HEALTH INFORMATICS AND ITS INITIATIVES IN INDIA: AN ACADEMIC AND TECHNO—MANAGERIAL CONTEXT

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Abstract

Health Informatics is a domain of interdisciplinary in nature. Health Informatics in professional context is the computation and information management applications in the health and medical related purpose. The practice of Health Informatics quite old but still in many countries the Health Informatics practice in initial stage. There are many reasons for the situation which include the proper management, Governmental initiatives, educational opportunities, research and innovation in the areas and so on. India hold second largest population base in the world and thus there are many health and medicinal requirement. Health and Medical Informatics has the potentiality to improve information systems in the Heath care settings. This paper is deal with several aspects of Health Informatics which includes the basics of Health Informatics; its characteristics, need and role. Health Informatics and allied domains are still limited in Indian educational institutes and thus such aspects with potentialities have been depicted. Moreover, paper is also highlighted to role of the Health Informatics in Indian context.
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INTRODUCTION

Medical Informatics is a kind of discipline and systems which is deals with the systematic and scientific processing of data, information, knowledge in the field of health and medical systems. Initially Health Informatics or Medical Informatics both deemed as a same domain but gradually the advancement of science and research have been revealed that the Health Informatics is much broader than Medical Informatics [1]. Health Informatics is an interdisciplinary domain responsible for managing and dissemination of the information for health and medical segment. Gradually the Health Informatics become more interdisciplinary and have good collaboration with other domains such as—Information Science, IT, Computing, Medical Science, Management Science. The practice of the Medical Informatics and Health Informatics no doubt boost the medical and health systems of any country or territory [2]. Medical and Health Informatics whatever needs proper planning and implementation to get solid and first response.

OBJECTIVES

The main and core objectives of this paper is includes but not limited to the as follows

- To know basics about the Health Informatics and Medical related aspects.
- To know about the Health Informatics and its basic areas and domains.
- To learn about the Health Informatics for the solid development in the healthcare and medical segments.
- To know about the SWOT from the Health Information Science education in the world and around the world.

- To know the current status of the Health and Medical Informatics in India and future potentials in academic context.
- To dig out the current educational programs in the field of Health Informatics, Medical Informatics, Medical Information Sciences etc in the Post Graduate, Bachelor, Masters level.

METHODOLOGIES

The main aim of this paper is to find out the latest on Health Informatics in academic and practice perspective. Thus several theoretical research methodologies have been used. The review of literature played an important and valuable role for the collection of secondary data and also primary data. The websites have been analyzed to get the knowledge of the Health Informatics and Health Computation in India. Paper is highlighted with academic possibilities and thus official website of Indian Association of Medical Informatics (IAMI), Ministry of Human Resource Development, UGC and their link have been analyzed to prepare the report. Currant journals related to the Health Informatics, Computing, Tele–Medicine have been consulted. Moreover the websites, case studies of few specific hospitals have been conducted.

HEALTH INFORMATICS FUNDAMENTALS

Health Informatics is a kind of domain which is dedicated to the information and technology solutions to the healthcare and medical settings. It is a novel discipline bridging the Health and Information Science. It is a blend of technology, management and informatics in concentration of the healthcare and medical sciences [3]. In a different context, Health Informatics is deemed as a scientific medical domains as like other available medical fields (and with the degree of MD/DM Doctor of Medicine) such as Surgery, Internal Medicine, Epidemiology or Microbiology. The discipline is a cross discipline or cross sectional discipline. Health Informatics is similar with some other domains such as Medical Information Science, Medical Information Systems etc [4]. Some of its sub fields are Nursing Informatics, Clinical Informatics, Hospital Informatics and so on. Its ultimate role has been provided in Fig: 1.

