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ENABLING EHEALTH IN TRADITIONAL MEDICINE: A SYSTEMATIC REVIEW OF INFORMATION SYSTEMS INTEGRATION REQUIREMENTS

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Abstract

This paper shall investigate the information systems integration needs towards eHealth implementation in Traditional Medicine. This review seeks to answer questions related to the locations of the integration points for integrated systems for the accessibility of electronic health records in both Traditional Medicine and modern medicine to identify of the most suitable health information systems model and the selection of the concrete integration technologies and standards to be implemented. A systematic literature review was conducted to select the relevant studies. A total of 11 articles were finally included for assessment. The findings of this review revealed that data integration is considered the most important precondition for the basis of further integration and is the backbone or starting point of a successful integration project. Other information systems integration needs are information model, interoperability standards, workflow or process integration and access to multiple repositories from different platforms. Establishment of Traditional Medicine databases of medications, procedures, information and diseases is crucial to ensure a generic and extensible information model can be designed so that new data sources can be integrated without major changes to the data schema.

Keywords: EHealth, Electronic health records, Information systems integration, Traditional medicine.

1. Introduction

Health Information Systems (HIS) in Traditional Medicine has progressed tremendously. Traditional Medicine (TM) is defined as a collection of health care traditions and products with a long usage history. TM often refers to medicinal knowledge established by native cultures that incorporate nature-based therapies, mystical treatments and manual methods intended to treat disease or preserve well-being [1]. The World Health Organization (WHO) defines Traditional Medicine as "the sum total of the knowledge, skills and practices based on the theories, beliefs and experiences indigenous to different cultures, whether explicable or not, used in the maintenance of health, as well as in the prevention, diagnosis, improvement or treatment of physical and mental illnesses" [1]. Traditional Medicine is regularly practised beyond allopathic medicine (commonly known as Western or modern medicine), which is the prevailing system of medicine in the developed world. Modern medicine is offered in the national healthcare system in major public healthcare facilities worldwide.

Hu et al. [2] commented that in some countries, Traditional Medicine is established in a public hospital or offered by the public healthcare system. According to Chen et al. [3] and Fang et al. [4], some prominent studies include the development of databases where specific information in Traditional Chinese Medicine (TCM) are organized in specific protocols including relevant genetic factor and illness data. This database is vital for the establishment of electronic health records. Samal [5] explained that in India, the Institute of Ayurveda and Integrative Medicine has established digital forms associated with the knowledge of Indian Traditional Medicine. Literature on application of informatics in other Traditional Medicine systems, such as Traditional Arabic Islamic Medicine (TAIM) was found to focus primarily on spiritual health, trailed by Hajj systems for observation and the use of electronic health records to monitor the blood glucose levels of Muslim patients who fast during the month of Ramadan [6]. These informatics interventions support users to accomplish religious responsibilities and encourage spiritual recovery by offering training and knowledge to users [7-9]. Future research should focus on developing a digital databank on the fundamentals of Traditional Arabic Islamic Medicine – therapeutic procedures, dietary herbal preparations, mind-body treatment, spiritual recovery and applied rehabilitation [10].

With regards to informatics infrastructure in Traditional Medicine, Traditional Medicine services in China and India are claimable by medical insurance companies due to the implementation of computerized insurance reimbursement systems [11]. As for middle east, national informatics initiatives is mainly executed to support modern medicine as informatics applications of Traditional Arabic Islamic Medicine (TAIM) are focused on individual use and not public infrastructure [12]. Overall, there is insufficient evidence to link informatics infrastructure to support the implementation of Traditional Medicine in countries as it is mostly focused on modern medicine [13].

