

Review Article

Dental Informatics: Integrating Technology into Dentistry

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Abstract

Advances in technology have incredibly changed our regular day to day lives by bringing everything within our reach. Healthcare industry has additionally observed major developments such as digitization of health records, virtual patient visits, high resolution digital imaging, etc. These advances have improved the quality of dental care as well as the efficiency and predictability of procedures. Health informatics is a combination of information science, computer science and cognitive science to assist in the management of healthcare information. It deals with the resources, devices, and methods, which are required to improve the acquisition, storage, retrieval, and use of information in health and biomedicine. Health informatics helps doctors with their decisions and actions, and improves patient outcomes by making better use of information making more efficient the way patient data and medical knowledge is captured, processed, communicated, and applied. These challenges have become more important since the internet made access to medical information easier for patients.

Keywords: "Informatics" Health Informatics; Dental Informatics; Public Health Informatics

Introduction

Informatics is an applied information science that designs the blue prints for the complex data systems that keep information secure, usable and responsive to the user's needs. Informaticians usually act as a knowledge builder who builds account for function and the needs of the user with local context [1].

Health informatics is a combination of information science, computer science and cognitive science to assist in the management of healthcare information [2]. There are numerous current areas of research within the field of health informatics, including bioinformatics, neuro-informatics, clinical informatics, public health informatics and dental informatics [3]. Bioinformatics uses molecular level data, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly credited. Tissue level data is employed by neuro-informatics and patient level data by Clinical Informatics whereas Public Health Informatics utilizes population data (either from the population or on the population) [4].

The application of informatics in the areas of public health which include surveillance, prevention, preparedness, and health promotion is known as public health informatics. It works on information and technology issues from the perspective of groups of individuals. It is extremely broad and can even touch on the environment, work and living places and more [5].

The main applications of Public Health Informatics is to promote the health of the entire population, which eventually promotes the health of an individual and to prevent diseases and injuries by changing those conditions that expands the risk of diseases in the population [6,7]. Basically, Public Health Informatics is used in

public health data collection, analysis and actions [5].

In collaboration with technical and public health skill set, public health informaticians refine data from IT applications within and outside of the health agency into actionable information to improve health of population [8].

The state and territorial health agency depends on the information systems guided by the principles and policies of informatics to make it easy for the people to get the right information at the right time [8].

To manage public health practice and enhancement of the well-being of society constructively, multiple resources are required to provide precise, high-grade and timely information [9].

In the development and promotion of computerized information systems and surveillance programs, Public health professionals have stood as pioneers by facilitating strategies to protect public health and enhancement for the quality of life [10].

In the past decade, Modern dental research was becoming more dependent with the development of computer and information technology.

Dental informatics is rationally a new field and is in the budding stage [11]. It 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 [12]. It is the application of computer and information science to improve dental practice, research, education and management [13], which was derived from an earlier definition that was coined in 1992 [14]. It is difficult to retrace the exact time when Dental Informatics was considered as a relatively independent research field. One of the earliest publications searched

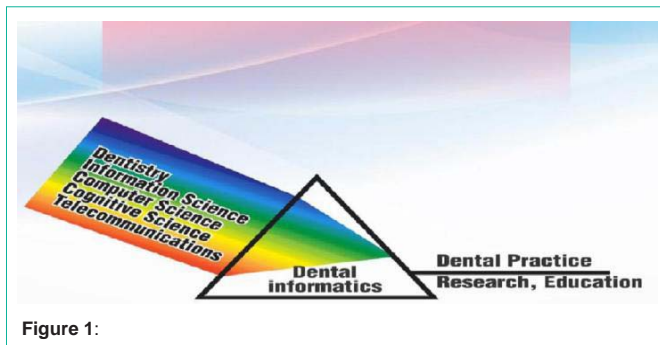


Figure 1:

in Medline with keywords of “dental informatics” was “Computers in Dentistry” written by Zimmerman et al., [15]. Who discussed including computer courses into the dental curriculum. It combines dentistry and several research disciplines, such as computer science, information science, cognitive science, and telecommunication [13].

Thus the purpose of informatics is to solve practical problems for researchers, practitioners and educators. Hence, available literature was reviewed for a better understanding of goals and methods of dental informatics so that individuals can identify more easily how informatics could potentially help them in their own work and also they must learn about the research issues and problems in the applied areas, so that they can target their work at the resolution of real, fundamental problems.

