



# Medical and Biomedical Information Research System Model: Emphasizing the User's Point of View

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## Abstract

**Objective:** In order to increase investment in medical and biomedical research particularly in developing countries the need for visibility of research outputs is very important since this would lead to more investments and more researches within the country. Medical and biomedical research information system utilizes computers and communication equipments that allow collection, storage, processing, exploitation and dissemination of research information in Medical and biomedical field. One of the most important success criteria for an information system are the users' comments, therefore, this study is aimed to investigate the users views regarding the medical and biomedical research information system in the country.

**Materials and Methods:** This is a comparative descriptive study in which the proposed model for the national information research system in the domain of medical and biomedical was initially prepared basing on comparison then the applicability of the model to meet users' needs was presented for final evaluation in the form of a survey to 40 users which were selected based on convenience sampling. A questionnaire was the tool used for gathering the data. The reliability and validity of the questionnaire was approved by a Cronbach alpha reliability of 94%. Descriptive statistic was used for data analysis.

**Results:** Results of the survey conducted on users indicated that all of the participants with the majority of items and categories presented in a designated five axes had a unanimous consensus and no item has been opposed. Also, cases such as the presence of educational system, researchers' evaluation system, automatic identification of research priorities and the process of integrating research outputs into industry were taken into consideration.

**Conclusion:** For the success of the system, all stakeholders involved in medical and biomedical research must coordinate in determining priorities, creating health research networking and in strengthening the overall capacity of the network and in collecting the baseline data. Assessment of tools and the stages of research implementation with corporate and national supervision, must comply with international scientific and ethical standards.

**Keywords:** Research information system, Medical informatics, Biomedical information, User-computer interface, Iran

## Introduction

The degree of accessible information as part of the current state of knowledge is growing in a quick and voluminous uncontrolled manner. Innovations in industry and services have pushed academics in the boundaries of research and development. Decision-makers and government policy-makers and research centers need to have easy access to research data (1,2). Therefore, the potential for exchange of information must be published in order that users will be able to access uniform information and research data through the same user interface (2,3).

In recent decades, designing an integrated research system aimed at increasing investment in medical-biomedical research especially in low and middle income countries has been raised. However, factors such as the little understanding of communication and the quality of medical-biomedical researches, poor visibility of outcomes and difficulties in keeping track of common areas and the

return of investment in the domain of medical-biomedical research, and lastly, the attempts for additional investments in medical-biomedical research in these countries has been questioned (3-5).

Collection of data in separate systems has resulted to duplication of efforts, inconsistencies and gaps in accessing information. With the development of national programs, the country's need for an integrated information system to provide accurate information in a timely manner has become apparent and in this manner enabling program planning and evaluation of inequalities in the provision of available services can be identified in a quick and timely manner (6,7) Quotations from Nixon and Sheppard, Joint Information Systems Committee (JISC) in the report, "Some of the key concerns and problems of researchers in this field is the lack of equal access to scientific resources and it takes a great deal of time in finding research data" (8,9). As Keith Jeffrey suggests, the ultimate need of us-

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ers is the access to relevant information in the right place and in the right time and in an appropriate form (10). In considering today's competitive environment, having the right information in order to take advantage of investment opportunities is vital for the scientists (11). With an increase in interdisciplinary researches and a new era of research, if the needed help will not be made available to researchers and administrators in order to view a larger image of research, the country would suffer a great loss (12). In this case, the presence of appropriate and powerful senior managers in the process of implementation would bring about balance between the demands in different groups of consumers (13).

Regarding the importance of the role of users in the success of the information system, several studies have been conducted (14) and in the majority of these studies, human factors whether individually or as a group has been indicated to be very important and played a decisive role. In one of this study which was conducted by Delon and McLean, they identified one of the most important criteria for measuring the success of an information system in relation to the users.

The main question that arises in this context is: how to design a research environment compatible to the needs of the users and how to make a significant progress within the country (15). Therefore, this present study is aimed to evaluate the research information system in the domain of medical-biomedical from the users and consumers point of view and design comprehensive model consistent to their needs.

## Materials and Methods

This comparative-descriptive study was conducted in the years 2010-2011 in Iran. Initially, in order to select the country to be evaluated, countries having national information research system in the domain of medical-biomedical were identified and based on the extent of information researches coverage and more availability of English documents, one country in each of the four continents (America, Australia, Europe and Asia) was randomly selected. Therefore, the national medical-biomedical information research systems in the countries such as America, Australia, the Netherlands, and Japan and the existing old health information research system in Iran were studied. It is important to note that characteristics of the national medical-biomedical information research systems of these countries were compared based on the following 5 axes:

1. Structure of national medical-biomedical research information system,
2. Contents of the national medical-biomedical research information system,
3. Methods of data collection,
4. Services and capabilities,
5. Method of notification and dissemination of the national medical-biomedical research information system.