2. Issues in Implementation of eHealth in Traditional Medicine

The demand for Traditional Medicine is growing yearly as patients seek more holistic and natural therapy [1, 14]. Introducing electronic health records in Traditional Medicine and integrating it into the public health care would require effort to understand the technical terms and standardise its efficacy, safety and

mechanism of action of the Traditional Medicine systems [15]. Traditional Medicine systems include spiritual faith and guiding principles incorporating the entire way of life. The medication quality, safety and efficacy of prescription is inadequate to meet the standards required to sustain worldwide usage. Adverse results and technique of treatment are also not expansively recorded and unstandardized. Even though there are a few Traditional Medicine systems such as Ayurveda and TCM that have endured demanding trials, Traditional Medicine formulations are not examined in detail. On the other hand, modern medicines are thoroughly standardized and have a defined procedure with information on precautions and side effects. Quality, dosage, safety and efficacy of medicines are well established and the mechanism of actions is proven. Practitioners are also qualified. The unestablished Standardisation in safety, procedures, measures, treatment and difficulty in quantification in many aspects in Traditional Medicine lead to difficulty in documenting information electronic health record. Table 1 summarizes the differences between modern medicine and Traditional Medicine and electronic health record implementation issues in traditional medicine.

Table 1. Issues in implementation of electronic health record in Traditional Medicine [15, 16].

Areas	Modern medicine	Traditional medicine	Electronic health record implementation issues in traditional medicine
Mode of treatment	Primarily through medicine or surgery with additional information about precautions and side effects.	Includes herbal preparations and lifestyle recommendations (including spiritual)	Treatment may not be quantifiable and difficult to document in electronic health records
Standardisation	Well standardised so that it can be comprehended all over the world.	TM remains unstandardized. There are differences within a healing method; hence, detailed descriptions are essential.	Unavailability of standardised electronic health record design/ structure
Training of practitioners	A well-defined system has been developed	There are differences in training programs and not all are well defined or standardised.	Unavailability of certification leads to difficulty to document/standardise a health record
Quality of medicines	The medicines go through extensive testing and pass safety standards.	Some of the Traditional Medicine systems undergo testing. However, this is not extensive and standardised within a country.	Unstandardized quality of medicines lead to difficulty to document/standardise a health record
Efficacy, dosage and mechanism of actions	Modern Medicine has details of the efficacy of medicines and surgical procedures. Also, the dosages have been worked out taking into account factors such as age, body weight and liver and kidney functions.	Efficacy and dosage of medications are not yet fully established and may not be quantified as it may involve spiritual and lifestyle wellbeing. Subtle theories such as "spiritual health," "energy treatment," and others, which are not defined in conventional medicine.	The need to establish standard medication efficiency, dosage, frequency and procedures to ensure standardisation when documenting health record

3. Information Systems Integration

Information systems integration can be viewed from two perspectives. From a technical perspective, integration is an instrument to portray the interconnectedness of information technologies within an organization and the level to which, a shared theoretical representation of data elements[17]. In other words, integration is defined as the degree to which, multiple systems of an organization are interrelated and can communicate with each other. From another perspective, integration is the extent to which, two or more independent organizations have standardized business procedures and those procedures are firmly connected through communication technologies and computers [18].

According to Auramo et al. [19], information system integration aims at facilitating exchange and information sharing within an organization. With regards to technological integration, information system integration requires application systems, data and communication to be interlinked to deliver real-time and consistent connectivity within functional component across business functions and organisations. Information systems integration can be divided into three main dimensions encompassing: domain, reach and direction [20]. Accordingly, the direction is either horizontal or vertical, reach is either intra-organization or interorganizational and domain is either data-wise, function-wise and, program-wise [20]. It has been highlighted in many information systems literature that information system alone is not a cause of sustainable performance and value creation [21]. Subsequently, integrating resources and aligning them in the organization's social and cultural setting is critical [22], in particular, in remodelling workflow and operations synchronization. In sum, integration has been found to be a sociotechnical phenomenon beyond a mere technological aspect such that it includes economical, organizational and even social factors [23].

4. Research Question

This review seeks to answer the questions of what, where and how with regards to the functional implementation of electronic health record in the Traditional Medicine domain. These research questions are raised because the medical data that needs to be shared in Traditional Medicine may not be quantifiable and difficult to document in electronic health records. In addition, the integration points and implementation of the electronic health record are unclear due to the unavailability of standardized electronic health record design and structure for data integration. The evaluation of relevance or contribution of the paper selected for this study shall be based on the following questions:

The "what": the question "what" relates to the aspect of the evaluation that needs to be focused on. The "what" question in this paper will only focus on and discuss the functionality and medical data that needs to be shared among different applications, healthcare levels and services.

