

Dental Informatics in India: Time to Embrace the Change

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ABSTRACT

Dental informatics is comparatively a juvenile and new field that has noteworthy potential for supporting clinical care, research, education and management. This field utilizes computer science, information sciences and the application of same to espouse dentistry. However, in the under-developed and developing countries almost most of the dentists are unacquainted about dental informatics, its goals, what it is capable of achieving and by what means they can get involved into it. Despite of emerging advances, certain conflicts also go along with it such as, professional under representation, security issues of the stored information due to universal access to computers high speed internet connections. Endnote software was used as resource material to collect literature which was carefully arranged in a synchronized way. Hence, the purpose of this review was to give an overall scenario of dental informatics, its applications, challenges and recommendations for further enhancement in this area.

Keywords: Bioinformatics, Dental care, Dental education, Information systems

INTRODUCTION

The renaissance in the field of Information technology has altered the society for good and will continue to do so in the future. The way, in which new generation of children grow up, companies do commerce, people shop and communities blend has changed considerably since the commencement of the information revolution. That revolution also has made its mark in the dental profession. Days are not far when computers will pervade virtually everything we do, from how we read our morning newspapers to how we formulate treatment options and decisions for our patients [1].

Informatics is derived from the term "Information Science", which implies collection, classification, storage, retrieval and dissemination of recorded knowledge treated as pure [2]. Even though there is advancement in every fabric of life but, unfortunately we are still holding highly inefficient health care system imaginable. We're still in an era where paper is used to write prescriptions. Nurses find it difficult to read the prescriptions that doctors have written. The pressing question is why we are so reluctant to prescribe with the help of computers and put the same on the electronic medical/dental records which can minimize the chances of error rates, helps in trimming down the long-term cost on our already ailing health care system, and creates potentials for job creation right now [3]?

Dental informatics is rationally a new field and is in the budding stage. It has immense potential for enhancing patient care at the clinical settings. Unfortunately majority of dentists are unacquainted of what dental informatics is, what its goals are, what it has achieved till now and how they can be a part of it [4].

Dental informatics may bring a wide range of applications and tools for clinical practice in terms of diagnosis of oral diseases, prescription, indications and contraindication of certain drugs in patients with specific conditions and many more. Dentists must keep a pace with such developments to make informed choices flawless. For health professionals it is increasingly hard to practice modern medicine without the right blend of information technologies.

Dental informatics is the application of computers and information science to improve dental research, education and management

[5]. According to Friedman "fundamental theorem" of informatics, it is considered as an appropriate use of technology so that it can be utilized to help professionals perform cognitive responsibilities better but not to mimic or replace human proficiency [3].

In the conventional method of record keeping 11% of laboratory tests are repeated, the reason being misplaced results, 30% of treatment orders are not documented, paper work absorbs 35% of physicians & nurses time, approximately 20-30% of national healthcare expenditures are spent on informational paperwork, around 50% of paper based medical records goes either missing or contain incomplete data [6].

A study among American dentists revealed that only 25 to 30% of dentists are using chair-side computers, infact approximately 90% of all dentists have computers in their offices [7]. Approximately 90% of all dentists have computers in their offices. Of those who use computers at chair side, very few of them use it to the fullest extent and potential, for example by doing and maintaining paperless patient charts or to evaluate clinical and therapeutic patient outcomes [8].

Once the hedge between the dentist and the computer system is resolved, the door for a whole swing of innovations such as decision support, real-time information diffusion, and continuing edification in the context of practice and collaboration will be opened [9].

In addition, it is becoming highly unlikely for the health professionals to face such patients who have not utilized information technology specific to their disease; which in turn could not have influenced their knowledge, attitude and health behavior. Thus health professionals should not only understand health informatics but also ensure these applications are developed, applied & evaluated properly. In depth understanding of dental informatics will help students, faculty and administrators appreciate how dental informatics can most productively help their efforts and how its methods can be exploited to lift up the state of the art in education, research, and patient care [4].

Although there are several reviews in the literature which explains what dental informatics is all about, still there is paucity of information about how to implement it especially in less developed countries. This review is an attempt to highlight the important

points of dental informatics and how it can be put into practice in a developing country like India.

HISTORICAL GLIMPSE

The word was coined in 1960's by the French as "informatique" it came from applied information science and concerned with science or technological communication and development of more efficient systems/techniques. It was popularized by Soviets as Informatika and now considered a branch of social sciences. France considered it to be applied computer science; U.S continued to use term "computer science". In the 1960s, "informatics" emerged as a distinct concept. For the first time it was Aleksei Mikhailov of Moscow State University who defined the term as the discipline that "studies the structure and general properties of scientific information including laws of all the processes of scientific communication" [10].

The birth of the term "Medical Informatics" took place in France and at the same time made its entry into the English literature in first half of era of 1970's. In 1986, "dental informatics" was first used in a MEDLINE-indexed publication [11]. Since 1997 funding started in the field of dental informatics and since then number of formally trained dental informaticians are slowly on the rise [4].