Methodology

A literature search was performed in the electronic databases of Google Scholar, PubMed and Science Direct. In order to define the keywords for search in databases, few seminal articles were analysed. Data was retrieved by a member of research team using keywords like “health informatics,” dental health informatics,” “informatics” were entered into Medical Subject Headings (MeSH) controlled vocabulary. The terms like public health, dental informatics, informatics were combined with the MeSH terms by Boolean ‘AND’ or ‘OR and entered in PubMed, Science Direct and Google scholar. We also made a manual search in the key journals available in the library of the institution. Some data was also obtained by cross checking the reference list of the articles accessed. A total of 39 articles were retrieved among those 20 articles were excluded as they were not relevant to this review. Peer reviewed studies which were relevant to the topic and were in English language were included in the present review.

Scientific Methods in Informatics

The scientific methods primarily come from four research areas, which is computer science, cognitive science, information science and telecommunications. However, many other fields such as social sciences, psychology, anthropology and mathematics also contribute to the scientific basis of informatics. Figure 1 illustrates that how a domain area combines with one or more component sciences of informatics to develop solutions in dental practice, research and education [11].

Goals of Dental Informatics

The main goal of dental informatics is to improve patient outcomes

and to make the delivery of dental care more competent. With sound evidence based, clinicians can solve more clinical problems by supporting and improving diagnosis, treatment and prevention of disease and traumatic injury; relieve pain; and preserve and improve oral health by maintaining or improving cost-benefit ratios [11,12]. Dental informatics also must support research and education, and improvements in these areas and often do, translate into improved patient care. As the dentists are with the problem domain, they must be familiar with the problem solving process. Computers can be used to maintain the competency. So, many dentists are using computers to maintain a level of new developments [16,17].

Dental Standards

Dental standards are to help patients and to keep everyone on the same page. It also ensures the safety of patients. For electronic transference, there are many developed architectures. Also, there are few readers who are familiar with the DICOM (Digital Imaging and Communication in Medicine) standard, which is used for transferring digital radiographs. The American Dental Association (ADA) signed an agreement in September 2009 with Health Level Seven International (HL7), to develop consistent dental IT standards in order to enhance coordination between medical and dental offices [18]. The ADA Standards Committee on Dental Informatics (SCDI) helps dentists to empower their practices with the use of information technology [19].

Dental Informatics in Public Health Practice

To maintain public health practices some technologies are used which can be categorized under the heading Public Health Informatics. A complete understanding of public health informatics is necessary for the development of an effective public health information system, the systematic application of information and computer science and technology to public health practice, research, and learning are required. Biostatistics, community health education and Geospatial Information System (GIS), including teledentistry are the main areas where dental informatics is applied [9,20]. There are many software programs which are used in many fields of public health practices. These fields are:

- **Research and Biostatistics:** Public health practice inevitably involves data collection from a large population. This data should be collected on a regular basis to evaluate the incidence and prevalence of certain diseases in a population and also to keep a track on the trends. The various software programs like SPSS (Statistical Package for the Social Sciences) [21], SAS (Statistical Analysis System) [22], Microsoft EXCEL [23], EPI-INFO [24] and Epicollect.
- Epicollect has been recently introduced software dealing with generic data collection, which allows to collect and submit geotagged data forms along with photos to a central project website from suitable mobile phones. These software have made the analysis easy and simple for such an extensive data [25].
- **Community health education:** In India use of informatics for dental care is still in its beginning. Almost all dentists are using computers in their routine life, among those very few are using them to educate the patients to improve their dental health and awareness towards improvement of oral hygiene through patient educating software. Software programs such as GURU, PATIENT ORIENTED

PROBLEM SOLVING, CASEY GURU, [26] PATIENT ORIENTED PROBLEM SOLVING, [27] CASEY PATIENT EDUCATION SOFTWARE, [28] ORASPHERE, [29] can be used to enhance the knowledge of patient's towards dental health under clinical settings as these programs have been proven effective in a clinical setting. At the primary health centers, the health education GIS (Geospatial Information System) and teledentistry software programs may be installed for creating awareness on health as well as oral health by the primary health workers.