The "where": the question "where" relates to the locations of the integration points in the framework of integrated systems for the accessibility of electronic health records in both Traditional Medicine and modern medicine. The integration points should cover technical and business functionality aspects that ensure the transferability and accessibility of the necessary medical data. Different types of integration requirements cannot be satisfied with one integration approach only;

selecting appropriate standards or approaches for each integration need is a complex task. The integration points of this evaluation will be focused at the functional level, which corresponds to the enterprise model in the Information Systems Architecture framework.

The "how": the question "how" relates to the identification of the most suitable health information systems model and the selection of the concrete integration technologies and standards to be implemented in the proposed framework. The evaluation also includes the technical infrastructure needed to support the framework solution (for example, clinical code sets, integration standard and architectural standard).

5. Methodology

5.1. Research strategy

The literature was sourced from major databases including Ebsco Host, ScienceDirect, ProQuest, IEEE Explore and Google scholar. Google Scholar was included as it forms a powerful addition to other databases even though it is not recommended to be used alone for systematic review searches [Haddaway] the search algorithm is not known and cannot be controlled [Piasecki]. The search term used was "Traditional Medicine", "Electronic Health Records", "EHR", "data integration", "comparative medicine", "integrative medicine", "Chinese medicine", "Ayurveda". Different groupings of the search terms above were also performed to improve the search results.

5.2. Article selection

Titles, abstracts and full articles were screened by applying the inclusion criteria as per Table 2. In addition, references of the included articles were checked for other articles eligible for this review. The integration case studies from modern medicine were also included to assess its applicability towards Traditional Medicine.

Articles shortlisted were then analysed to extract the main themes and summary of findings of the study. The research question was then applied to these themes and findings and the results were grouped into relevant categories.

Table 2. Inclusion criteria.

Inclusion criteria
• **Lessons learnt from data or electronic health records integration case studies in modern and/or traditional medicine.**
• **Integrated electronic health records models or frameworks at an organization/national level.**

6. Results

The initial search had generated 52 articles based on the title relevance and conformance to the inclusion criteria. After title screening, articles were rescreened based on the abstract and 29 articles were eligible for full-text screening. Finally, the articles were screened by the author and another reviewer for full text by applying the selected inclusion criteria. A total of 11 articles were

finally shortlisted and considered for further assessment. The systematic literature review methodology used is shown in Fig. 1.

In the early stage of the review, only EHR articles within the scope of Traditional Medicine articles were taken into consideration. However, due to the limitation of resources regarding the implementation of EHR in the Traditional Medicine domain, the search also included modern medicine articles related to the implementation of an integrated EHR approach at an organization/ national level and the inclusion criteria were revised. A summary of an analysis of the articles shortlisted is available in Table 3. Russo [24] stresses there is a gap in providing standardized clinical documentation in integrative medicine. "Integrative medicine" is the term used by most healthcare systems to identify their use of complementary and alternative therapies within the structure of traditional medical care. Amongst the existing gap highlighted are EHR Standardized Format Development and Coding Guideline.

According to Leung et al. [25], Standardisation of Traditional Chinese Medicine information forms the basis for accurate and efficient communication of electronic Traditional Chinese Medicine data. It facilitates uniform communications and reduces costs of technical integration. A proper management framework on standard development lifecycle will ensure the concepts are properly created, described and organized, which will enhance data accuracy and quality for health information exchange. Both CM Terminology tables and the maintenance process are essential to the development and daily operation of terminology standard to support data sharing to the EHR. This framework highlights the importance of Standardisation of the clinical term coding, such as CPT and ICD 10 to define diseases diagnoses and medical procedures, however, in the context of traditional medicine. Leung et al. [25] framework also emphasized on one factor of a patient-centric system, that is to cater for patients who are unwell to attend to hospital appointments and can be treated in the comfort of their home.