Importance of Health Informatics

Health informatics can be considered as *Logic of health care* as the way physiology is considered as 'physiology of life' and pathology analogous to 'logic of disease' [12].

It is a system which looks for the reason which we judge about our patients and the useful mode by which treatments are defined, chosen and evolved, the study of how clinical facts are created, shaped, shared and applied. Ultimately it is the method about how we systematize ourselves to productively create and run health care organizations [4]. When this computer based information science is applied to domains like medicine, or dentistry it becomes "informatics" [5,13].

Health informatics is particularly focused on [9]:

- Through apprehension of the basic nature of the information and communication systems espoused by unfolding the principles which delineates them.
- Provides a platform for devising interventions which can have an obvious advantage over present information and communicating systems.
- Creating meaningful methods and principals to implement such interventions.
- Studying the impact evaluation of these interventions on individuals or organizations, or on the outcome of the work.

Even though dental informatics first appeared in MEDLINE in 1986 but when T.K Schyler et al., searched dental informatics on PUBMED only 200 citations can be compared to 29,500 citations in medical informatics [13].

Dental informatics paves the way for building up database for EBD (Evidence Based Dentistry), by which approach to oral health care can be improved by judicious integration of systematic assessments for clinically relevant evidence and specific clinical intervention so that greatest possible health gain can be achieved within available resources [9].

Current time has witnessed that the integrity of ethics and scientific knowledge have become extremely important for research. Ethical and research guidelines apply to epidemiologists and other research scientists. Researchers are answerable for their research to society in terms of explaining the purpose, methods and importance of their research to lay people in an understandable manner and to achieve this health informatics becomes a very useful tool [14,15].

Goals of Dental Informatics [9].

- Dental informatics helps the healthcare provider to improve patient outcomes.
- To make the delivery of dental care more competent.
- Serving practitioners solve clinical problems more with sound evidence based.
- To uphold continuing competency among practitioners and researchers.

Fundamentals of Health Informatics

1. Interoperability in Health Information System

Interoperability in healthcare information system is the ability of varied systems within information technology to communicate and to exchange data accurately [16].

2. Electronic prescribing

It can be understood as computer-based support for the establishment, transmission, dispensing, and monitoring of pharmacological therapies. The goal of Electronic prescribing systems is to minimize medication errors and consequently improve standards of patient safety [17].

Electronic Health Records (EHR). The righter development in the field of dental informatics is the development of the Electronic Oral Health Records; EOHR (Electronic oral health record) is considered the centre-piece of information for dentistry [18]. The EOHR can be a basis for the establishment of favorable dentist-patient relationship as it can act as a central repository of information about the patient that includes clinical data pertaining to the patient's oral condition as well as psychological and medical information about the patient [18]. EHRs can be of immense help to improve the efficiency, quality and most importantly safety of care. These features helps equip clinicians to formulate better and accurate clinical decisions thereby preventing avoidable errors. Clinicians must start employing such clinical decision support tools.

3. Information Retrieval

This concept can be understood as an art and science of searching documents, pertinent information, searching and exploring metadata which might be of standalone databases type or hypertext networked databases like Internet or intranets, text, sound, or images [19].

4. Information Extraction

It is nothing but selecting relevant details regarding a specified subject from documents [20].

5. Information Visualization

It is the technique to represent information. It depicts the computer supported abstract data more cognizable visually [21].

6. Artificial Intelligence

It is creation of artificial intelligence programs in the computers in Medical/Dental fields which aids in performing diagnosis flawlessly and helps in recommending therapeutic measures [22].

7. Expert Laboratory Information System

Computers are provided with some programs which can automatically interpret the test results when relevant data are entered for interpretation of lung function tests, PUFF system can be included for liver function tests, LFT (liver function test) system can also be included and many more [22].

8. Clinical Decision Support System (CDSS)

To improve the safety of the patient and to improve the prognosis, CDSS are available. These are active knowledge systems which exercise various items from the patient data and generate case-specific advice [23].

9. Health Information Exchange (HIE) [3]

HIE is the need of the hour as it helps in the exchange of health information of the patient care across conventional business boundaries in health care still maintaining confidentiality.

Health information exchange has arisen from the convergence of four historic trends-

- a. Upgrading the quality within the cost effective range of health care.
- b. Countering appropriately to public health emergencies and imperative need for enhanced surveillance systems
- c. Emergence of technologies capable of providing electronic per-centric health information on demand.
- d. Development of use friendly technologies by which information can be shared between the users and the providers.

Oral Health Information Systems at the Global and Regional Levels

Monitoring of oral disease patterns and trends over time and data regarding the same are the essential component of oral health information systems. WHO in 1996 established oral health database online on Internet, this was supported by WHO Collaborating Centre of oral health at Malmö University, Sweden, and University of Niigata, Japan [24].