HEALTH INFORMATICS AND INDIA

Health Informatics in India started in the late of 1960's and mainly in 1970's. In the year 1971 the MEDLINE was established and which was the remarkable moment of the Health Informatics journey in India [26], [37]. The HELLIS i.e. The Health Literature, Library and Information Service was established in India in the year 1979. However its core and main functioning was started in the later. The most major computing and informatics firm was established as the National Informatics Centre (NIC) and popularly called as NICNET. This NIC and NICNET played a great role during the initial age of the health information development [25], [38], [39]. Later on the NICNET and MEDLINE played an wonderful role for the developing the health related database. The joint venture of ICMR-NIC was noted in the year 1986 [5], [11]. However due to the limited awareness and popularity the programs was not sustain and failed.
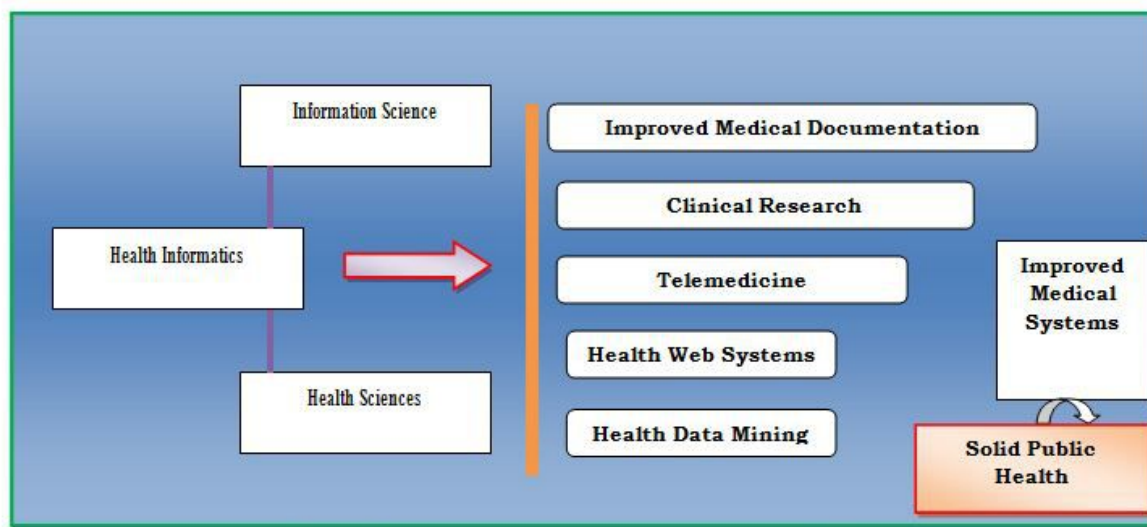
Fig: 1- Health Informatics and its core role at a glance

However the development of solid Health Informatics practice was started in the 1990's. In the 1993 the National Informatics Centre again started as a Health Information Network and initially with over 200 centers. Gradually, it was started its medical related database collection and formation. Within the few years it touches collection of 160 countries. The main benefit and advantages of this project was including the collection of bibliographical data collection. Moreover it also offers the full text data and also the internet facilities [7], [8], [13].

The solid grounding of Medical and Health Informatics was also started in the initial and gradual role of the National Medical Library is the top most Health Information Dealing organization in India and comprises with the formal Health Care Network. [6], [9], [12] And which should be consisted with the medical colleges, hospitals, clinical centers, dental centers and so on. India is suffering from Health Informatics related problems which include

- Better and improved task management [15], [41].
- The less awareness and popularity of the Health Informatics programs.
- Problems related with the proper funding and finance are also main problem in India for solid Health Informatics practice [10], [16].
- Initially the Health Informatics program needs the initial development phase and task in proper digitalization and integrating technologies [18].
- Like any other fields the Health Informatics is handled by the educated professionals and there is a shortage of qualified manpower in this segment. Thus we need to prepare the manpower in this regard [29], [40].

HEALTH EDUCATION, HEALTH INFORMATICS AND INDIA
Health Education in India comprises with the medical and allied health science programs. The medical degrees are offered with the MBBS nomenclature and for 5.5 years of duration with internship. The Post Graduate program is offered with the MD Degrees and there many specializations are offered. Similarly then the DM (Super Specialty) programs have been offered in many medical and allied Health Science colleges. The Health Informatics programs not at all offered in MD level or PG level as like other Health Science specializations like community medicine, family medicine etc. Though there is a huge potentiality to offer the program with such specializations. However the Health Informatics programs in India is offered with the MSc level with specialization of Health Informatics and Medical Informatics [14], [15], [30].

