

Quantitative and Qualitative Evaluation of The Structural Designing of Medical Informatics Dynamic Encyclopedia

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ABSTRACT

Introduction: Encyclopedias and their compilation have become so prevalent as a valid cultural medium in the world. The daily development of computer industry and the expansion of various sciences have made indispensable the compilation of electronic, specialized encyclopedias, especially the web-based ones. **Materials and Methods:** This is an applied-developmental study conducted in 2014. First, the main terms in the field of medical informatics were gathered using MeSH Online 2014 and the supplementary terms of each were determined, and then the tree diagram of the terms was drawn based on their relationship in MeSH. Based on the studies done by the researchers, the tree diagram of the encyclopedia was drawn with respect to the existing areas in this field, and the terms gathered were put in related domains. **Findings:** In MeSH, 75 preferred terms together with 249 supplementary ones were indexed. One of the informatics' sub-branches is biomedical informatics and health which itself consists of three sub-divisions of bioinformatics, clinical informatics, and health informatics. Medical informatics which is a subdivision of clinical informatics has developed from the three fields of medical sciences, management and social sciences, and computational sciences and mathematics. **Results and Discussion:** Medical Informatics is created of confluence and fusion and applications of the three major scientific branches include health and biological sciences, social sciences and management sciences, computing and mathematical sciences, and according to that the structure of MeSH is weak for future development of Encyclopedia of Medical Informatics.

Key words: Encyclopedia, Web-based Encyclopedia, Medical Informatics, Encyclopedia of Medical Informatics.

1. INTRODUCTION

Medical Informatics (MI) is by nature a complex topic. Among the characteristics that shows the expanse of medical informatics is that the field is now divided into such different branches bioinformatics, clinical informatics, consumer health informatics, dental informatics, health services and management informatics, telematics, nursing informatics, pharmacy informatics, public health informatics, and veterinary informatics (1). Medical informatics is one of the fast-growing and evolving bases of the health sector in the 21st century, which leads us towards life in an "informed society". Medical informatics as a topic which is greatly welcomed by many organizations is in fact considered as one of the main issues and worries. Studies show a degree of discrepancy among the existing definitions for this field so that the need for an

acceptable, global definition is strongly felt (2). Different names have also been proposed for medical informatics including computer-based medical information systems (MIS), information methods in medicine, computer sciences in medicine, medical information processing, models of decision making in medicine, medical computer technology and etc.(1).

The growth of human knowledge and the need to record it, gradually led man to write and record his knowledge to the extent that and it is centuries that the culture governing the world is a writing-based one. Therefore, certain books were compiled to record and transfer knowledge, which contain the sciences of their time. Gradually, with the expansion of knowledge types, some compilers began to classify and summarize them in their writings. In this way, the first multi-science books

were formed, the modern form of which is called encyclopedia nowadays. Encyclopedias, as a cultural medium, and their compilation have become so prevalent now (3).

Encyclopedia compilation has been among strategic endeavors in publishing knowledge and making sciences reach human beings and their cultural society. It has a history of more than two thousand years and has had a special place among different written materials (4, 5). Despite their benefits, printed encyclopedias have certain remarkable weak points (6). Therefore, individuals now prefer using electronic references to published ones (7, 8) and the worldwide web with its large volume of information has changed into a promising source of encyclopedic information (9) so that with the expansion of communication and information technologies specially the web, certain changes have occurred in gathering, organizing, spreading, and sharing information, and such changes have made certain encyclopedias called dynamic encyclopedias emerge. Despite the accompanying problems and challenges, dynamic encyclopedias have presented a new concept called the use of collaborative wisdom (10).

Wikipedia is the representative of the new generation of encyclopedias called dynamic encyclopedias. The main characteristic of the wiki software is the considerable reduction of spreading costs and creating shared content and keeping it up to date. Besides, the non-limitation of entries and following it, the great volume and the unlimited variety of editorial community, have all made Wikipedia distinct from any other project (10).

Also some studies have been conducted on encyclopedias. Among them are the study by Ginneken et al. for planning and implementing an electronic encyclopedia called "diagnostic encyclopedia workstation" for personal computers (11), the study by Kubiszewski et al for knowing about the credibility of Internet encyclopedias (12), the study by Helena Dryzek for studying the power of searching for the vocabulary items in the electronic version of encyclopedia of occupational health and safety compared with its printed version (13). And among the existing web-based encyclopedias, one can name proteopedia as a collaborative three-dimensional web-based encyclopedia about protein, nucleic acid, and other bimolecular structures (14, 15), ENCODE or the encyclopedia of DNA elements (16, 17), the online AskDrWiki encyclopedia (18), Ganfyd (19) and Radiopedia (20).

