be designed into ‘standards, processes, tools, and systems’ and cannot simply or reliably be retrofitted (Evans, McKemmish and Reed, 2009; Rolan, 2017). In other word, the demand for interoperability between diverse MISs developed is truly still disgruntled (Hammami et al., 2014)

Due to that demand, recordkeeping standards-setting needs to find a way to maintain systems interoperability while continuously incorporating variation that arises from jurisdictional pressures.

Designers and users of archival systems need to comprehend that metadata is used purposefully for interoperability, rather than simply comply with a value in every slot. Systems need to be designed to ensure that metadata is appropriately entered and applied at its point of capture. Data entry fields should be constrained to capture only meaningful values where possible, so that inter-operational integrity can be maintained. (Rolan, 2017)

Bunn (2017), suggested that an investigation has to be made into which 'standards' are being used, and how they are being used, within archives, records management and other related fields today. For instance, the attention would be into the relationships between standards such as ISO 23081 and guidelines such as MoReq2010, traditionally thought of as of interest to records managers, those such as Preservation Metadata: Implementation Strategies (PREMIS) which come from digital preservation, and those which are more concerned with resource discovery, such as Metadata Object Description Schema (MODS) and Dublin Core. More of such works would be beneficial in the establishment of metadata standard and guidelines fit with the system in place to expand the option of resolving the problem specifically

4.2.1 Interoperability and data exchange

Interoperability is the ability of different health information technology (HIT) and applications to accurately and consistently exchange, use, and communicate medical in a medical context. It able to reduce the time for medical documentation, integrate care coordination of patient as well as intensify patient- doctor relationships (Eichelberg, Aden, Riesmeier, 2005; Mohd Salleh & Abdullah, 2016). Yet, the major challenges of traditional EHR is data integration and interoperability. Major obstacle in the exchange of healthcare data between different stake-holders involving the deficiency of data interoperability standards and solutions. (Bahga & Madisetti, 2013)

In Malaysia conversely, it was noted that the implemented system still has limited integration and interoperability for supporting clinical operations among other Ministry of Health Malaysia (MOHM) hospitals, health centres, and clinics (Mohd Salleh & Abdullah, 2016). The situation put a situation where different providers and hospital having additional barriers in term of interoperability to effective data sharing. This deficiency of synchronised data management and exchange reflects that health records are fragmented, rather than cohesive (Ekblaw et al., 2016).

The same scenario in archival records, current recordkeeping and archival standards seem to be insufficiently prescriptive to certify interoperability, and do not model all the required elements to enable discovery and access by the members of the wider community. In a smaller scale of an organisational perspective, study found structural barriers in developing interoperability initiatives for public access.(Rolan, 2017)

4.2.2 Security, privacy and data ownership

Other challenges in EHR integration is security, privacy and data ownership. Most healthcare professionals reported the ease of access for patients' records are related to security and privacy. They identified the action are taken without permission of accessing patients' EHRs (Almuayqil, Atkins, & Sharp, 2016). The integration of EHR would enable the access of medical in one stop centre. The advantages are now become weaknesses or challenges to the system.

Other than that, privacy data protection and ownership is also a major concern. Patient confidentiality always at the forefront without hindering the development of innovative solutions. However, the dilemma emerge regarding the balance between the patient as the owner of data and the academic and medical profession's documentation and use. (Wicks, Stamford, Grootenhuis, Haverman, & Ahmed, 2014) It is being worsen that the present effort also lacks of proper schemes to protect users' sensitive EHRs from violation and illegal disclosure an employee (Hoang & Chen, 2014)

Through respective literature, many factors has been identified for affecting privacy of patients' information such as ease of access to such information without permission (Khalifa, 2013; Almuayqil et al., 2016). The scenario is being worsen by human errors and ethics. In 2012, the evolution of health record reveal from forensic investigation and security division where Verizon's data breach investigation reported to compiled data from 47,000 reported security incidents. The result has found 621 confirmed data breaches. Additionally, a study showed that 94% of hospitals had at least one security breach in the past two years concerning patient privacy and data security (Kupwade Patil & Seshadri, 2014) Also, other major concern is about losing physical control of own EHRSs by patients themselves. The concern is about the unknown of how the EHRs are processed, who can gain access over EHRs, what details or data are disclosed to others, and whether the process of security and privacy protection are follows.

Further supported by Sarfraz (2015) privacy and access control requirements have not been adequately addressed for ensuring security and privacy of information for online access and sharing of health records in a healthcare environment. In recent years, several researchers have pointed out that the privacy requirements should be captured in access control systems for the proper enforcement of privacy policies within an enterprise data handling practices. Therefore, the automated control over the EHR system through metadata manipulation can be considered as better approach in controlling EHRs. This suggested that there is a need for structural settings of the system being adjusted with proper documented standard or guidelines particularly the metadata standardization which is directly control the core content of the system.