The Amrita Institute of Medical Sciences in its initiative of Medical Informatics and Multimedia Education (IMIME) offered 2 years MSc Degree in Medical Informatics. It is also offers the one year PGDMI (Post Graduate Diploma in

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Medical Informatics). A solid Medical and Health Informatics degree will be possible with the professionals from the diverse background and which include the physicist, IT and Computing expert, Management components etc to make the programs much more healthy and interdisciplinary. Similar program also offered at the Manipal University, Karnataka with the program of the MSc Health Informatics [17], [31], [35]. The MBA program is also offered in some universities where Health and Medical Informatics are also taught. The another program at the College of Allied Health Science, Manipal University, Manipal Karnataka is offer an MBA (Health Information Administration). The another public health institute is also offers the Masters program in Health Informatics (MSc) at the Public Health Foundation of India (Indian Institute of Public Health), Hyderabad. They also offer the integrated MSc-PhD Health Informatics programs of 5 year duration [21], [22], [33]. The smaller duration programs are offered by the some of the institutes such as MedVersity (in association with Apollo Group of Hospitality), Foundation of Healthcare Technologies Society; New Delhi, School of Telemedicine and Bio Medical Information, Sanjay Gandhi Post Graduate Institute of Medical Sciences Lucknow; Uttar Pradesh, Centre for Development of Imaging Technology; Kerala, Osmania University; Hyderabad, Department of Telemedicine and Health Informatics, Mahatma Gandhi University of Medical Science and Technology; Rajasthan [37], [28], [36]. Details of some programs of related to Health Informatics offered at the Post Graduate Diploma level and Masters Level with institutes are depicted in Table 1 and 2.

Table: 1 The popular and running Masters Degree programs in Indian Institutes/Universities

Masters Program in Health Informatics	
Amrita Institute of Medical Sciences, Amrita University, Tamilnadu	MSc in Medical Informatics
College of Allied Sciences, Manipal University, Manipal, Karnataka	MSc in Health Informatics
College of Allied Sciences, Manipal University, Manipal, Karnataka	MBA- Health Information Administration
Public Health Foundation of India (Indian Institute of Public Health), Hyderabad	MSc-Health Informatics
Mahatma Gandhi University of Medical Sciences and Technology, Rajasthan	MSc- Health Informatics

Table: 2 Few Post Graduate Diploma programs in Indian Institutes/Universities

PGD Program in Health Informatics	
MedVarsity (in association with Applo Group of Hospitals)	Post Graduate Diploma in Medical Informatics
Amrita Institute of Medical Sciences, Amrita University, Tamilnadu	Post Graduate Diploma in Medical Informatics
Osmania University, Telangana	Post Graduate Diploma in Medical Informatics (Advanced)
Mahatma Gandhi University of Medical Sciences and Technology, Rajasthan	Post Graduate Certificate in Health Informatics
Mahatma Gandhi University of Medical Sciences and Technology, Rajasthan	Post Graduate Diploma in Health Informatics

HEALTH INFORMATICS: POSSIBLE PROGRAMS AND INDIA

Hence it is a fact that India needs healthy dealing with the introduction of the Health and Medical Informatics and related subjects and fields [23], [26], [32]. There are many possibilities and each of them are depicted as follows—

In Science Stream

The Health Informatics in India is mainly available with Science Degrees leading to BSc/MSc in Medical Informatics or Health Informatics. Though, the CSIR though it's University is also offers PhD (Science)-Health Informatics. Importantly all these programs are offered as Health Informatics degree [24], [25], [34]. Not a single universities offered Health Informatics Major/ Specialization/Honors. Thus it has potentialities with other programs, the Table: 3 depicted some of the possible programs in this regard.

Table: 3 Some possible Health Informatics programs in the context of Science domains.

Possible Bachelor Degrees	Possible Masters Degrees
BS/BSc- Health Informatics BS/BSc-Medical Information Sciences BSc- Information Technology (Health Informatics) BSc-Computer Science (Health Informatics) BSc-Computer Application (Health Informatics)	MS/MSc- IT & Health Informatics MS/MSc -Medical Information Sciences MSc- Information Technology (Health Informatics & Telemedicine) MSc-Computer Science (Health Informatics & Telemedicine) MSc-Information Science (Health Informatics) MSc-Computer Application (Health Informatics & Telemedicine)

In Engineering Stream

As far as Engineering Stream is concerned Health Informatics is absent, though it has tremendous possibilities as an Engineering program with the nomenclatures of BTech (Bachelor of Technology), BE (Bachelor of Engineering) etc. Importantly it may also offer as ME/MTech etc. Thus it is better to introduce such innovative programs. Learn more from the Table: 4.

