APPLICATIONS OF FRAMEWORK IN HEALTH CARE: A SURVEY

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Article Info	ABSTRACT
Article type: <i>Review</i>	Introduction: The use of healthcare frameworks and, in particular, policy makers is crucial for designing and evaluating systems. Frameworks provide the ability to measure and compare health system functions in different countries in order to make better and more meaningful decisions, to make comparisons within and between countries, identifying gaps, and sharing information. Researchers also have the ability to use the dimensions of the frameworks to measure progress over time. Due to the importance of the subject, the purpose of this study is to describe the framework concepts and the introduction of framework applications in the field of health care.
Article History: <i>Received: 2019-04-02</i> <i>Revised: 2019-05-17</i> <i>Accepted: 2019-07-27</i>	Material and Methods: This study is based on a search of the ProQuest, PubMed, Google Scholar, Science Direct, Scopus, IranMedex, Irandoc, Magiran, ParsMedline and Scientific Information Database (SID) databases, as well as the study of specialized keyword web sites and the standard was done. After a thorough study, 50 sources were selected according to the study objectives and were used to formulate the final article.
* Corresponding author: <i>Hamed Tabesh</i> <i>Department of Medical Informatics,</i> <i>Faculty of Medicine, Mashhad</i> <i>University of Medical Sciences,</i> <i>Mashhad, Iran.</i> <i>Email: tabeshh@mums.ac.ir</i>	Results: The framework can be used to manage health system investments, identify important research areas in the field of health, and define new and useful research.
	Conclusion: Given the importance of the health framework, the need to provide a framework for other critical health care sectors is essential.
	Keywords: <i>Software Engineering, Framework, Healthcare.</i>

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INTRODUCTION

The framework focuses on one thing why and how it should work; in fact, it provides the user with a map; it is a prefabricated template or pattern that manages most common and duplicate features and the possibility provides reuse [1, 2]. In other words, a framework is a basic conceptual framework that is used to solve complex problems and is usually a set of tools, materials, or components [3]. This is a phrase from the architecture world to software and sometimes managed [4]. It has applications for improving and redesigning processes and services, designing and manufacturing systems, designing/ revising an enterprise architecture, integrating systems and e-services, designing new services/

products, and incorporating many benefits, including simplicity, high performance, integration ability, higher security, the ability to develop, facilitate program updates, the ability to reuse written codes [5, 6].

Frameworks have different types, including theoretical frameworks, conceptual frameworks, operational frameworks, and software frameworks. Theoretical frameworks deal with the relationships between variables such as independent, dependent, interferential and transformative variables, helping to create such frameworks in establishing and constructing hypotheses, measuring them as well as completing a researcher's perception (research question) [7]. The theoretical framework statement is usually used in quantitative research. While the

researcher uses a theory or a combination of several theories to prepare a road map and explain research hypotheses. In a study, a theoretical framework for coordination care in chronic diseases requiring long-term care was presented. This framework included the association of the team members with the patient for proper interaction, team features including cultural characteristics, workload, work complexity, etc. [8]. In a study, the presentation of a theoretical framework for Public Health Ethics includes the production of benefits, avoiding, preventing, removing harms, and utility, distributive justice, respecting autonomous choices and actions, protecting privacy and confidentiality, keeping promises and commitments, disclosing information, speaking truthfully, building and maintaining trust [9].

A conceptual framework is a set of general goals and related basics that determine overall goals and objectives, and defines the basics and concepts for achieving these goals. These concepts are tips for choosing events, deals, and conditions to be considered [8-10]. Conceptual framework terms are commonly used in qualitative research. The researcher uses the analysis and categorization of previous research findings as a road map for designing research tools and research questions. In studies of conceptual frameworks, for the analysis of health care organizations' performance, for performance of healthcare, including effectiveness, quality and improvement, for measuring the performance of the public health system, for quality of care, including the dimensions of efficacy, effectiveness, efficiency, empathy, and environment, for developing a comprehensive e-health assessment tool, for the IOT-based health care system using cloud computing, and the theoretical frameworks in this regard to determine good health status in Jamaica, And for supporting research on health service innovation [11-20].