4.2.3 Preservation

Next challenges in EHR integration is preservation. There several literatures mention that metadata is critical in the preservation of EHR. It stated that in ensuring the manageability, denotation and preservation of electronic records, metadata is critical factors. (Franks & Kunde, 2006). It serves as the elements in describing resources in order to discover, preserve and right management. (Corrado & Jaffe, 2014)

In archival environment, normally users are unable to refer to the creators. They also uncappable of detecting the reuse of preserved digital objects and it depends on proper descriptions provided through the archive. The document process preservation would be very helpful in this situation where it provides an architecture-independent description of the intent behind a document process (Wittek, Jacquin, Déjean, Chanod, & Darányi, 2011)

However, to describe archive or records particularly in this case the EHR is not easy. The challenges are on the system as well as the nature of records in the system. As mentioned above, document process is important and to further assist, metadata standard is critically needed.

5. ANALYSIS OF RELATED RESEARCH PERTAINING TO THE NEED FOR RESEARCH ON RECORDKEEPING METADATA

The analysis of related research is important in recognizing the relevancy of research topic and the area that has been explored by previous researchers. The researcher used Scopus analyze tools to search related research that has been done and publish in Scopus. The researcher basically using three combinations of keywords. The result is organized into three categories includes, year, country and subject area. The purpose of choosing these categories to explain the up-to-datedness (years), the most popular country engages in the topic (country) and the contribution on the research field (subject area). The keywords that has been used are as follows:

5.1 "metadata" AND "electronic health records" (by years, by countries and by subjects)

The first selection of keyword combination is to see the connection between general terms of metadata and electronic health records. It is to separate the specific research that has been done in health area only. The keyword is analyzed into three main categories of years, countries and subjects.

5.1.1 Keyword combination "metadata" AND "electronic health records" by year

The first combining keywords that researcher used is metadata and electronic health records. The range of years are from 2003 until 2017. The results show that the topic was most popular in 2013. Meanwhile in 2005 and 2007 was the least popular. Even though the result was decline from 2013 to 2017, the topics is still being discuss and researchers believe that the topics is moving into in-depth research which will be explain in the next analysis. Figure 1 describe the details of results.