Table: 4 Health Informatics domains Vis-à-Vis possible Engineering Degrees

Possible Bachelor Degrees	Possible Masters Degrees
BTech/BE- Health Informatics & Computing BTech/BE -Medical Information Sciences with Public Health BTech/BE - Information Technology/ Computer Engineering (Health Informatics) BTech/BE –Software Engineering (Health Information & Software)	MTech/ME- IT & Health Informatics MTech/ME -Medical Information Sciences & Cheominformatics MTech/ME - Information Technology (Health Informatics & Cloud) MTech/ME -Computer Science (Health Informatics & Tele-systems) MTech/ME -Information Science (Health Informatics) MTech/ME –Telecommunication Engineering (Telemedicine)

In Humanities

Humanities is deal with the human being and with the societal aspects, facets etc. The health is also a major concern. The possible and proposed programs in this segment have been depicted in the Table: 5.

Table: 5 Health Informatics fields in the Humanities and Social Sciences

Possible Bachelor Degrees	Possible Masters Degrees
BA (Health Information Systems) BA Public Administration with Health Informatics BA Public Health with Health Informatics BA Sociology with Health Informatics BA Social Work with Health Informatics BSW (Health & Medical Information Systems)	MA (Health Information Systems) MA Public Administration with Health Informatics MA Public Health with Health Informatics MA Sociology with Health Informatics MA Social Work with Health Informatics MSW (Health & Medical Information Systems)

In Medical Sciences
Health Informatics is fall under the domain of the Medical Science and there are many options to offer Health Informatics and related programs such as (as depicted in Table: 6)—

Table: 6- The proposed Health Informatics implementation in respect of Biological Sciences

Possible Bachelor Degrees	Possible Masters Degrees
MBBS (Health Informatics as a paper) BDS (Dental Informatics) B .Pharma (Pharma & Health Informatics) BSc-Nursing (Nursing & Health Informatics) BSc-Bio Technology (Tele Medicine & Health Informatics)	MD (Health Informatics Specialization) MDS (Dental Informatics) M .Pharma (Pharma & Health Informatics) MSc-Nursing (Nursing & Health Informatics) MSc-Life Science (Bio & Health Informatics)

In Management
Health Informatics is related with the Health Information Science as well as Medical Information Science and there are healthy possibilities to include or integrate Management Science (as depicted in the Table: 7).

Table: 7-Educational Strategies towards implementing Health Informatics in Management domain
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Possible Bachelor Degrees	Possible Masters Degrees
BBA (Health Informatics)	MBA (Health Informatics)
BBA (Health Information Management)	MBA (Medical Information Management)
BBM (Health & Hospital Informatics)	MBM (Health & Hospital Informatics)
B.Com (Computer & Health Management)	M.Com (Computer & Health Management)
	M.Com (Health Information Systems)

In Computer Application
Computer Application is the application of the computing and information technology in several settings and environments. Computer Applications programs are available with Post Graduate Diploma, Bachelors, Masters, Doctoral levels. It is easily accommodate Health Informatics or Medical Information Sciences into the program. The possible programs are (In Table: 8)—

Table: 8- The root for developing Computer Application with focus of Health Informatics.

Possible Bachelor Degrees	Possible Masters Degrees
BCA (Health Information Systems)	MCA (Health Information Systems)
BCA (Medical Informatics)	MCA (Medical Informatics)
BCA (Health & Telemedicine)	MCA (Health & Telemedicine)
	MCA (Medical Information Science)

FINDINGS

- Health Informatics is an interdisciplinary domain and combines with the facet and philosophy of arts, science and technology.
- Health Informatics is the broader domain than Health Informatics and among some of the popular areas are Health 2.0, Pharma 2.0, Nursing 2.0, Health Analysis, Health-Big Data Management.
- Health Informatics is still neglected in India due to the problem of unwillingness, government support and cooperation among the stakeholders.
- The domain/s of Health Informatics is lacking technological supports and integration of Cloud Computing, Human Computer Interaction etc.
- Health Informatics is mainly available in the Masters level in India with MSc degree. However the Health Informatics with focus of Humanities, Commerce, Technology.
- Health Informatics programs mainly available with mainly Health Informatics or Medical Informatics nomenclature/s. The nomenclature of Medical Information Science, Health Information Science, Pharma Informatics, Nursing Informatics etc are not offered.
- Most of the Health Informatics programs are offered by the Private Universities, Deemed Universities. Though not a single Government state/ central universities offering the programs.

SUGGESTIONS

- Government need to put better and healthy cooperation for smarter Health Informatics practice from the Health, Family Welfare and related departments and ministries. The NGOs and social welfare organizations needs proper steps.
- Universities, colleges, research centers requires proper initiatives for the promotion of Health Informatics and promotion of allied domains and fields. For this education from the several level needs to start.
- Initially if starting full-fledged Health Informatics or allied programs are tough then the specializations in the field may also be started.
- Professionals engage in the current Health Informatics projects in the healthcare settings, establishments etc needs proper contemporary training, seminars, workshop etc.
- Government and universities need to do activities on Health Informatics which including the initiation of the new age programs and research in the Health Informatics and allied fields.
- The 'Digital India' initiative may be focused on healthcare segment for producing new tools, systems and applications.