2. MATERIALS AND METHODS

First, with the help of an expert in linguistics and terminology and by searching the 2014 MeSH online, all the terms having been indexed under medical informatics were extracted. The keywords gathered in the first stage were reviewed; in this way, the tree diagram of the collected words was drawn, and these terms were compared with the ones existing in MeSH. The reason was to make sure about the correctness and wholeness of the collected terms. After the collection of these terms, the main and secondary terms were determined and translated into Persian. Then, the existing sources were studied to gather the scientific information related to medical informatics areas and terms. Using the studies conducted by the researchers, the tree structure (diagram) of the encyclopedia was drawn in the form of areas and terms.

3. FINDINGS

By searching and studying MeSH, the researcher was first trying to determine the terminology related to medical informatics. Therefore, following the researcher's searches, all the words put under Informatics in MeSH (2014) were extracted. This task started by searching the term "Informatics" and went on by looking into the hierarchical structure of MeSH terminology till the end of the tree diagram. (All these words and terms are given in Appendix 1). After extracting the preferred terms and determining the secondary ones related to each of them, a tree diagram was drawn to clarify the relationships among the words extracted from MeSH. This tree diagram was obtained considering the relationships existing among these words in MeSH (See Appendix 2). The extracted words were then translated from MeSH into Persian. The equivalent Persian words are taken from the two-volume "Persian Medical Thesaurus" (21) compiled by Fatemeh Rahadoust. For the words not found in this book, the researcher's translations were employed. It is to be mentioned that the three terms "Dental Informatics", "Nursing Informatics", and "Public Health Informatics" have no sub-branches in MeSH (See Appendix 2).

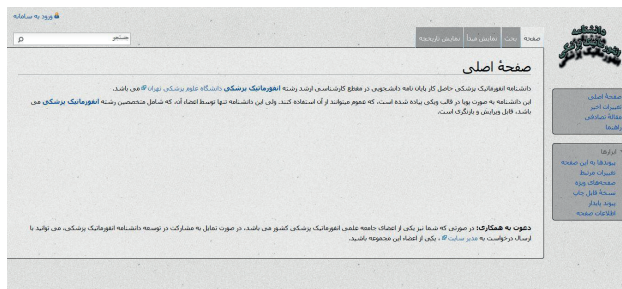


Figure 1. Medical Informatics Encyclopedia Main Page

The studies conducted by the researcher led to generation of Figure 1. This model is taken from the book "Public Health Informatics and Information Systems" (22) with minor changes.

After the extraction of words from MeSH, determination of preferred and substitute terms, and generation of the main body of medical informatics encyclopedia, designing a site for the implementation of encyclopedia was started. In designing the site, modules of Mediawiki Foundation, PHP language and CSS codes were used. Such a thing was done through manipulation and optional edition of Mediawiki Foundation modules using PHP language and CSS Codes by the researcher to create the desired form and design of the medical informatics encyclopedia.

4. RESULTS AND DISCUSSION

A lot has been done in the field of web-based encyclopedias in the world, and perhaps certain activities are being done just now; a simple search on the Internet can prove this claim. What has been done, however, has been outside the research domains and been just an effort by an individual, a group or an organization towards the creation of an encyclopedia for general and specific audience. Now what has been the result of their work is not clear for us; therefore, the activities which have been done in the field of creating or designing encyclopedias which have been the result of a research are not just