The operational framework includes guiding principles, specific criteria, steps, methods and attributes that relevant to corporate policies, goals, standards, procedures and training. Generally, it describes the corporate organization or management structure. It includes how the leaders manage the company and its hierarchy of divisions or management teams. It includes policy makers of the company. It can include a guide to the principles of behavior, recruitment and promotion [21]. In a study, an operational framework for health policy included process, actor, content and context items [22]. A community-based care for mothers and infants in Queensland was also presented in the form of an operational framework, in the form of essential roles and dimensions [23]. The proposed operational framework for risk management involves injury training, athlete monitoring, risk factors, sports requirements, athlete profiles, athlete

management, which can be helpful for practitioners in managing risk of injury [24].

The software framework is a framework for helping startup programs, and by putting all of the software components together, it is possible to develop a project or system. They can include support programs, compilers, libraries, tools and APIs [4]. A study was designed to use practical statistical frameworks for recommending medication to diabetic patients [25]. A study was performed using panel ensemble techniques to determine benign or malignant breast cancer [26]. A study was developed using probabilistic frameworks that processed mammography images for cancer diagnosis [27]. A framework study presented using the Bayesian method for determining variations in EEG / FMRI [28].

MATERIALS AND METHODS

This review study is based on a search of the ProQuest, PubMed, Google Scholar, Science Direct, Scopus, IranMedex, Irandoc, Magiran, ParsMedline, and Scientific Information Database (SID) databases, as well as web site reviews.

Related Keywords and the standard were done. After detailed study, the full text of 50 articles, books and scientific text (derived from the website) was selected according to the objectives of the study and was used in the compilation of the final article.

RESULTS

Examples of useful health care frameworks are as follows:

1. Framework for health care control and planning

A 4x4 framework for health care control and planning has been proposed by Hall (Fig 1).

2. Applied conceptual architecture of health care system using big data analysis

An applied conceptual architecture of the healthcare system using big data analysis has been proposed by Raghupathi and Raghupathi [29], as presented in Fig 2. The proposed framework comprises several layers:

Data source layer:

Internal and external health care data sources found in a several situations in a variety of formats.

Transition layer:

This layer performs operations such as extracting, transferring, and loading data within a large data platform through data staging techniques such as

middleware and data warehousing operations.

Big data platform layer:

This layer comprises various Hadoop ecosystem tools implemented using the Map-Reduce programming model based on the Hadoop Distributed File System (HDFS).

Analysis layer:

Performs various operations such as querying, reporting, online analytical processing and data mining techniques.

Raghupathi and Raghupathi [29] have introduced health data meta-analysis tools and platforms (Table 1).

	Medical planning	Resource capacity planning	Materials planning	Financial planning	
Strategic	Research, development of medical protocols	Case mix planning, capacity dimensioning, workforce planning	Supply chain and warehouse design	Investment plans, contracting with insurance companies	↑ hierarchical decomposition ↓
Tactical	Treatment selection, protocol selection	Block planning, staffing, admission planning	Supplier selection, tendering	Budget and cost allocation	
Offline operational	Diagnosis and planning of an individual treatment	Appointment scheduling, workforce scheduling	Materials purchasing, determining order sizes	DRG billing, cash flow analysis	
Online operational	Triage, diagnosing emergencies and complications	Monitoring, emergency coordination	Rush ordering, inventory replenishing	Billing complications and changes	
	← managerial areas →				

Fig 1: An example of the application of a health care control and planning framework for a hospital [30]

Fig 2: A conceptual framework for big data analysis [29]

Table 1: Big economic data analysis tools and platform [29]

Platform/Tool	Description
The Hadoop Distributed File System (HDFS)	HDFS enables the underlying storage for the Hadoop cluster. It divides the data into smaller parts and distributes it across the various servers/nodes.
MapReduce	MapReduce provides the interface for the distribution of sub-tasks and the gathering of outputs. When tasks are executed, MapReduce tracks the processing of each server/node.
PIG and PIG Latin (Pig and PigLatin)	Pig programming language is configured to assimilate all types of data (structured/unstructured, etc.). It is comprised of two key modules: the language itself, called PigLatin, and the

Platform/Tool	Description
	runtime version in which the PigLatin code is executed.
Hive	Hive is a runtime Hadoop support architecture that leverages Structure Query Language (SQL) with the Hadoop platform. It permits SQL programmers to develop Hive Query Language (HQL) statements akin to typical SQL statements.
Jaql	Jaql is a functional, declarative query language designed to process large data sets. To facilitate parallel processing, Jaql converts “high-level” queries into ‘low-level’ queries” consisting of MapReduce tasks.
Zookeeper	Zookeeper allows a centralized infrastructure with various services, providing synchronization across a cluster of servers. Big data analytics applications utilize these services to coordinate parallel processing across big clusters.
Hbase	HBase is a column-oriented database management system that sits on top of HDFS. It uses a non-SQL approach.