In order to compare the national medical-biomedical in-

formation research system in selected countries a checklist was used. After comparing the similarities and differences of these chosen systems, a model for a new national medical-biomedical information research system was prepared. The validity of the proposed model was confirmed through qualitative evaluation of scientific literature and related researches and also, through consultations with professors and experts. Finally, applicability of the proposed model was presented to the users for final evaluation using the convenient sampling. The study sample in this stage includes 40 Masters and PhD students enrolled in medical informatics and health information management in the year 2010 and 2011 at Tehran University of Medical Sciences, which from among 40 study sample 31 persons participated in the study.

Tool used in collecting the data for the purpose of verifying the proposed model by end users was a questionnaire composed of two parts; the first part which is the demographic information of the students (name and family name, course of Study, professional degree) and the second part involve 9 closed questions in the format related to the axes of the final model. In order to improve the questionnaire and confirm its validity, the questionnaire was distributed to 5 IT experts and in order to establish the reliability of the questionnaire, the Chronbach alpha was used. In order to analyze the reliability of the questionnaire, the total score considered for the entire questionnaire was 94% considering the appropriateness of the Chronbach alpha (0.7) of the scientific community results obtained represents higher validity of the questionnaire. For data analysis regarding the final approval of the proposed model by end users, the descriptive analysis was used (frequencies and percentages). In general, the stages in the implementation of this project include the review of existing documents and articles of the chosen countries, determining similarities and differences of the components of the medical-biomedical information research system, designing the initial proposed model based on comparative approach, implementation of meeting of experts for the purpose of finalizing the model and analyzing the strengths and weaknesses, threats and opportunities of the model and finally, the evaluation of the users in terms of the model's practicability.

## Results

The proposed model for the national medical-biomedical research information system is composed of five main axes and each axis include 1) The trustee responsible for organizing the final model of Iran's national medical-biomedical research information system are the Ministry of Health and Medical Education and the Ministry of Education in cooperation with the private sector with an area of coverage that include Medical Sciences, Basic Sciences, Engineering and Humanities, 2) contents of the new portal include; research projects, theses and dissertations, books, research articles, maps, indexes, data collection, organizations, speeches, inventions, honors and awards, workshops, researchers, journals, conferences, techni-

cal reports and computer products, 3) for the purpose of collecting data for the mentioned system; abstracts, open archives and protocols for metadata harvester and centralized hierarchical architecture was used, 4) system's services and capabilities including: information database, electronic resources (local and international), electronic library, citation information, portal users and program applications, cataloguing system, service provider reports, inventory, relation of repositories, news, subject category, template to export data, search, RSS-Tube, Twitter, Online Thesaurus, personalize, bibliographic database, multimedia, mash up, statistical services, anonymous, translation access policy and quality assurance services and 5) possibility of disseminating information through portals, knowledge translation, reporting (new statistics), notifications on( conferences, news, ordering and presentation of online proof.

For users in both groups, the Master's and PhD students enrolled in management and medical informatics course in the year 2010 and 2011 at Tehran University of Medical Sciences were selected as the study group, from among the 31 participants 51.6% were females and 48.4% were males. 61.3% of the participants were Masters' students and 38.8% were PhD students, 38.7 were enrolled in Health Information Management while 41.9% were enrolled in Medical Records Technician course.

All participants in cooperation with the Ministry of Higher Education, Ministry of Health and Medical Education and the private sector all agreed to be the trustee of the national medical-biomedical research information system. Also, 80.6% of students requested for complete and comprehensive topic coverage of the proposed model while 19.4% of the subjects expressed that the topic of coverage of the proposed system should be exclusive to medical sciences.

With regards to the second axis of the proposed model, all participants agreed to the inclusion of articles, conference papers, books, Master's theses, PhD theses, research projects, seminars and conferences, journals, researchers and faculty members, workshop training, inventions and speeches to the proposed system. Meanwhile, data collection having an 80.6% of maps, indexes, technical reports, appreciation and awards with 87.1% showed the least amount of agreement.

Regarding the third axis on this proposed model, all participants have unanimously agreed to the collection of abstracts as a method of gathering data followed by centralized architecture with an approval of 96.8%. Method of recording data directly on the web had an approval of 93.5% while the Open Archives Initiative Protocol for Metadata Harvesting had 80.6% respectively.