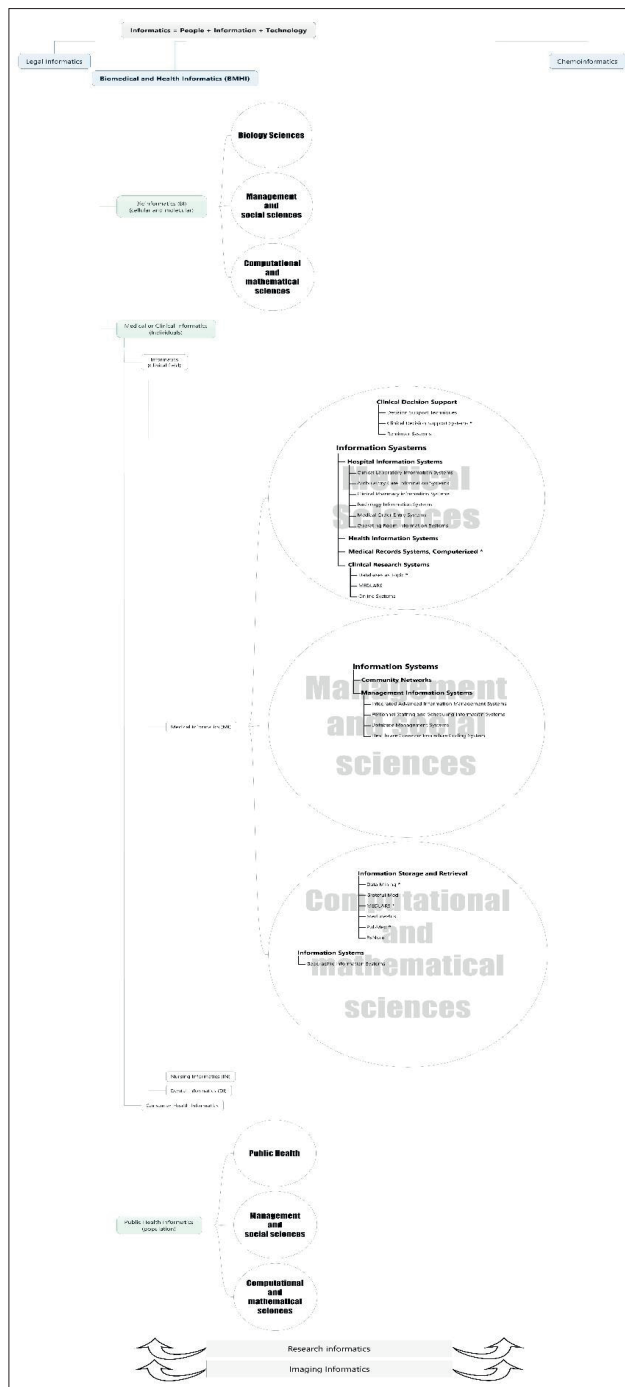


Figure 2. Informatics Diagram and the Related Domains Together with MeSH Terms (2014)

few; rather, they may not exist at all. Since the researcher could not find a work like the present study in the articles and bases he searched, the findings of the study are discussed in this section without making a comparison with other pieces of research, and then a conclusion is arrived at.

In this study, the preferred terms (Headlines) in the MeSH base are considered as the main terms of the medical informatics field. The list comprises 75 main terms and 249 secondary ones. The list of words derived from MeSH is so limited and does not include all the terms of medical informatics. That is due to the fact that many of the terms used in medical informatics, as an example, “telemedicine”, are not indexed under “Medical Informatics” in MeSH. However, this word is widely used in the field of informatics, especially medical

informatics. This could be due to the fact that the main goal of MeSH is to provide help for listing and indexing, and for easier storage and retrieval of information. In other words, the classification view in MeSH is mostly technical than specialized; therefore, the hierarchical structure presented in MeSH does not aim at classifying different sciences or putting them in different domains. Therefore, not all the words used in informatics can be found under this word in MeSH base. The collection of the words of medical informatics field showed that some of the words are repeated in more than one place in MeSH hierarchical structure, which means that a term cannot surely be attributed to only one of the existing branches.

To translate the MeSH terms, especially those having been indexed under the term medical informatics, unfortunately not many sources were found, except for the mentioned book. And since this book is based on the older version of MeSH, many of the words which exist in MeSH 2014 are not seen in the present book. And in this field, the need for valid sources like the mentioned book which matches the newer versions of MeSH is felt. Especially, considering the dynamism of such fields as informatics, it seems that activities like this can be much valuable and can pave the way for researchers and users of MeSH in Iran.

After the main and secondary terms of medical informatics in MeSH were determined, a link was established between these terms so that by searching each of the secondary terms (whether in Persian or in English), it would be linked with the main word and the related materials would be shown. This link was made both for the English terms and for the equivalent Persian terms. In other words, since the medical informatics encyclopedia is designed in Persian, the Persian term is considered as the main term in each group. In other words, all words including the main word in English are linked with the equivalent Persian word. This term is put in the column for Persian Equivalent at the beginning of each line in Table 1 (Appendix 1).