3. Patient-centered personalized health care frameworks

Chawla and Davis [31] presented a patient-centric personalized health care framework based on the collaborative refinement approach. In this framework, patient similarities are collected and personalized disease risk profiles are created for each individual. They have developed a system called Collaborative Assessment and Recommendation (CARE) to predict personalized disease risk (Fig 3).

4. Big Data Analytical Framework Using Comprehensive Health Care System

A big data analytical framework utilizing a comprehensive health care system has been proposed by Kim et al. (Fig 4). Vital signs (such as ECGs) extracted from the accelerometer are analyzed by the framework to provide health care services. It uses an open standard platform to support interaction between data and different devices.

Fig 3: CARE process diagram [31]

Fig 4: Big data platform for vital signs analysis [32]

5. Health Informatics Processing Pipeline Framework

A framework called "health informatics processing pipeline framework" has been proposed by Fang et al. [33]. As shown in Fig 5, this framework combines a sequence of steps to collect meaningful patterns of healthcare metadata. Each step in the pipeline plays a vital role in delivering valuable and high quality data analytics gains.

The pipeline steps are:

- Capturing: Defining data sources such as: electronic health care data, decision support data sources, and laboratory results
- Storing: Determining the effective storage infrastructure for analyzing health care data
- Sharing: Secure exchange of health care information between scientists and physicians
- Analyzing: Performing tasks such as data pre-processing, feature selection and machine learning
- Searching: Extracting meaningful patterns of interest from analysis results

- Decision Support: Model-Based Benefits for Effective Decision Making in the Health Informatics

6. Framework for big analysis of healthcare data in mobile cloud computing

A framework for big analysis of health care data in mobile cloud computing has been proposed by Youssef [34] as follows (Fig 6):

- Cloud: Hosts patient information and offers health care services.
- EHR: Integrates patient information records from various sources such as: pharmacy, hospital, and laboratory.
- Security: Ensures security and privacy by encryption and authentication techniques.
- Big Data Analytics: Deploying different analytics tools to discover different patterns of EHR
- Care Delivery Organization (CDO): Health care delivery organizations that are distributed in different locations.

Fig 5: Pipeline health informatics processing [33]

Fig 6: Framework for EHR based mobile cloud computing and big data analysis [35]

7. Web based ontology language framework

The importance of semantic interaction between clinical information has been proposed by Legaz-Garca et al. To determine the semantic integration of Health Care Electronic Data (EHR), a Web Ontology Language (OWL) framework called ArchMS has been proposed. The data collected from relational databases to construct the ontology are converted to OWL and then the anthology built to explore data

such as EHR-based classification and visualization, as presented in Fig 7.

8. SmartHealth framework

A physical-cyber system based on the Health Care Framework "SmartHealth Framework" was proposed by Sakr and Elgammal [36]. It integrates sensing technologies, cloud computing, IoT, and big data analytics.

Fig 7: ArchMS architecture overview [35]

Fig 8: Layer of architecture for smart health framework [36]

As shown in Fig 8, the different layers of the SmartHealth framework are:

Data Connection layer:

For data measurement, data extraction and data integration

Data Storage Layer:

For storing relational, non-relational and cloud-based data

Big data processing and analytical layer:

Performing various analytics such as descriptive, predictive and prescriptive

Presentation Layer:

Designing dashboards and graphics workflows

9. Cloud-based framework for big data:

A cloud-based framework for identifying the impact of socioeconomic, geographic and demographic conditions on public health has been proposed by Mahmud et al. [37]. The framework uses the Amazon Web-based cloud platform along with geographic information system to collect, store and visualize large data.

10. Integrated big data framework:

Jokonya et al. [38] proposed an integrated large data framework to help control and prevent diseases such as HIV/AIDS (Human Immunodeficiency Viruses/Acquired Immune Deficiency Syndrome), Tuberculosis, and Silicosis (abbreviated as HATS). This framework addresses the need for a statistical

prevention model to predict and control these diseases. Fig 9 shows the suggested framework.