The fourth axis of the proposed model as shown in Table 1, includes a list of services and capabilities which was agreed by all participants and the list include; the system's use of 2 languages, databases, internal electronic resources, electronic library, portal users and program applications, access policies and access rights, search, carry out all online orders and distribution of data. Web analysis and

reference tool Zotero with 77.4 % had been given the least attention by the participants in this study.

Also, 100% of users have completely agreed to simple and advanced searches and the use of Boolean operators. The use of the service Mash up with an 80.6% has been chosen by the participants as the least service needed for the proposed model while the possibility to search by product number and the ownership number has been agreed by 83.8 percent of participants.

With regards to the fifth axis of the proposed model, conclusion can be made based on table 2 in which majority of the participants 96.8% in this present study have agreed to use all methods considered in this proposed model to disseminate information.

In designing the portal for the national medical-biomedical research information system, features such as Home, About us, membership, simple search, advanced search, general rules for online use (copy right, responsibilities), contact us, comments, news, what's new, visual reports, national library, catalog cases, registration and sending documents, Subject Index and indexes, bilingualism, method of ordering resources, statistics and reporting and ranking system, cataloging, data harvesting, data export format, personalization, article database, books database, theses database, research projects database, technical reports database, conference and conventions database, journals database, researchers and faculty members' database, workshops training database, inventions database and database on speeches were unanimously agreed by all participants also the participants have suggested the inclusion of the following items: the presence of the educational system, researcher evaluation system, automatic identification of priorities in research and the process of using research products in industries to be added to this proposed model.

## Discussion

As an overview of the results of the survey conducted on Master's and PhD students in the field of Medical Informatics and Medical Records and Health Information Management, School of Management and Medical Informatics, Tehran University of Medical Sciences, it is evident that all participants in the majority of items and categories presented in five areas designated had a unanimous consensus and absolutely no opposition has been given with regards to the item being considered. The structure of National Information Research System is designed in a way that government institution(s) would be acting as its trustee and the area of coverage will be on medical sciences, humanities, engineering, social sciences and etc., and the results of the survey conducted on the users have also confirmed the above issue. Also, in Italy, in order to have an integration between repositories of scientific publications management systems, the National System with the cooperation of the Ministry of Education and Research and the support from the universities and research centers was created and this finding is consistent with our present study (16). Also, in the study to evaluate the importance

**Table 1.** Users' Point of View Regarding the National Medical-Biomedical Research Information System's Services and Capabilities

Items	Agree		Not Comment		Disagree		None	
	No.	%	No.	%	No.	%	No.	%
World News broadcast on the Internet	29	93.5	2	6.5	-	-	-	-
Bibliographic database	30	96.8	1	3.2	-	-	-	-
Distribution and entities management	30	96.8	1	3.2	-	-	-	-
Carry out all online orders	31	100	-	-	-	-	-	-
Anonymous	29	93.5	2	6.5	-	-	-	-
Warning	29	93.5	2	6.5	-	-	-	-
Service Provider reports	29	93.5	2	6.5	-	-	-	-
Multimedia	30	96.8	1	3.2	-	-	-	-
Receipt and billing	26	83.8	5	16.2	-	-	-	-
Search	31	100	-	-	-	-	-	-
Management of fax and e-mail distribution	29	93.5	2	6.5	-	-	-	-
Meta data registries	30	96.8	1	3.2	-	-	-	-
Statistical Services	30	96.8	1	3.2	-	-	-	-
Relation of Repositories	29	93.5	2	6.5	-	-	-	-
Indexes / collections	30	96.8	11	3.2	-	-	-	-
Access policies and access rights	31	100	-	-	-	-	-	-
Quality Assurance Services	25	80.6	3	9.7	-	-	3	9.7
Portal users and programs applications	31	100	-	-	-	-	-	-
Citation information	30	96.8	1	3.2	-	-	-	-
Electronic Library	31	100	-	-	-	-	-	-
Internal electronic resources.	31	100	-	-	-	-	-	-
External electronic resources	30	96.8	1	3.2	-	-	-	-
Databases	31	100	-	-	-	-	-	-
Cataloguing System	29	93.5	2	6.5	-	-	-	-
Templates to export data	28	90.3	3	9.7	-	-	-	-
twitter	29	93.5	2	6.5	-	-	-	-
RSS	30	96.8	1	3.2	-	-	-	-
Tube	29	93.5	2	6.5	-	-	-	-
Online Thesaurus	28	90.3	3	9.7	-	-	-	-
Subject classification	29	93.5	2	6.5	-	-	-	-
Personalize	28	90.3	-	-	-	-	3	9.7
End note	29	93.5	2	6.5	-	-	-	-
Bibtex	25	80.6	-	-	-	-	6	19.4
zotero	24	77.4	5	16.1	-	-	2	6.5
National distribution of Google Scholar	26	83.6	5	16.1	-	-	-	-
Bilingual	31	100	-	-	-	-	-	-
Translation	29	93.5	2	6.5	-	-	-	-
Mash up	25	80.6	6	19.4	-	-	-	-
Webometrics analysis	24	77.4	7	22.6	-	-	-	-