By computerizing health records, we can avoid dangerous medical mistakes, reduce costs and improve care. Thus it provides an easier way to access relevant patient information and helps to improve clinical decision making [25].

Application of Health Informatics [26].

1. Storing, grouping, and analysing large amount of health related data.
2. Statistical analysis of health related data.
3. Evaluation of data obtained by health surveys.
4. Graphical presentation of health related data.
5. Patient information, education and motivation from health related data.

Opportunities in Dental Informatics [1,27,28].

1. Longitudinal, lifetime, comprehensive and patient-centered dental records.
2. Universally accessible patient records that ensure privacy and confidentiality.
3. Significant reduction of practice management and administrative overhead.
4. Clinical care based on empirically determined best practices.
5. Expansion of knowledge-based ontology of dental concepts.
6. Escalating the evidence base of risk actors, diagnosis, prevention, therapeutic, and therapeutic outcomes.
7. Comprehensive electronic oral health record can be mounted flawlessly integrated into medical record.
8. To develop and maintain a nationwide oral health database.
9. Overcoming distance.
 - a. Bio Terrorism: detection and coordinating response.
 - b. Telemedicine: frequent checks on the chronically ill.
10. Mapping of human genetics and exploring oral health disparities among different ethnic groups, Biomedical informatics can be of immense help.

Challenges [27,29]

- Universal patient identifier.
- Secure user authentication.
- Universal access to computers and high-speed Internet connections.

- National list of authorized dental practitioners.
- Collections of large databases of patient information.
- Professional under- representation.
- Lack of literature of dental informatics.
- Academia unfamiliarity due to non inclusion in dental research community.

IMPLEMENTATION STRATEGY

Interdisciplinary Course

An updated information resource training (IRT) courses can be planned to make acquainted the students with the information technology accessible to them. For implementing such courses first evaluation of entering students' basics regarding information technology, web searching and e-mail, and that the dental literature searching should be done and then newer issues like the patients electronic health/oral health records, and tele--dentistry should be presented to students [14].

Curriculum for Dental Researchers

There are various modalities of biomedical informatics training programs for dental researcher; like single full time course or series of part time short courses covered in few years. In these part time of full time courses students are make acquainted with the core competencies of the courses, followed by application of the same. The core competencies of biomedical competencies can be taught through textbook such as Shortliffe et al., Medical Informatics: Computer Applications in Health Care and Biomedicine (2001), which renders the required overview of biomedical informatics curriculum for dental researchers. This basic curriculum includes: (1) in depth information of biomedical informatics; (2) acquiring skills about data management system; (3) learning software engineering. In addition to this basic knowledge other areas like appraisal, biostatistics, and methodology of the research designs are typically covered in graduate courses [28].

Dental Informatics Internship Program- Such programs are already in existence in other countries. Starting internship program in India will open up new arenas of opportunities for dentist to learn and practice dental informatics.

With An Online Community- E-communities should utilize the huge opportunity to triumph over various obstacles faced by dental Informaticians by bringing researchers together at a resource hub and giving them the required break to share information, and find collaborators [29].

FURTHER RECOMMENDATIONS [30,31]

For the sake of easy reach of dental informatics for everyone and to enhance its capability to bring about its research goals, some of the underlying recommendations might be useful:

1. Crafting dedicated community of dental informaticians worldwide.
2. Number of Biomedical informaticians interested in dental problems should increase.
3. Dental informatics field should be career oriented and researchers should be getting enough career opportunities to earn their livelihood.
4. Dental informatics should be capable of addressing dental public health problems at community level.

The implementation of the dental informatics should have good surveillance system so that the principle of confidentiality should not be reached and proper Information and Communication Technology (ICT) education, training and support systems should be developed and incorporated in dental fraternity [32].

CONCLUSION

Computer technology has reshaped the society already. The burning question is; to what extent it will reshape dental field. Making the dream of implementing theories and concepts of informatics into reality requires considerable endeavor and resources. Many projects on this road may fail. Dentistry, however, should learn from the failures as much as it does from the successes, only then will we realize the promise of informatics.

In summary, dental fraternity of the future will have to be far more computer-literate than today's practitioners. The appropriate use of newer technology will permit a better level of care with greater efficiency and productivity. At the same time patients will benefit from these productive advances, but concomitantly it is the challenge for the dental profession to fit in these advances into everyday dental practice.

To be truly useful, informatics must be understood as a research discipline aimed at uncovering generalizable principles. Systematic understanding of the goals, technique, methods and implementing strategy of informatics, individuals and communities working in applied areas of science will be able to identify effortlessly how informatics could potentially be a useful tool in their own work. Conversely, informaticians must learn as much as possible about the research issues and problems in the applied areas, so they can target their work at the resolution of real fundamental problems. If all dental fraternity can agree on a set of challenges and opportunity facing the field, then we all can begin to develop solutions to addressing the same.

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