The paper by Yang et al. [29] focusses on a structured method in creating a Chinese EHR module. It requires assembling a Chinese EHR document from the paper-based record, splitting into content modules and dividing the content modules into data elements. This framework provides a guideline in the creation of EHR records where there are paper-based records exist. It also highlights the importance of a structured EHR record for data interoperability and interchange. Aickin [27] focuses on a patient-centric EHR whose data is accessible, flexible and with the integrated data repository. Yu et al. [36] commented that framework is important to show that a standard communication protocol such as HL7 is an important tool to assist data exchange and interoperability in existing health information systems states a method of achieving standardizes clinical exchange using HL7 as the data exchange standard.

Pang et al. [30] provide a design of a terminal solution for integration of In-Home Health Care Devices And Services (IHHS). The design principles of the IHHS solution are derived based on the reuse of 3C platform, certification of the Health Extension, interoperability and extendibility, convenient and trusted software distribution, standardised and secured EHR handling, effective service composition and efficient data fusion [30]. The design proposed in this paper shows how integration can be presented from a single terminal via in-home care. The design also displays how integration can cross the gap between industrial business practices and technology development. A successful solution must resolve both technical and

business challenges simultaneously where technology explorations and business applications should be closely combined instead of separated.

Huser and Cimino [31] compared three large Integrated Data Repositories (IDRs) from three medical institutions in order to identify common architectural features that enable efficient storage and organization of large amounts of clinical data. Three high-level classes of underlying data storage models were also defined. Finally, an important list of characteristics were proposed or an integrated data repository where the main characteristics include single patient identifier, information storage model, support for fact nesting, semantic integration, terminology model, context representation and documentation. Ranganathan et al. [32] provides an integration alternative via workflow or interfacing systems without the need to customise data or functions when customization is financially and timely costly and there are duplicate functions or data in one of the targeted systems.

Lenz et al. [33] propose a data integration model in the healthcare sector. Data integration is the most important precondition or basis for further integration. It is the backbone and starting point of each successful integration project because any process control always requires a meaningful exchange of data [33]. Abd Ghani [34] proposes an integrated and distributed Malaysia telemedicine framework. AlJarullah and El-Masri [35] propose a design of semi centralised approach for National Integrated EHR. The design is divided into a few phases - the high-level architecture, the data model and the modular architecture. This framework is useful is providing a conceptual design example for the proposed framework in this study, that is to include high level, modular and information model architecture in the proposed framework. A summary of the analysis of frameworks based on what, where and how perspective is displayed in Table 3.

The analysis of frameworks presented in Table 3 is then summarized and grouped into the following themes.

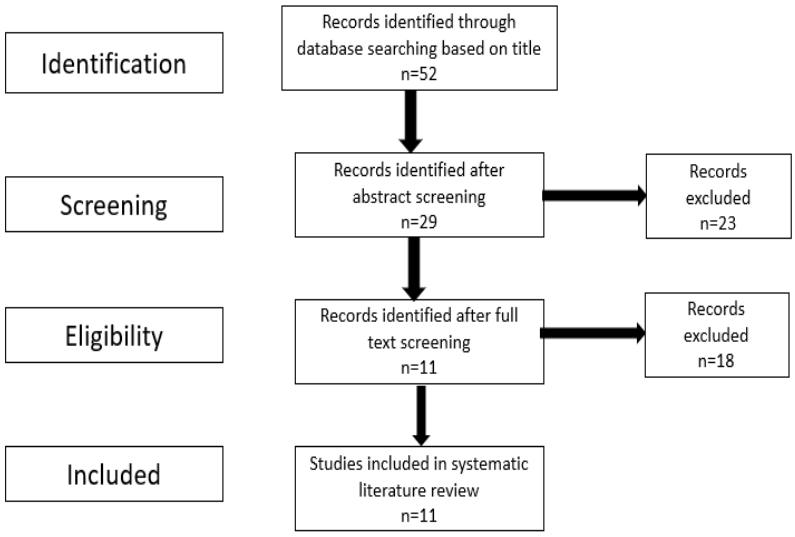

Fig. 1. Systematic literature review methodology.