**Table 2.** Methods of Information Distribution of the National Medical-Biomedical Research Information System From the Users' Point of View

Items	Agree		Not Comment		Disagree		None	
	No.	%	No.	%	No.	%	No.	%
Production and delivery of documents online	31	100	-	-	-	-	-	-
Online ordering system	31	100	-	-	-	-	-	-
Portal	31	100	-	-	-	-	-	-
Statistical reporting	30	96.8	1	3.2	-	-	-	-
Reporting of new cases that are added to the system	30	96.8	-	-	-	-	1	3.2
Information on seminars, research opportunities, workshops, and other research priorities	30	96.8	-	-	-	-	1	3.2
News Provider and What's New	31	100	-	-	-	-	-	-

of the prerequisites for establishing the system from the user's perspective, majority have emphasized on factors that are related to management, allocation of resources and acculturation; meaning the acceptance of the system

from the management and user levels of the organizations concerned (17). Basing on the users feedback, they emphasized on the following items such as; article components (magazines, business, conference), books, theses



(bachelor, master, doctoral and postgraduate), workshops, research projects, resume or CV, researchers and faculty, inventions, lectures, organizations and universities, databases, computer products, technical reports, seminars and conferences, journals, appreciation and awards, data collection, indexing and maps to be included among the contents of the proposed model. Also, this present study is consistent to the core of the research information system of the Karolinska Institute of Technology that includes publications, research competencies, research projects, patent registration and technologies (18). Norway research documentation system (Frida), which has five modules: (research results, research project catalog, list of researchers, lists of institutions and annual reports) is consistent in several aspects with the present study (19). The centralized hierarchical method to be used in this proposed study was approved by the users in a way that the concentration of information was created in a hierarchical way for the purpose of lessening the central system's load and the methods of control and supervision of received information will be in accordance to the administrative research system providing a ground for more flexibility. In 2006, Oh and his colleagues designed a successful comprehensive system comprising of features to integrate and to focus systems in such a manner that while having all the information, at the same time the burden of the system is being reduced (20), also, in study of Chelsom and colleagues, the use of harvesting protocol in clinical research information system using XML has been considered which is consistent with our present study (21). In this present study, users, in considering that identification is the most common feature used in the evaluation conducted, they have further stressed on 38 services to be integrated into the proposed system. Joint in 2008 (22) and Scholze et al in 2012 (18) in their study have stated the possibility of automated data export and import and have cited repositories as a great advantage in research information systems which is consistent with our present study. Nadkarni et al has stated in their study regarding a biospecimen data management system intended for multi-center collaborative clinical studies that involved shipment of biospecimens between the sites which is inconsistent the results of our study (23).

Users have emphasized the use of the following features such as; transactions, Booleans, limitations, methods of viewing results, types of sorting and presentation of geographic data on the search section of the proposed model. In another study conducted, features such as the possibility of limiting search results based on language, date and title, organizing search results based on relevance and date has been suggested for their search engine (24) which is consistent with our present study.

In the proposed model, features such as reports of new cases, notifications about seminars, fellowships, workshops and priorities of research and knowledge translations were also emphasized by the users. Leskosek, has raised the issue on the possibility of distant publication of data on clinical researches with a user-friendly online

system (25), this study was inconsistent with our present study in terms of security issues. Avital and colleagues has expressed that in order to improve the current state of information systems creating a comprehensive portal for research articles and researches, capability of being multi-lingual, permanent address for each article, use of metadata standards in order to perform advanced search and automated notifications must be integrated into the system (26).

Without doubt, in order to increase the participation of all stakeholders in medical-biomedical research they must be involved in setting priorities for research system, create a medical-biomedical research network and enhance the overall capacity of the network and to pursue basic data collection meanwhile, evaluation of tools and stages in implementing research must be in compliance with international scientific and ethical standards and must be considered in accordance to the national corporate governance policies.

### Ethical issues

All ethical considerations have been observed in this study.

### Conflict of interests

The authors declared no conflict of interest.