CONCLUSIONS

Today Health Informatics is one of the important and valuable aspects, tools and domain in health and medical segment. It is also a healthy and important domain in the healthcare science as well as medical science for advancement of research and development in Health Informatics and Medical Informatics. Health Informatics and its solid implementation no doubt will be helpful for healthy and sophisticated public health development; as it is deals with many stakeholders. The Health Informatics segment is growing in both academic in practice space as far as India is concerned. But it needs much empowerment and enhancement to meet modern advancement in healthcare. The educational institutes needs healthy planning, policies and their implementation for real and proper development of information technology, computing, information systems in the healthcare and medical space. India is one of the important developing nation and moving towards a develop nation thus overall development are most imperative.

REFERENCES

1. *Aarts, J., Peel, V., & Wright, G. (1998). Organizational issues in health informatics: a model approach. International journal of medical informatics,52(1), 235-242.*

2. *Cohen, E. B. (2004). Applying the Informing Science Framework to Higher Education: Knowledge Development, Management, and Dissemination. Konferencja Pozyskiwanie wiedzy i zarządzanie wiedzą (Proceedings of the Knowledge Acquisition and Management Conference) May 13-15, 2004 Kule, Poland.*

3. *Eysenbach, G. (2000). Consumer health informatics. British medical journal,320(7251), 1713.*

4. *Friede, A., Blum, H. L., & McDonald, M. (1995). Public health informatics: how information-age technology can strengthen public health. Annual review of public health, 16(1), 239-252.*

5. *Haux, R. (1997). Aims and tasks of medical informatics. International journal of medical informatics, 44(1), 9-20.*

6. *Hersh, W. R., Junium, K., Mailhot, M., & Tidmarsh, P. (2001). Implementation and evaluation of a medical informatics distance education program. Journal of the American Medical Informatics Association, 8(6), 570-584.*

7. *Hook, S. A. (2003). Teaching health informatics: designing a course for a new graduate informatics program. Journal of the Medical Library Association, 91(4), 490.*

8. *Kun, L. G. (2001). Telehealth and the global health network in the 21 st century. From homecare to public health informatics. Computer methods and programs in biomedicine, 64(3), 155-167.*

9. *Martin, S.B. (1998). Information technology, employment, and the information sector: Trends in information employment 1970–1995. Journal of the American Society for Information Science, 49(12), 1053–1069.*

10. *Michael Buckland and Ziming liu (1995).History of information science. Annual Review of Information Science and Technology vol. 30: 385-416.*

11. *Pau1, P.K., (2012) "Health 2.0: Powered By Web 2.0 and Cloud Computing Platform - Promoting Information Transfer Cycle (ITC) among Health Professional and others" International Journal of ESST, 2 (1/2), 1-8*

12. *Pau1, P.K., (2012b) "Medical 2.0: The tool for proper Information Transfer Cycle (ITC) among the Medical Professionals and Physician with special reference to its difference with Health 2.0" International Journal of FEE 4 (2), 183-190*

13. *Pau1, P.K., Ashok Kumar, Dipak Chaterjee (2012) " Health Informatics and its Practice: Emerging Domain of Information Science-Indian Scenario" in Current Trends in Biotechnology and Chemical Research, 2 (2), 83-87*

14. *Pau1, P.K., D Chatterjee, M Ghosh (2012) "Medical Information Science: Emerging Domain of Information Science and Technology (IST) forsophisticated Health & Medical Infrastructure Building — An Overview" in International Scientific Journal of Sports Science, 1 (2), -104*

15. *Pau1, P.K., D Chatterjee, M Ghosh (2012b) "Neural Networks: Emphasizing its Application in the World of Health and Medical Sciences" Journal of Advances in Medicine, 1 (2), 17-23*

16. *Pau1, P.K. (2013) "CFTRI- Knowledge Hub:The Wonderfil Information and Knowledge Resource Center of Food and Nutrition Science in India" in Abhinav National Journal of Science and Technology, 2 (3), 37-42*

17. *Pau1, P.K., M Ghosh (2013) "Web 2.0 and its Possible, Emerging and Future Domain Related to Health and Medical Sciences" Journal of Information Technology and Engineering, 4 (2), 51-55*