- **Geographic Information System (GIS):** These are computer-based tools, which are used to store, visualize, analyze, and interpret geographic data. Geographic data identifies the geographic location of features, which includes the data that can be mapped. It can refer to a number of different technologies, processes, techniques and methods. It combines large amounts of different data to manage and retrieve the data in useful manner. Software components, which are used in GIS, are (a) a Database Management System (DBMS) (b) tools for the input and manipulation of geographic information (c) tools that support geographic query, analysis, and visualization (d) a Graphical User Interface (GUI) tools. In Public health, the applications of GIS include infectious disease surveillance and control that meet the demands of outbreak investigations and response, which analyze spatial and temporal trends. It also analyze the populations at risk including risk factors, assessing resource allocation; planning and targeting interventions and monitoring diseases and interventions over time [20].

- **Teledentistry:** The combination of telecommunications and dentistry, which involves the exchange of clinical information and images over remote areas for dental consultation and treatment planning is known as teledentistry. Earlier, the concept of teledentistry was developed in 1989 as part of the blueprint for dental informatics, which was funded by the Westinghouse Electronics Systems Group in Baltimore. It improves access to oral health care and its delivery and is cost efficient. It helps in eliminating the inequality in oral healthcare between rural and urban communities and to bring specialized healthcare to the remotest corners of the world. In this, special video conference equipment and a video/internet connection is set up at both the hub site and remote site. Through the online electronic patient record system, Questionnaire, examination and any imaging or documents that are included in the dental record are transmitted to the hub. The specialist starts an online consultation with the patient through video conferencing. In many developed countries, Telemedicine have been successfully implemented. Whereas Teledentistry still needs to be develop its roots in developed countries. In India, the scope of teledentistry is enormous. But, for its implementation poverty, illiteracy, and lack of infrastructure, are the major challenges in our country [30,31].

Challenges to Dental Informatics Application

There are certain roadblocks that encounter the dental informatics. The foremost challenge is financial investment to develop, implement and maintain e-health initiatives to nurture dental informatics [32]. The second most important challenge is the availability of trained manpower in remote rural areas for establishment and maintenance of oral hygiene. Universal access to computers and high-speed internet connections is one of the major challenge in the application

of dental informatics [9].

Discussion

In the field of healthcare and dental sectors, governments of many developed countries have already channeled information and communication technologies. In India, there are disparities in equality where access to oral health care among urban and rural population is different, so there is a need for a proper oral health information management system to decrease the burden of oral diseases. In 1988, All India Institute of Medical Sciences (AIIMS) developed an open source software called Health Management Information System (HMIS) where information recorded (input) is stored and retrieved, which further helps in decision-making (output). In oral health care sector of India, there is no software program has been developed [33].

Petersen P.E et al has introduced an oral health information system model where Data on oral health status for monitoring disease patterns and trends over time represent an essential component of the system.

Risk factor surveillance: WHO has suggested that regular oral health surveys should be conducted for effective oral health surveillance, every 5-6 years in the same community, which can provides continuous or periodic data collection, analysis and interpretation of population health data, so as to provide timely informations of such data to user.

The goal is to prevent and measure the outcome of the disease by framing oral health indicators. WHO suggested a stepwise approach for effective risk factor surveillance, which has been, designed in such a way that it adapts to the local and international needs.

Oral health status: oral health status of a country or a community can be determined by an organized and periodic oral health surveys. Data obtained from these oral health surveys can be stored in database so that it is accessible worldwide and preventive measures can be taken to prevent dominant and highly prevalent diseases. In developing country like India, the amount of dental caries tends to increase in young children due to change in life style and the increased consumption of sugars, which have a negative impact on oral health. Public health software programs can be used to reduce the burden of disease on community level, which will help in creating awareness and educating people about maintenance of oral health care.

Care and intervention: Through various surveys database is collected to establish the prevalence of disease. Once it is established the type and amount of public health services provided through public health system has to be quantified. At this stage Information Technology (IT) helps to maintain data related to oral health by using Electronic Oral Health Records (EOHR).

Administration of care: To improve the quality and quantity of health services, an effective management is required. Its main objective is to support program managers in monitoring and supervision of the workers. Similarly, it can be done to assess the health workers performance and also in OHIS monitoring. The recording and listing of activities in work plan makes supervision easier.

Conclusion

The purpose of informatics is to solve the problems for

researchers, practitioners and educators. It helps to enhance the knowledge of patients towards dental health under clinical settings by using certain software programmes. To be truly useful, informatics must be understood as a research discipline, which aims to uncover the generalizable principles. With a better understanding of its goals and methods, individuals in applied areas will be able to identify more easily how informatics could potentially help them in their own work. For the proper implication in the respective fields, informaticians must learn the possible research issues and problems in the applied areas, so they can target their work at the resolution of real, fundamental problems. Dentistry, however, should learn from the failures as much as it does from the successes. Only then will we realize the promise of informatics.