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### References

1. Honegaar A, van Meel M, Dijk E. What are your information needs? Three user studies about research information in the Netherlands, with an emphasis on the NARCIS portal. <http://elpub.architexturez.net/doc/oai-elpub-id-120-elpub2010>. Published 2010.
2. Mark G. Social foundations for collaboration in virtual environments. Access to knowledge: New information technologies and the emergence of the virtual university. 2001:241-63.
3. Rani M, Bekedam H, Buckley BS. Improving health research governance and management in the Western Pacific: a WHO Expert Consultation. *J Evid Based Med*. 2011;4(4):204-213.
4. Spyns P, Van Grootel G, Jörg B, Christiaens S, editors. Realising a Flemish government innovation information portal with Business Semantic Management. CRIS; 2010.
5. Ghorbani N, Ahmadi M, Sadoughi F, Ghanei M. Developing data elements for research information system in health; a starting point for systems integration. *Iran J Public Health*. 2012;41(12):30.
6. Sheppard N. Learning How to Play Nicely: Repositories and CRIS. Ariadne. 2010. <http://www.ariadne.ac.uk/issue64/wrn-repos-2010-05-rpt>.
7. Ghorbani NR, Heidari G, Noot R, Fakour Y, Meraji M. Research information system in health domain: comparative approach. *Crescent Journal of Medical and*

- Biological Sciences. 2015;2(3):81-86.
8. Jeffery K, Asserson A. Institutional repositories and current research information systems. *New Review of Information Networking*. 2009;14(2):71-83.
  9. Nixon W. Enrich: improving integration between an institutional repository and a CRIS at the University of Glasgow. In: Stempfhuber M, Thidemann N, eds. *Connecting Science with Society: The Role of Research Information in a Knowledge Based Society*. Aalborg, Denmark: Toptryk Grafisk ApS; 2010:55-64.
  10. Jadad AR. Promoting partnerships: challenges for the internet age. *BMJ*. 1999;319(7212):761-764.
  11. Tomlin R, editor. *CRIS and The Challenge of New Research Paradigms*. 2000.
  12. Kaplan B, Brennan PF, Dowling AF, Friedman CP, Peel V. Toward an informatics research agenda. *JAMA*. 2001;8(3):235-241.
  13. Ali BM, Younes B. The impact of information systems on user performance: an exploratory study. *Journal of Knowledge Management, Economics and Information Technology*. 2013;3(2). <http://www.scientificpapers.org/economics/the-impact-of-information-systems-on-user-performance-an-exploratory-study/>.
  14. Van Der Meijden M, Tange HJ, Troost J, Hasman A. Determinants of success of inpatient clinical information systems: a literature review. *J Am Med Inform Assoc*. 2003;10(3):235-243.
  15. Parinov S, editor. *A CRIS driven by research community: benefits and perspectives*. CRIS; 2010.
  16. Šulík P. NARCIS-National Academic Research and Collaborations Information System, Holandsko. 2010.
  17. Snyder-Halpern R. Indicators of organizational readiness for clinical information technology/systems innovation: a Delphi study. *Int j Med Inform*. 2001;63(3):179-204.
  18. Scholze F, Maier J. Establishing a research information system as part of an integrated approach to information management: best practice at the Karlsruhe Institute of Technology (KIT). *Liber Quarterly*. 2012;21(2):210-212.
  19. Lingjoerde G, Sjørgren A, editors. *Remodelling Frida—from institutional registration to common registration and responsibility across member institutions*. 10th International Conference on Current Research Information Systems; 2010.
  20. Oh WK, Hayes J, Evan C, Manola J, George DJ, Waldron H, et al. Development of an integrated prostate cancer research information system. *Clin Genitourin Cancer*. 2006;5(1):61-66.
  21. Chelsom JJ, Pande I, Summers R, Gaywood I, editors. *Ontology-driven development of a clinical research information system*. *Computer-Based Medical Systems (CBMS)*, 2011 24th International Symposium on; 2011: IEEE.
  22. Joint N. Current research information systems, open access repositories and libraries: ANTAEUS. *Library Review*. 2008;57(8):570-575.
  23. Nadkarni PM, Kemp R, Parikh CR. Leveraging a clinical research information system to assist biospecimen data and workflow management: a hybrid approach. *J Clin Bioinforma*. 2011;1(1):1.
  24. Bar-Ilan J. Expectations versus reality—Search engine features needed for Web research at mind. *Cybermetrics*. 2005;9(1).
  25. Leskosek B, editor. *A clinical research information system: an example of prospective observational study in oncology*. *AMIA Annual Symposium Proceedings*; 2007.
  26. Avital M, Björk B-C, Boland RJ, Crowston K, Lyytinen K, Majchrzak A. ICIS 2008 panel report: open access publishing to nurture the sprouts of knowledge and the future of information systems research. *Communications of the Association for Information Systems*. 2009;24(1):30.

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