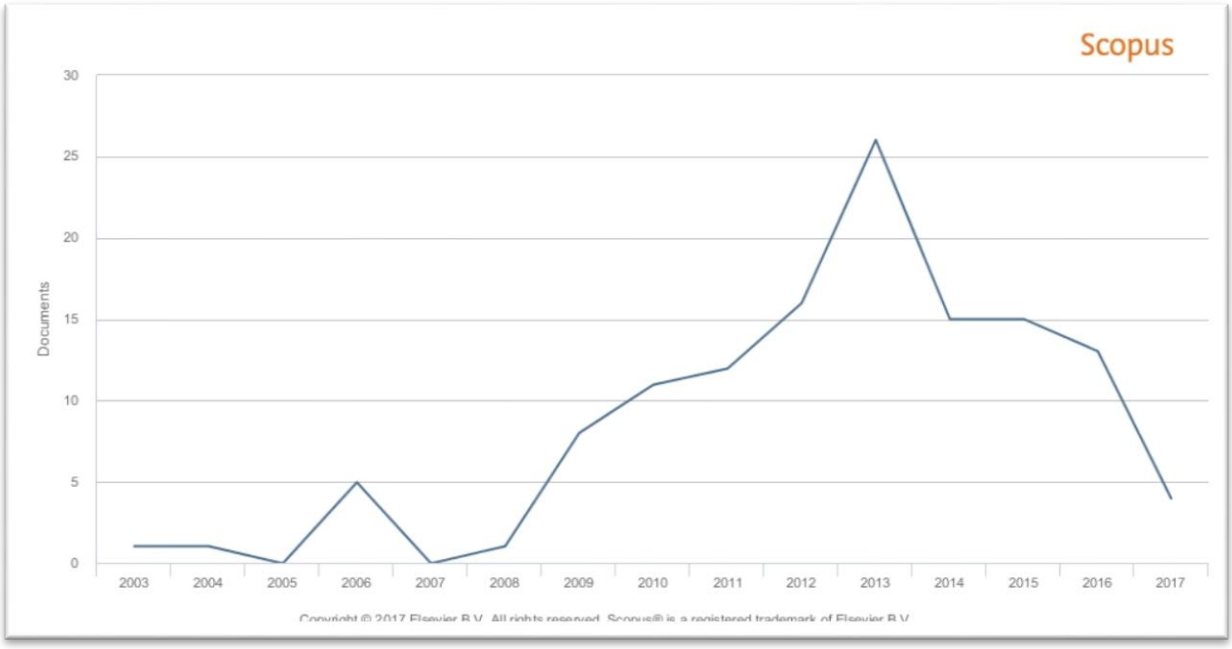

Figure 2 Keyword combination "metadata" AND "electronic health records" by year

5.1.2 Keyword combination "metadata" AND "electronic health records" by country

The next combination of keywords is analysis by the most popular country engage in the research topics. The results reveal that the United States are the highest contributors. Followed by Germany, Australia, Austria and United Kingdom. China is the next in line as contributor from Asia. Malaysia has not appeared in the results and that seem as the opportunity to contribute in the research field. The selection of best practices standard to be analyze to achieve RO1 for this study will also be choose considering this analysis. The following Figure 2 describe about the results.

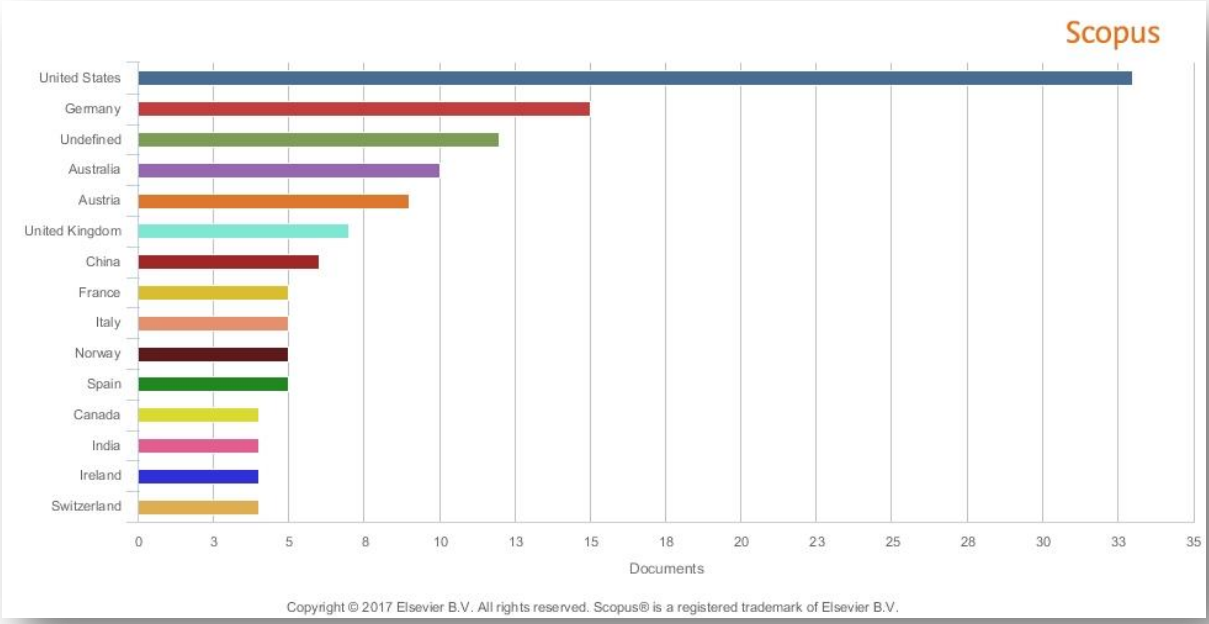

Figure 3 Keyword combination “metadata” AND “electronic health records” by country

5.1.3 Keyword combination “metadata” AND “electronic health records” by subject

Another category that researcher analyze is by subject area. It is seen that the highest percentage is in medicine, followed by computer science, health professional and then engineering. The management subject area only covers 2.3% from the whole percentage. From the results, the researcher sees that there will be more to explore in order to expand the contribution of such topics in the management area. The explanation is outline in Figure 3.