Table 3. Analysis of HIS frameworks based on what, where and how perspective.

Framework	Focus	What	Where	How
[24]	Standard EHR format, Coding guideline, education	1. EHR record 2. Coding 3. Education	1. Data repository 2. Module 3. Users/ practitioners	1. Standardized EHR format 2. Coding guideline, i.e., HL7, ICD 3. Training programmes
[25]	Standardisation of clinical terms	Clinical terminology	Data repository.	Standardized clinical terms, i.e., ICD
[26, 27]	Patient centred system, in home care. integration data repository	Flexible access EHR record	Multiple devices data retrieval	1. EHR access from portable devices 2. Access to multiple data repository
[28]	Interoperability standards	EHR record	Data transfer	Applying interoperability standards, .i.e., HL7
[29]	Structured EHR format, modules based on data elements	EHR record	Data repository	Structured EHR record
[30]	Reusability of 3C platform (computing, communication and consumer). Interoperability and extendibility. Standardised EHR record	1. User access 2. Multiple Device/ System integration 3. Standardised data exchange format	1. Multiple devices access 2. Data repository/user interface 3. Data exchange format	1. User access via desktop and mobile. 2. Multiple devices or software can be extended from system 3. Data exchange format is standardised based on relevant standards, i.e., HL7
[31]	Characteristics of Integrated Data Repository (IDR)	Patient health record	Patient health record data model	1. Single patient identifier 2. Support for nesting generic and extensible information storage model 3. Representation of contextual information on multiple levels 4. Use of coding and clinical standards
[32]	Interfacing two existing systems	System data	System interface	Technical integration
[33]	Data integration	1. System data, development technologies 2. Semantic guidelines	Data, technical and semantic layers	1. Data sets 2. Data model 3. Application integration 4. Coding and clinical guidelines
[34]	Integrated National Telemedicine Framework	Clinical support systems	Data accessibility and flexibility	1. Integration flow 2. Data standards
[35]	Semi centralised design for Integrated National EHR	Conceptual design for National Integrated EHR	Data layer, business layer and presentation later	1. Data model 2. High-level architecture model 3. Modular model

6.1. What is involved and where should the IS integration take place?

Information model

The review answered the question on what and where the information systems integration should focus or take place; that is at the structured information storage model or EHR model. This information model should be sufficiently generic, extensible and relatively stable in time so that new data sources can be integrated without major changes to the data schema. This includes some design issues of her, which is recommended to be complied that is support for nesting, generic and extensible information storage model, representation of contextual information on multiple levels [31]. Data integration involves a significant degree of transformation

of original data and the information model should offer storage structures that allow preservation of how groups of related facts relate to each other. An information model should define what level of fact nesting is possible and define explicitly how nested facts can be linked to master events. The information model may need to be able to represent contextual information on multiple levels, in addition to storing individual clinical facts. The existence of a dataset is also important as data is a starting point for each successful integration project because any process control always requires a meaningful exchange of data [33]. Mode of treatment, medication and diagnosis methods remains unstandardized in Traditional Medicine. There are differences within a healing method; hence, detailed descriptions are essential to be established in order to design a sufficiently generic, extensible and relatively stable a structured information storage model or EHR model.

6.2. How should the IS integration be implemented?

6.2.1. Interoperability standards

The integration should take place using interoperability standards. The interoperability standards can be divided into organisational and medical standards. Organisational semantic integration is technical standards, templates or guidelines that exist to facilitate EHR interoperability such as HL7. Medical semantic integration is medical standards that facilitate the integration of medical terminologies into standard coded data. The existence of both standards are vital to ensure meaningful and standardised reporting and data exchange. Amongst the popular medical standards available are ICD and SNOMED. Within the healthcare industry, providers, coders, IT professionals, insurance carriers, government agencies and others use ICD codes to properly note diseases on health records, track epidemiological trends and assist in medical reimbursement decisions. The World Health Organization (WHO) owns, develops and publishes ICD codes and national governments and other regulating bodies adopt the system. SNOMED Clinical Terms (SNOMED CT) is a comprehensive, computerized healthcare terminology – containing more than 311,000 active concepts – with the purpose of providing a common language across different providers and sites of care.