11. RFID-based healthcare framework

The interest in RFID (Radio-Frequency Identification) technology in the healthcare industry has increased. This technology is used for such things as tracking medical equipment, hospital supplies, patient information and medications. While this technology has important implications, it raises privacy concerns. Rahman et al. [39] proposed an RFID-based healthcare framework, PriSens-HSAC, to address privacy issues. As shown in Fig 10, this framework contains two components:

PriSens Protocol:

Used as an authentication protocol to measure RFID tags.

HSAC:

Provides a mechanism for accessing the health care service to ensure user privacy.

12. Cloud-based distributed health information system framework with emphasis on security and privacy aspects:

A cloud-based distributed health information system framework with emphasis on security and privacy aspects has been proposed by Sarkar [40]. The framework proposes a set of security constraints and access control mechanisms to ensure the integrity, confidentiality, and privacy of medical data (Fig 11).

Fig 9: HATS metadata conceptual framework [38]

Fig 10: PriSens-HSAC framework architecture [39]

Fig 11: (a) Suggested framework for distributed health information system (b) A schematic of the EHR [40]

13. Conceptual Framework for Big Data Intelligent Health Care System

Pramanik et al. [41] have provided critical analysis of recent advances in health care systems (with emphasis on the application of smart technologies). They have proposed a conceptual framework for the big-data-driven smart healthcare system to provide more intelligent inclusive healthcare solutions. Some layers of this framework are (Fig 12):

Data Source Layer:

For managing structured, unstructured and semi-

structured data sources.

Data Analytics Layer:

Performing computing, managing and visualizing big data.

Smart Service Layer:

Facilitating services such as: data monitoring, security and privacy agreements between consumer and service provider.

Knowledge Discovery Layer:

Add capabilities such as: anticipating needs for existence, planning and estimating, evaluating and modeling health care service mechanisms.

14. Personalized big data framework for real-time health care preparation

A big-data framework for real-time personalized health care customization based on field-based surveillance technology has been presented by Forkan et al. (Fig 13). This framework facilitates big data analysis within a cloud environment to detect patient-specific anomalies from large amounts of data. With the advent of the cloud, the big data generated is collected from heterogeneous fields and implements a two-step methodology [42].

The first step is to apply a Map-Reduce based Apriori algorithm to discover the relationship between field characteristics and threshold values of critical parameters of patient data.

Second, supervised learning algorithms, such as multilayer perceptron networks, decision trees, Bayesian networks, are implemented on the associative rules produced to implement context-aware decision making.

15. A framework for evaluating health information technology

Improving quality, efficiency and effectiveness of health services are the most important goals of health systems. If health organizations have the appropriate structure in place to regularly evaluate health information systems, they play an effective role in achieving these goals. The purpose of designing and implementing health information systems evaluation is to ensure the availability, use and applicability of data necessary to measure key health indicators.

Sadoughi et al. [43] described the process of evaluating health information systems, focusing on the WHO program. The stages of evaluating health information systems from the World Health Organization's perspective are as follows:

- 1) Determine the scope of authority
- 2) Collect and review existing relevant information
- 3) Finalize the evaluation services and topics
- 4) Determine system performance indicators
- 5) Designing and testing evaluation tools
- 6) Evaluation logistics
- 7) Performing evaluation
- 8) Analyze the results and prepare the evaluation report
- 9) Adjustment suggestions and preparation of the operation plan [43]

A conceptual framework for evaluating health information technology has been proposed by Eisenstein et al., Which can be used for hospitals, clinics, and health care systems [43].

- 1) Domain: Specifies the difference between an information intervention and its achievement.
- 2) Mechanism: Specifies the specific components of the new information technology or health care system so that it can be the subject of an evaluation study.
- 3) Timing: Determines the occurrence before or after the implementation of health information technology.

The answers to these three questions determine a set of evaluation types, each comprising a set of evaluation questions, study designs, data collection requirements, and analysis methods.

16. Framework for comprehensive health service evaluation and monitoring

Reeve et al. [44] developed a framework for evaluating and monitoring a health care service, integrating hospital and community services. This framework comprises three main areas: structure, process, and outcome to determine health service performance (Fig 14).