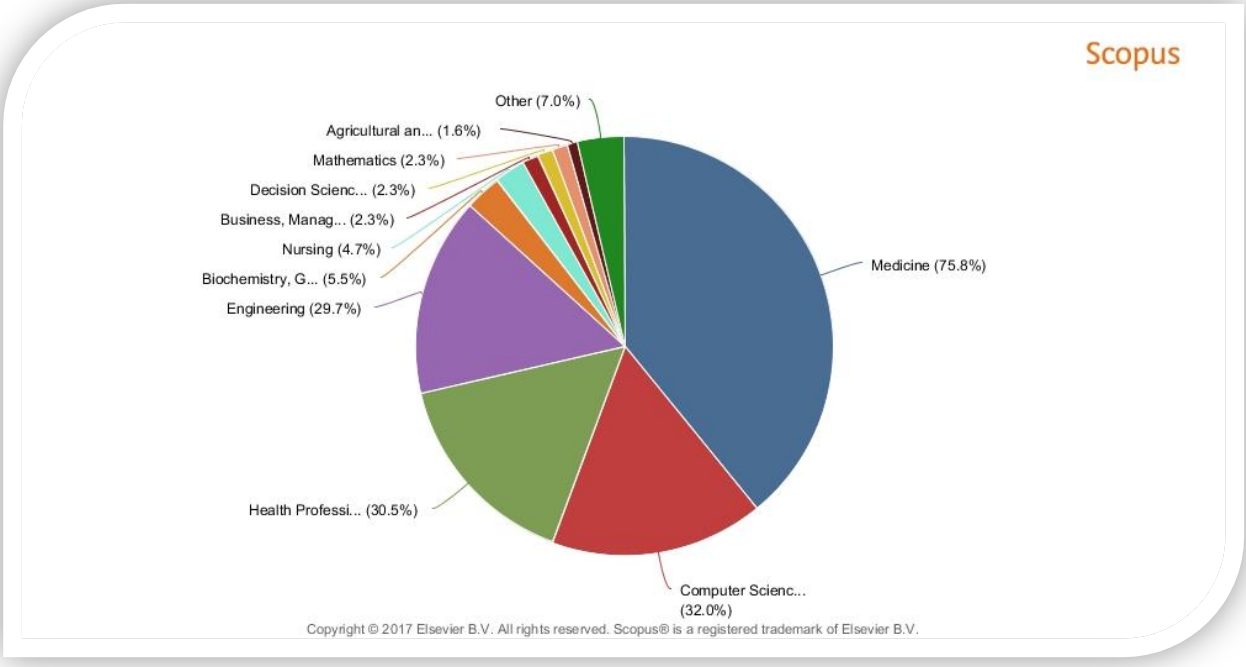

Figure 4 Keyword combination “metadata” AND “electronic health records” by subject

5.2 "metadata" AND "system integration" (by years, by countries and by subjects)

The second selection of keywords combination is used to see the connection between metadata and system integration. The keyword is used to explore the research that has been done in metadata within any field related to system integration. It is also analyzed separately into three main categories of years, countries and subjects.

5.2.1 Keyword combination "metadata" AND "system integration" by year

The keyword combination being used is zooming into specifics keywords. The keywords is the combine of metadata and system integration. The range of years begin in 1983 until 2016. 2010 appear to be highest. The result shows an incline in two range of years includes 1997 to 2003 and 2008. It shows the decline in three range of years which is 2003 to 2008, 2011 to 2014 and 2015 to 2016. Despite all of these results it seen that topics has evolve from years to years and it still in the spotlight as well as more to explore and study.