18. *Pau1, P.K., M Ghosh (2013b) "Cloud Computing and its possible utilization in Health and Hospital Administration" Journal of Business Management [JBM]- An International Journal, 5 (2), .147-152*

19. *Pau1, P.K., J. Ganguly, M Ghosh (2013) "Chemo Informatics: the Healthy Results of Information Science and Chemical Science Integration" International Journal of Computer Science Systems Engineering and Information Technology, 6 (2), 92-96*

20. *Pau1, P.K., (2013) "Food and Nutrition Information Systems in India: Challenges and Issues" International Journal of Computer Science and Knowledge Engineering, 7 (2), 134-138*

21. Pau1, P.K., J. Ganguly, M Ghosh, (2013) "Medical Information Science: Overview and a model curriculum of MSc-Information Science [Medical Information Science]" Submitted for Current Trends in Biotechnology and Chemical Research, 3 (1), 50-54

22. Pau1, P.K., (2013) "Web 2.0 and Social Networking in Pharmacy and Allied Medical Domain: An overview" International Journal of Marketing Theory, 3 (2), 137-143

23. Pau1, P.K., J. Ganguly, M Ghosh, "Chemical Information Management powered by Chemo-Informatics: Possibilities and opportunities emphasizing need and way in Academics and Universities" Submitted for Current Trends in Biotechnology and Chemical Research, 3 (2),

24. Paul, P.K., M. Ghosh, Dipak Chaterjee, (2014) "Information Systems & Networks (ISN): Emphasizing Agricultural Information Networks with a case Study of AGRIS" Scholars Journal of Agriculture and Veterinary Sciences, 1 (1), 38-41

25. Pau1, P.K., (2013) "Sports 2.0: the Emerging Dimension of Web 2.0- the sophisticated Electronic Information and Communication" International Scientific Journal of Sport Sciences: 2(1&2), 69-73

26. Pau1, P.K., (2014) "Medical 2.0 and Health 2.0: ContemporaryInformation and Communication Tool- A Conceptual Study" Journal of Advances in Medicine, 2(2), 67-74

27. Pau1, P.K.,, J. Ganguly (2013) "Medical and Health 2.0: Important and possible Interdisciplinary Domain of Information Science-Overview with possibilities, Challenges and Issues" In Scholars Journal of Applied Medical Sciences (SJAMS), 1066-1069

28. Pau1, P.K., (2013) "Nutrition Information Networks: Possible domain and Future Potentials" Scholars Academic Journal of Biosciences (SAJB), 1(6), 342-345

29. Pau1, P.K., (2013) "Web 2.0: emphasizing Pharmacy 2.0/ Pharmaceutical 2.0-Promising Interdisciplinary Information Science Field" Scholars Academic Journal of Pharmacy (SAJP), 2(6):476-480

30. Saracevic, T. (1996). Relevance reconsidered. Information science: Integration in perspectives. In Proceedings of the Second Conference on Conceptions of Library and Information Science (pp. 201–218), Copenhagen, Denmark: Royal School of Library and Information Science.

31. Saracevic, T. (1975). Relevance: A review of and a framework for the thinking on the notion in information science. Journal of the American Society of Information Science, 26(6), 321–343.

32. Saracevic, T. (1979b). An essay on the past and future of information science education. II. Unresolved problems of 'extemalities' of education Information Processing & Management, 15(4), 291–301.

33. Vakkari, S.P. (1996). Library and information science: Content and scope. In J. Olaisen, E. Munch-Petersen, & P. Wilson (Eds.), Information science: From development of the discipline to social interaction. Oslo, Norway: Scandinavian University Press.

34. Vickery, B.C., & Vickery, A. (1987). Information science in theory and practice. London: Butterworths.

35. Wersig, G., & Neveling, U. (1975). The phenomena of interest to information science. Information Scientist, 9, 127–140.

36. Yasnoff, W. A., O'Carroll, P. W., Koo, D., Linkins, R. W., & Kilbourne, E. M. (2000). Public health informatics: improving and transforming public health in the information age. Journal of Public Health Management and Practice,6(6), 67-75.

37. www.ugc.ac.in (Accesed several section on 05-08-2016)

38. www.aicte-india.org(Accesed several section on 05-08-2016)

39. www.mhrd.gov.in(Accesed several section on 05-08-2016)

40. https://en.wikipedia.org/wiki/Health_informatics (Accesed on 05-08-2016)

41. www.ischools.org