References

- Public Health Informatics.
- Healthcare Informatics.
- Herland M, hoshgoftaar TMK, Wald R. A review of data mining using big data in health informatics. *Journal of Big Data*. 2014; 1: 2.
- Bhat PK, Raj K, Ahmed F, Shivaprasad RK. Informatics Innovation in Dental Care: A Visionary Scenario for Dentistry. *I J Pre Clin Dent Res*. 2015; 2: 34-40.
- Hassan A Aziz. A review of the role of public health informatics in healthcare *Journal of Taibah University Medical Sciences*. 2017; 12: 78e-81e.
- Hoyt R, Bailey A. *Health informatics: practical guide for healthcare and information technology professionals*. 6th ed. Raleigh: Lulu Press; 2014.
- Chen H, Hailey D, Wang N, Yu P. A review of data quality assessment methods for public health information systems. *Int J Environ Res Public Health*. 2014; 11: 5170e-5207e.
- Medicaid and public health integration learning series | public health informatics.
- Yasnoff WA, O'Carroll PW, Koo D, Linkins RW, Kilbourne EM. Public health informatics: Improving and transforming public health in the information age. *J Public Health Manag Pract*. 2000; 6: 67-75.
- Friede A, O'Carroll PW. CDC and ATSDR electronic information resources for health officers. *J Public Health Man Pract*. 1996; 2: 10-24.
- Schleyer T. Dental Informatics: An Emerging Biomedical Informatics Discipline. *Journal of Dental Education*. 2003; 67: 1193-200.
- Chhabra KG, Mulla SH, Shravani GD, Chhaba C, Jagjeet S, et al. Dental informatics in India: Time to embrace the change. *Journal of clinical and diagnostic research*. 2016; 10: ZE12-ZE15.
- Patwardhan N, Bhaskar DJ, Bumb SS, Agali C, Punia H. Dental informatics in planning an effective oral health information system: A review article. *TMU J Dent*. 2015; 2: 12-16.
- Collen MF. *A history of medical informatics in the United States*. Washington, DC: American Medical Informatics Association, 1995.
- Zimmerman JL, Ball MJ, Petroski SP. Computers in dentistry. *Dent Clin North Am*. 1986; 30: 739e-743e.
- Kalkwarf KL. How the licensure process will evolve. *J Am Dent Assoc*. 1999; 130: 1737-1742.
- Schleyer TK, Forrest JL, Kenney R, Dodell DS, Dovgy NA. Is the Internet useful for clinical practice? *J Am Dent Assoc*. 1999; 130: 1501-1511.
- Health Level Seven and the American Dental Association Sign Agreement to Develop Joint Healthcare IT Standard Initiatives. 2009.
- Standards. American Dental Association.
- Athavale AV, Zodpey SP. Public Health Informatics in India: The potential and the challenges. *Indian J Public Health*. 2010; 54: 131-136.
- IBM, SPSS statistics 20 brief guide. 2010.
- Sector P. *An Introduction to the SAS System*.
- MS- EXCEL. Cited 15th April 2013.
- CDC. Epi-Info Community Health Assessment Tutorial, published by: Centers for Disease Control and Prevention, October. 2005.
- Epicollect.
- Acharya A, Wali T, Rauch J, GURU. Patient Education Software. *J Dent Edu*. 2009; 73: 137-139.
- Chiodo G, Tolle SW, Bartley M. Antibiotic prophylaxis for dental treatment. Review and update III. *Dent J* 1990; 59: 599-560.
- Patterson dental system, CASEY SMILE CHANNEL user guide. 2009.
- ORASPHERE. Dental Patient Education Solution.
- Chhabra N, Chhabra A, Jain RL, Kaur H, Bansal S. Role of Teledentistry in Dental Education: Need of the Era. *J Clin Diagn Res*. 2011; 5: 1486-1488.
- Chen JW, Hobdell MH, Dunn K, Johnson KA, Zhang J. Teledentistry and its use in dental education. *J Am Dent Assoc*. 2003; 134: 342-346.
- Solberg KE. Telemedicine set to grow in India over the next 5 years. *Lancet*. 2008; 371: 17-18.
- Bhat PK, Raj MRK, Ahmed F, Shivaprasad RK. Informatics innovation in dental care. *I J Pre Clin Dent Res*. 2015; 2: 34-40.