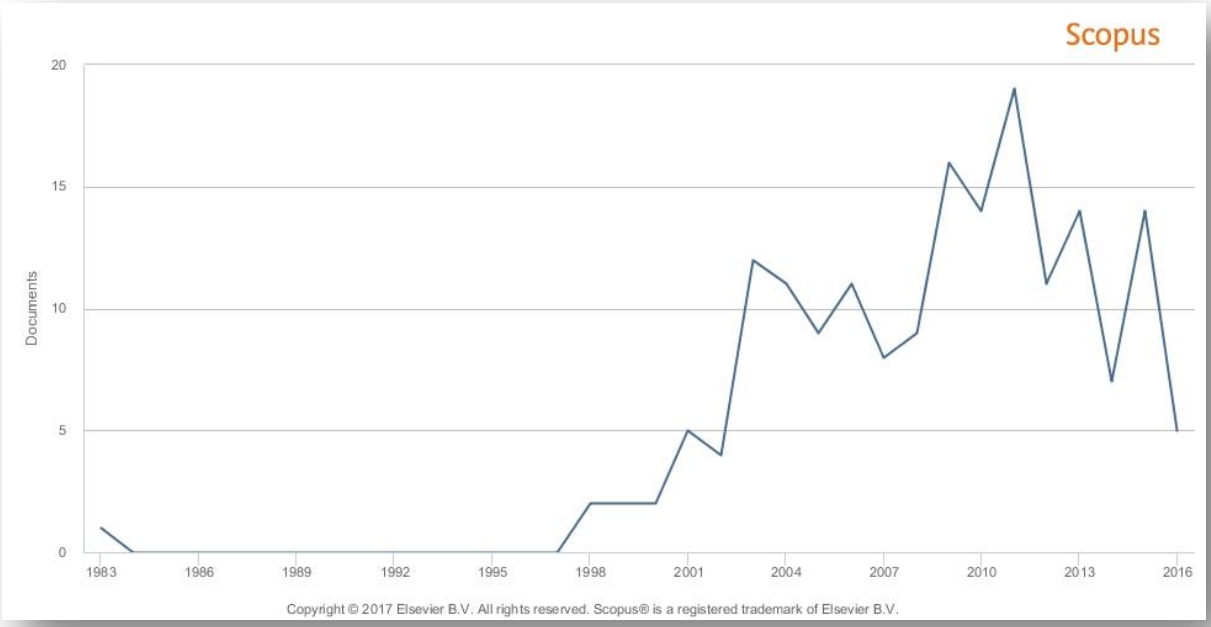

Figure 5 Keyword combination "metadata" AND "system integration" by year

5.2.2 Keyword combination "metadata" AND "system integration" by country

Meanwhile, the search by country has reveal the United States as dominants from others countries. Next highest is Germany, China, United Kingdom, Spain and Poland. Once again United States is at the top and there is no doubt to includes standard and best practices from United States to be analyze in order to achieve RO1. The other selection will be used to strengthen the constructed model which is considered to be fit in Malaysian environment.

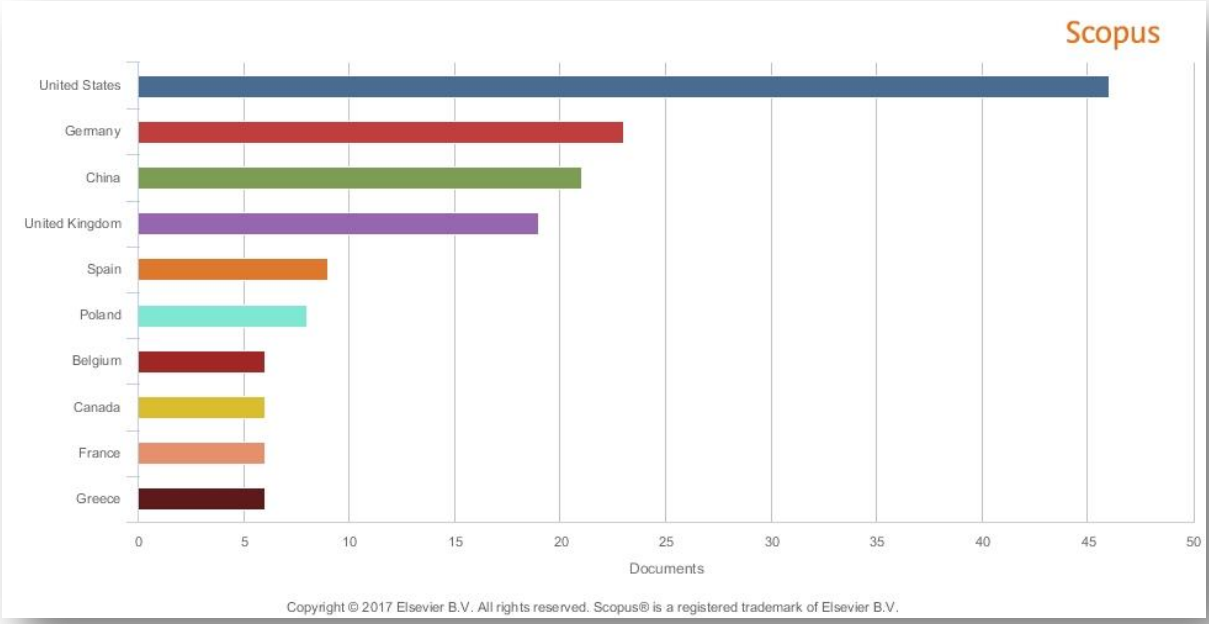

Figure 6 Keyword combination “metadata” AND “system integration” by country

5.2.3 Keyword combination “metadata” AND “system integration” by subject

The next Scopus analyze results shown the subject that the topics has contributed. The highest subject area that contribute is computer science. It is then followed by engineering, medicine, mathematics and health professional. Management is only 2.8% from the percentage which even though not the lowest but still demand for further expansion of research exploration.