17. Development of frameworks for the semantic interaction of health information systems

The major challenge for health information systems is the semantic interaction for establishing shared e-health care. Lopez et al. [45] proposed a framework for the semantic interaction of health information systems. The proposed methodology is based on the Rational Unified Process (RUP) to integrate with other architectural approaches such as Service-Oriented Architecture (SOA), Model-Driven Architecture (MDA), ISO 10746, and HL7 Development Framework (HDF). The following Fig 15 shows the framework architecture.

Fig 12: Applied conceptual framework for a health care system [41]

Fig 13: Full architecture of BDCaM model [42]

Fig 14: Health service evaluation framework [44]

Fig 15: Framework for semantic interaction of health information systems [45]

18. A framework for monitoring the health system

In the global model of the health system, the role of governance and leadership is very important. Coordination between the various public and private actors in the utilization of health resources (labor, information, equipment and technology as well as the necessary funding) provides essential services to promote health and meet the needs of the community and fair participation in the provision of resources. Improving governance and leadership performance in the health system has an indispensable role in promoting health system

functions such as fairness, efficiency and effectiveness and continuity in service delivery.

The model proposed by Mehroolhassani et al. [46] consists of 5 components:

Governance and Leadership:

A key component of the model, it regulates strategies and policies of other dimensions and areas of the health system.

Provision of services:

Includes different levels such as: primary health care, family physician, home care, health and

hospital services, and rehabilitation

Population Health:

The situation is monitored for basic demographic indicators as well as mortality, disease burden and risk factors.

Financial dimension:

Examines the status of financing locations, resource accumulation, purchasing and resource specialization, payment system and strategic purchasing of services.

Infrastructure:

Examines the components of human resource management, knowledge and information, equipment and medicine as well as the legal nature of organizations.

Although these frameworks pursue specific health care goals, they are geared towards adopting standard architectural guidelines such as data collection, pre-processing, data analysis, interpretation and visualization. Due to the specific nature of the scope of the big data healthcare framework, professionals should make the utmost effort to select the tools used at different levels of the design and implementation of the framework [47, 48].

DISCUSSION

Various frameworks have been presented to date in the field of health care; for example, the framework for controlling and planning health care was proposed by Hall [30], which the hospital managers used using the components of the framework, including resource management and principles Strategic counseling can be taken to improve care services. An applied conceptual framework of the health care system is also presented using big data analysis by Raghupathi and Raghupathi [29]. This framework works for researchers who intend to use big data analyzes in the field of health as a road map. Rahman et al. [39] provided a RFID-based healthcare framework for addressing security issues. In this framework, two RFID tag-based authentication components and privacy have been considered as two important factors in maintaining security. Lopez et al. [45] introduced a framework for communicating between health information systems using the standards, protocols, and principles of interaction in these types of systems. Mehrolhassani et al. presented a framework for monitoring the health system, which can be used to evaluate a good health system, taking into account dimensions such as the financial dimension and delivery of services. Reeve et al. [44] developed a comprehensive evaluation and monitoring

framework for a comprehensive health system that covers three areas of structure, process, and achievement. Chawla and Davis [31] suggested a personalized framework for the patient that the patient, using a mechanism based on the profiles of similar patients, predicted the risk for each patient. Considering the importance of focusing on the Big Data Area [49] and providing a lot of frameworks in this area, it is recommended that other important health care sectors provide frameworks in this regard, and it is also recommended in future studies of other widely used tools for software engineering in the field of health care Including modeling, simulations, etc., are being investigated, introduced and used [50].

CONCLUSION

The framework is a valuable and widely used concept in the field of health care, which has been used in recent years. In this paper, the survey reviewed its implications in the field of health care. The framework in the field of health care has many advantages and especially for policy-makers to evaluate the system, measure and compare the function of health systems in different countries, for key decisions, the possibility of comparison within and between countries, identification Chatting and sharing of information. The results obtained on the basis of the framework can be used to manage health system investments, identify important fields of research in the field of health, as well as areas that are important and less worthwhile, and define new and useful research. The possibility of designing standard systems is provided.

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AUTHOR'S CONTRIBUTION

All the authors approved the final version of the manuscript.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest regarding the publication of this study.

FINANCIAL DISCLOSURE

No financial interests related to the material of this manuscript have been declared.

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