As a core EHR terminology, SNOMED CT is essential for recording clinical data such as patient problem lists and family, medical and social histories in EHR in a consistent, reproducible manner. SNOMED CT can be mapped to other coding systems, such as ICD-9 and ICD-10, which helps facilitate semantic interoperability. In most developing countries, medical information and clinical notes are generated by many different systems using many different proprietary structure formats [15]. There is a need of an authoritative body to take the lead and accordingly identify and address the interoperability gaps and issues and to harmonize the development process of Standardisation for health data. There is also a lack of privacy and ethical issues in managing these medical data. Shortage of professionals in both Traditional Complementary and Alternative Medicine and modern medicine health informatics experts have also hindered this progress [15].

6.2.2. Workflow integration

The integration should also be represented in a workflow, particularly if the system integrated are merely interfaced. The workflow should specifically mention the integration paths or processes.

6.2.3 Access to multiple repository and from different platforms

One of the major motivation of integration in health information systems is access to multiple repositories, i.e., different institutions, healthcare providers, departments, etc., to increase accessibility towards lifetime health records. Thus, interoperability standards are crucial to ensure the data integration and accessibility can be implemented. Patients of Traditional Medicine often seek treatment in home, centre of Traditional Medicine practitioners and wellness centres [16]. Access from different platforms also allows the system to be patient-centric, where patient can get access to healthcare in the comfort of their home, particularly for elderly or chronic patients [13].

7. Challenges of Implementing Integrated eHealth in Traditional Medicine

Electronic health records involve healthcare practitioners and patients that interact with the system. Thus, human resistance to change and insufficient training program to train the staffs to use the software application because of time constraint are amongst main issues that may slow the EHR adoption [37]. In modern medicine, there are indications showing the transition to compliant coding and information that is entered only slows down physicians and may result in a 10 to once, however, if used many times; will reduce the probability of 20% reduction in productivity for a period of months or more [37]. Thus, this can take more time in Traditional Medicine as the practitioners are mainly non-IT savvy and rely on traditional methods to execute their treatment.

Most Traditional Medicine interventions use complex treatment methods, which include botanical medications; individualized diagnosis and treatment; an emphasis on maximizing the body's innate ability to heal itself and a "whole systems" approach, wherein the physical, mental and spiritual attributes of a patient are emphasized, rather than a focus on the disease as in modern medicine. The initial adoption cost for EHR is also high. The cost of an EHR system may be prohibitive enough for a healthcare provider to sacrifice implementing adequate security measures that would ensure patient confidentiality [37] . Extensive training programs including planning for training and coordination system across the hospital personnel, are necessary during for implementation of an EHR system. Shortage of professionals in both Traditional Complementary and Alternative Medicine and modern medical health informatics experts have also hindered this progress[15]. There is a shortage in professionals who are experts in both knowledges of complementary and alternative medicine and information technology and who can integrate these two worlds. Traditional Complementary and Alternative Medicine professionals are mostly non-tech savvy and rely on traditional methods to execute treatment.

8. Conclusion

The major information systems integration needs to be highlighted from the review are information model, interoperability standards, workflow or process integration, access to multiple repositories and from different platforms. This information model should be sufficiently generic, extensible and relatively stable in time, so that new data sources can be integrated without major changes to the data schema. Some design issues of her, which is recommended to be complied, are supported for nesting, generic and extensible information storage model, representation of contextual information on multiple levels. This literature review also has

highlighted that data integration is considered the most important precondition for the basis of further integration in Traditional Medicine and is the backbone or starting point of a successful integration project because any process control always requires a meaningful exchange of data. The usage of interoperability standards is vital to ensure meaningful and standardised reporting and data exchange. Benefits of EHR implementation are significant including reduces lost records, improves service time, efficiency and, cost savings. Amongst major threats highlighted are perceptions towards EHR investments, resistance in change and high adoption cost. Major recommendations proposed are enabling policies for EHR adoption to facilitate or stimulate usage of electronic medical records and standardisation of health informatics standards in traditional medicine.

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