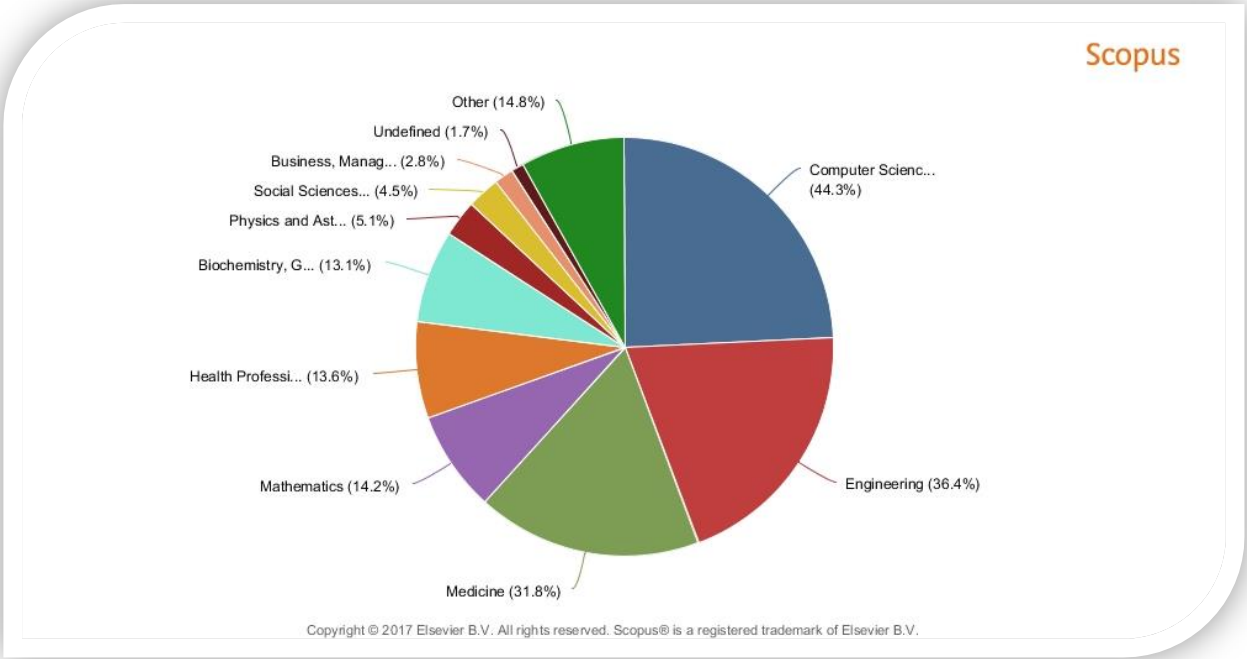

Figure 7 Keyword combination “metadata” AND “system integration” by subject

5.3 "metadata" AND "(electronic health records" OR electronic medical records)" AND "system integrate" (by years, by countries and by subjects)

The last keyword combination is more specific in terms of metadata and system integration. It was lead to a specific field of health and medical area. However, the two terms of health records (HER) and electronic medical records (EMR) is seen to be alternately used in various papers. Therefore, the keyword combination also widens the search analysis that combining both terms.

5.3.1 Keyword combination "metadata" AND "(electronic health records" OR electronic medical records)" AND "system integrate" by year

As the analysis is focus into in-depth search, the next keywords combination used is metadata "(electronic health records" OR electronic medical records)" AND "system integrate" The results reveal the following figures. The results show that topics is at it peaks in the years of 2009 to 2010, 2013 and 2015. The trends reveal that the topics keeps on evolve even there are some years it shows the decline in results. It is promising that in the year ahead the topics will keep on evolve as for the researcher there is more to explore based on issues arise related to system integration.