The studies done by the researcher revealed that the tree diagram of MeSH words had a weak trunk for the future development of the encyclopedia because the informatics domains had not been appropriately considered and/or certain domains had not been considered at all. This is also true about the classification of terms. So most probably, such a thing will lead to vagueness and weakness in the future development of the encyclopedia. Therefore, as it can be seen in Fig. 1, informatics is the sum of three topics of individuals, information, and technology, which is divided into three main groups “Legal Informatics”, “Chemoinformatics”, and “Biomedical and Health Informatics (BMHI)”. The BMHI itself is divided into:

- Bioinformatics which is related to the application of informatics in the field of biology and cellular and molecular studies,
- Medical/Clinical Informatics which deals with the application of informatics in personal health, and which includes Clinical Informatics and Customer Health Informatics,
- Public Health Informatics (PHI) which refers to the application of informatics in public health.
- Medical Informatics, Bioinformatics, and Public

Health Informatics have all emerged from the convergence, mixture, and application of three main scientific branches including biology and health sciences, management and social sciences, and computational and mathematical sciences. Here, “management and social sciences” refer to the management of business, human resources, and organizational behaviour; and “computational and mathematical sciences” refer to computer sciences, information technology, and statistical sciences. In fact, the difference among medical informatics, bioinformatics, and public health informatics is the domain of health on which they have concentrated. In other words, the main difference among these three branches of informatics is summarized into biology and health sciences. Medical informatics is active in the field of medicine, bioinformatics in biology and general health informatics, and public health informatics in public health. It is quite clear that this issue is also correct about other fields of informatics.

Since bioinformatics, medical/clinical informatics, and public health informatics are the three main fields of health and medical bioinformatics, the main domains of these fields are referred to in Figure 1. However, only medical informatics is discussed in detail because the following research is mainly on medical informatics. The two fields of imaging informatics and research informatics, drawn at the bottom of the graph in Fig. 1, are in fact the fields of informatics which have common application in all domains of informatics including bioinformatics, clinical informatics, public health informatics, and so on. They are not put into a special group; therefore, they are brought separately at the bottom of the graph. It should be mentioned that all terms in Figure 1 which are marked by asterisk includes the following categories and subcategories, but they have not been shown in the figure due to avoid overcrowding.

One of the most basic structural pillars of an encyclopedia is choosing entries. Choosing entries is as important as the existence and proper functioning of parts for the performance expected from a system. Choosing suitable entries helps to create a bright and lasting structure. The importance of this issue becomes apparent especially in medical sciences where a concept is sometimes expressed by several words or expressions. The issue is also of importance from the viewpoints of accumulation of subject matters or abundance of information. Because if care is not taken in the choice of a suitable entry, chances are that a concept be placed under different topics and different points in the tree diagram; such a thing may lead to confusion both in structure and in concepts and will make the future development of the encyclopedia more difficult. In addition to the choice of entries, another point of importance here is the place of each entry in the encyclopedia's tree structure because it will help to prepare the encyclopedia's tree structure and make easier the task of classifying the domain and terms and the future development of the encyclopedia.

Coordination of structural components is an important determinant in strengthening the encyclopedia and giving it a valid and scientific form. Therefore, it determines the structure, groundwork, and power of an encyclopedia, and if this foundation is made with sufficient care and more delicacy, the

future development of the encyclopedia will be easier. This task is of great importance especially in encyclopedias of such specialized fields as medical informatics in that the borderline between terms and between domains becomes clearer due to it.

The effort to compile specialized encyclopedias requires team-work and the use of specialists' collective wisdom, and is a trans-generational issue; and as long as the limits and borderlines of a science are not determined — although it seems to be an arduous and at times impossible task — expecting completely specialized encyclopedias to be formed is quite far-fetched. Considering the interdisciplinary nature of medical informatics and the involvement of different domains of science in this field, the issue has changed into a tangible task to the point that there is no consensus at present over the exact borderlines of this field in the world, and as a result, the field has been defined differently by specialists from its birth to the present time.

It cannot be ignored that there is a long way ahead before general uniform principles in encyclopedias are arrived at, especially now that all things — even words — are moving towards being standardized, and standardizations have changed into an everlasting worry. Moving towards the standardization of encyclopedia compilation principles also seems to be essential and should be considered. And finally an encyclopedia should try to provide its user with the desirable answer in the shortest time, at the lowest cost, and requiring the least amount of energy. Such a thing is possible only with a movement towards designing similar patterns in designing encyclopedias.

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CONFLICT OF INTEREST: NONE DECLARED.

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