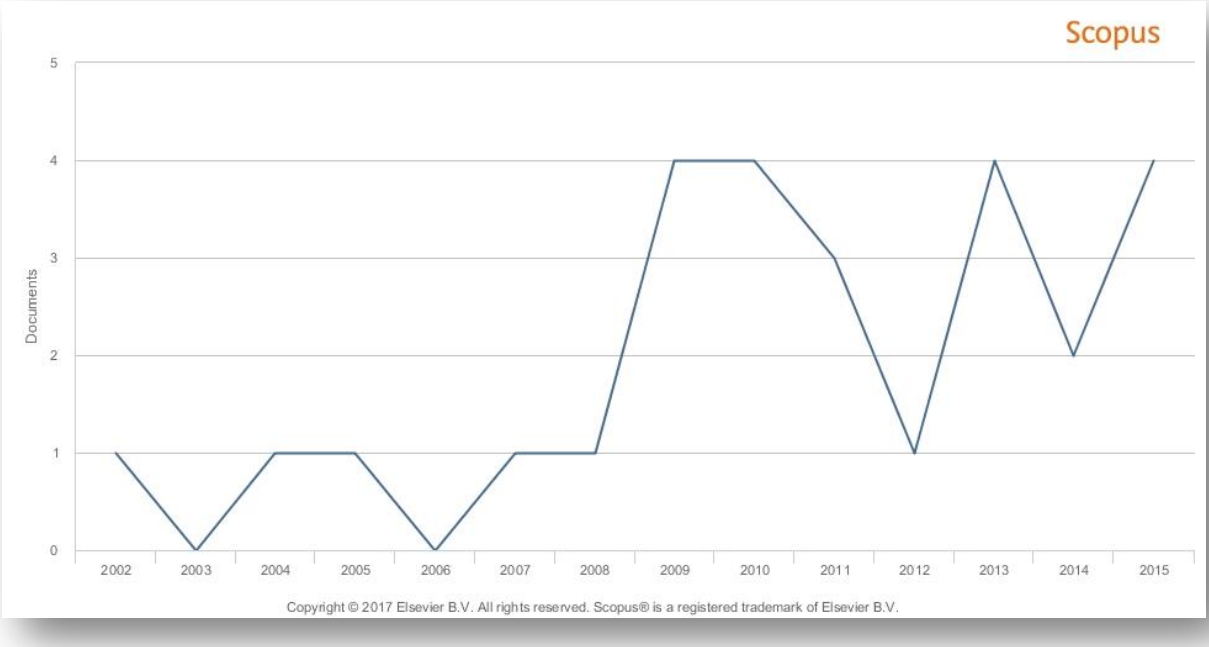

Figure 8 Keyword combination "metadata" AND "(electronic health records" OR electronic medical records)" AND "system integrate" by year

5.3.2 Keyword combination "metadata" AND "(electronic health records" OR electronic medical records)" AND "system integrate" by country

Meanwhile, the search by country has reveal the United States as dominants from others countries. Next highest is Germany, Spain and United Kingdom and Canada and South Korea. Once again United States is at the top. These countries appear to be consistent in their involvement of the topics.

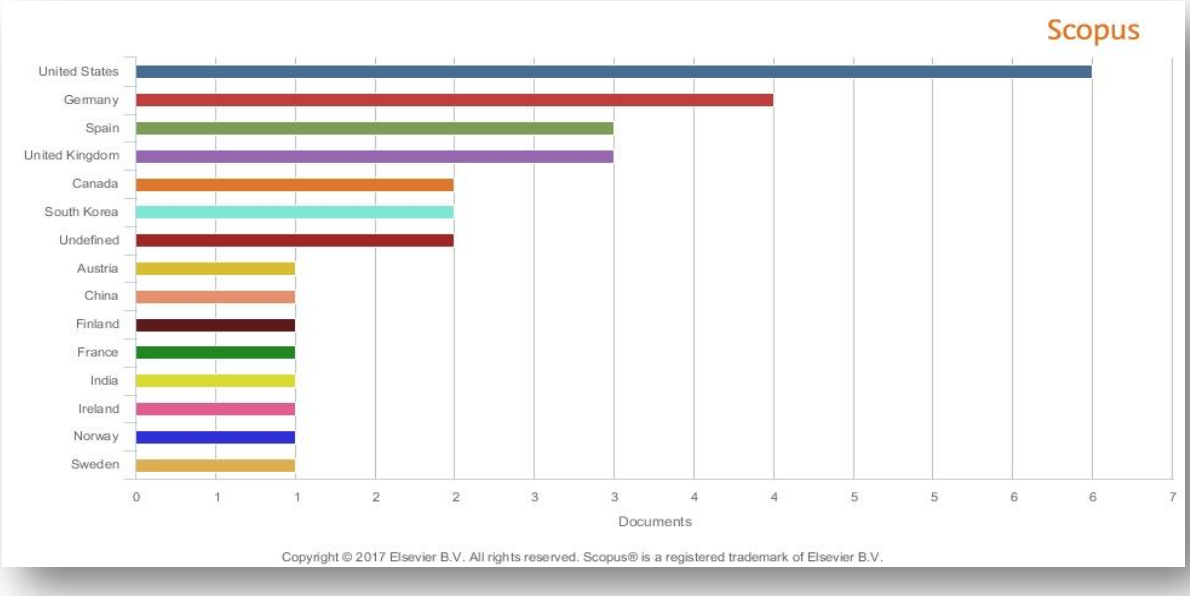

Figure 9 Keyword combination “metadata” AND “(electronic health records” OR electronic medical records)” AND “system integrate” by country

5.3.3 Keyword combination “metadata” AND “(electronic health records” OR electronic medical records)” AND “system integrate” by subject

As the search is becoming specific, the trends of subject area that has contributed in the topics being discuss is becoming clearer. The Scopus analyze results shown the subject that the topics has contributed the highest is medicine. It is then followed by health professional, engineering and computer science. Management is not included in the results and researcher consider that there is the opportunity to contribute in system integration involving the manipulation of metadata specifically in electronic health records which always dominant in technical and medical subject area.

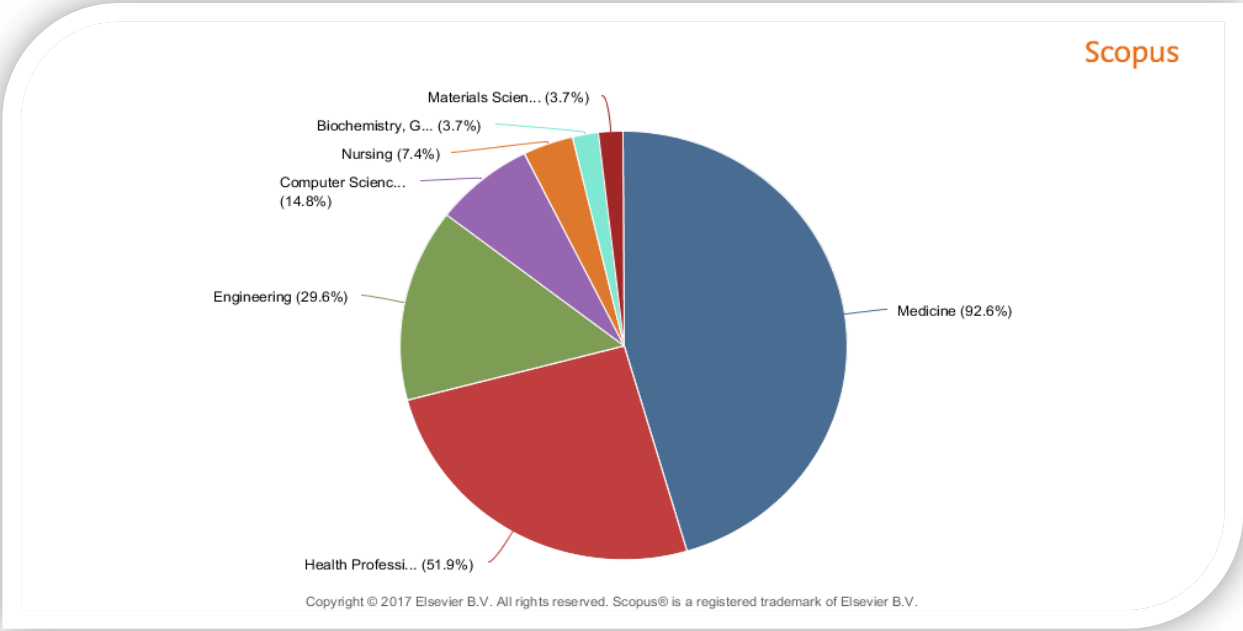

Figure 10 Keyword combination “metadata” AND “(electronic health records” OR electronic medical records)”

AND “system integrate” by subject

The summary of findings concludes that the needs for future research on record keeping metadata standardization is crucial. The challenges that has been highlighted in literature review reveals that there is demand for solution in record keeping metadata standardization. The main barriers such as interoperability, security and privacy and preservation require some uniformity and standardization in record keeping metadata. The analysis of related research is then reveals that the research topics current status. The issue is still relevant to be explored and require to be resolve for better management of EHR. The evolution of topics by years show the topics is still being discuss and some angle are not yet being explored. There is a decline in the findings of popularity of the topics by years. However, the topics is still being discuss until 2017. The analysis by countries shows that Malaysia has not appeared to be involved much on metadata research and system integration which give the opportunity for further exploration on this topic within the country. Western countries are appeared to be dominant in this areas which reveals Asian are yet to be explored especially Malaysia. Research works is demanded to be done to explore the possible solution of these issues. The more important thing is the areas that contributed in the research topics. The analysis reveals that management areas is not dominants on the selected research areas. This shows there is more to explore and some perspective are not being discuss yet. The most common subject area that involved in metadata and system integration is medicine and technical subject areas. It proves that more research on management subject area should contribute and complete the various perspective on the topics. More than that, on a wider view, a complex structural and procedural framework in implementing interoperability in e-health systems requires involvement of all relevant stakeholders and necessitates action at political and legal levels, as well as organizational, semantic, and technical levels. Public education and awareness raising are also included covering action at all levels. (Kovac, 2014). Continuous effort in research would give greater impact that will address the issue as well as the beginning of all effort to be taken.

6.0 CONCLUSION

As for the conclusion, it is hope that this analysis would give an idea for future researchers to engage in such topics. The more works and research being done would contribute to the new knowledge and perspectives that would soon complete the loops of subject matters. It is highly recommended that the research is continuously being explored especially in the areas that has been highlighted. The western countries which has been engaged earlier in such topics could be the benchmark for future research. It also can be the starting point or overview to the current scenario that can assist at the beginning of future research work. More than that, it is hope that Malaysia could benefit in this research works especially in management field and records management areas.

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