DENTAL INFORMATICS IN PLANNING AN EFFECTIVE ORAL HEALTH INFORMATION SYSTEM: A REVIEW ARTICLE

Nitin Patwardhan,[1] Bhaskar DJ,[2] Swapnil S. Bumb,[3] Chandan Agali,[4] Himanshu Punia[5]

Professor,[1] Professor & Head,[2] Post Graduate Student,[3] Reader,[4,5]

1-5 Department of Public Health Dentistry, Teerthanker Mahaveer Dental College & Research Center, Moradabad.

Abstract

Technology in dentistry is a novel science and it will continue to grow in future. The research field that study dentistry from a technical perspective is dental informatics. Dental informatics engrosses every discipline in dentistry. Oral health information system is important in the evaluation of public health initiatives as well as for the assessment of achievements of goals for health. Over the past two decades, there have been significant achievements in oral health in India, but, it still remains a challenge to achieve the establishment of a database for monitoring and surveillance. Improved quality of oral health information systems may help to strengthen health systems and operational research may assist in translating sound knowledge about prevention program and health promotion for the benefit of the poor and disadvantaged population groups. Dentistry, however, should learn from the failures as much as it does from the successes. Only then will we realize the promise of informatics.

Key Words: - Dental Informatics, Health information system, Teledentistry

Introduction

Information technology has developed very rapidly in a short span of 40 years and touched almost every aspect of the society. According to Merriam Webster it is defined as ―the technology involving the development, maintenance, and use of computer systems, software, and networks for the processing and distribution of data.‖ [1] It is continuously growing and advancing with time. The way in which children grow up, companies do business, people shop and communities socialize has changed significantly since the beginning of the information revolution. This revolution has also made its mark in the dental profession.[2] According to 1997 survey by ADA, almost 80 percent of dentists have computers in their offices, 30 percent have access to the internet, and an increasing number use a variety of other technologies, including digital intraoral cameras and paperless patient records.[3]

According to Merriam-Webster's Collegiate Dictionary, informatics is derived from the term ―information science,‖ which is the collection, classification, storage, retrieval and dissemination of recorded knowledge treated both as a pure and applied science.[4] When applied to a specific domain of health sciences, it becomes Medical, Dental or Nursing ―informatics‖ .

Dental informatics is defined as ―the application of computer and information sciences to improve dental practice, research, education and management‖ It is a sub discipline of medical informatics.[2] Medical informatics is defined as the discipline, dedicated to the systematic processing of data, information and knowledge in medicine and health care.[5]

Dental informatics combines dentistry and several research disciplines, such as computer science, information science, cognitive science, and telecommunication.[6]

The distinguishing features that make medical informatics different from dental informatics is the way, by which it performs examinations, methods of reimbursements and development of treatment data.[7] Most of the design work that forms the development of computer-based medical records is not applicable to computer-based dental records. Dentists collect, display and analyze data differently.

The field of medical informatics is still in its infancy. So, if medical informatics is still in its infancy and dental informatics has had an even more delayed start, then the field could be considered as mature as a newborn. Hence, Dental informatics is a young discipline. It has seen many developments since early computers were first exploited to address problems in dental practice, research and education.[8]

Dental informatics can be used successfully to provide oral health information system. The published literature on the applicability of dental informatics in oral health information system is limited. This paper makes an attempt to review the existing literature on dental informatics in public health practice and discuss the feasibility of integrating dental informatics in planning effective oral health information system in India.

A brief note on history and evolution of Dental Informatics:

The word ‗computer' is an old word that has changed its meaning several times in the last few centuries. Originating from the Latin, by the mid-17th century, it meant ‗someone who computes'. The American Heritage Dictionary (1980) also defines it similarly. The computer remained associated with human activity until about the middle of the 20th century when it became applied to ―a programmable electronic device that can store, retrieve, and process data‖ as Webster's Dictionary (1980) defines it. According to The Computational Science Education Project, US, the computer has evolved through many stages and is as necessary as oxygen in today's life. Dental informatics has developed significantly since the 1960s, when the first uses of informatics approaches to address dental issues were documented. In the 1960s, the National Library of Medicine (NLM) in the USA began to accumulate in a computer the bibliographic citations of the more than 3000

biomedical journals stored and indexed by the NLM. A search programme called ELH ILL was developed to retrieve these references. By 1971, these references were available in MEDLINE, the first interactive online medical bibliographic database. Since 1979, MEDLINE has included all references contained in the index to Dental Literature and is the most comprehensive bibliographic database of the published dental literature. Many dental computer systems have been developed by individual dentists seeking to improve practice management operations in their own unique private practice environment. Interest in dental informatics rose gradually, and the first conferences and workshops on the subject such as the Symposium on Second Generation Clinical Databases and the Electronic Dental Record (1990) took place.[9,10] In the early 1990s, some professional organizations—such as the International Medical Informatics Association, the American Medical Informatics Association, and the American Dental Education Association—began to organize interest groups in dental informatics. A key development was the initiation of funding for dental informatics training by the National Institute of Dental and Craniofacial Research (NIDCR) in 1996, which for the first time recognized the need for a formal education of dental informaticians. (The National Library of Medicine [NLM] had been funding similar training in medical informatics since 1972 [Braude, 1991]).[8] The evolution of Dental Informatics in India has been a new-comer. The vast strides made by the country in the field of Information Technology have helped popularize the use of computers in Dentistry. Several dental software programs have been indigenously developed for clinical care, patient education, for practice management last but not the least for data analysis.[11]

Dental informatics in public health practice:

The technologies that are used to maintain public health practices can be categorized under the heading Public Health Informatics. Development of effective public health information systems requires understanding public health informatics (PHI), the systematic application of information and computer science and technology to public health practice, research, and learning.[12,13] The main areas of application can be in: (a) biostatistics, (b) community health education, and (c) geospatial information system (GIS), including teledentistry.

A brief note on various Software programs used in public health practices

A) **Research and Biostatistics**: Public health practice invariably involves collection of data from an extensive population. This data needs to be collected on a periodic basis to assess the prevalence and incidence of various diseases in a population as well as to keep a track on the trends. The various software programs like SPSS (Statistical Package for the Social Sciences),[14] SAS (Statistical Analysis System),[15] Microsoft EXCEL[16] and EPI-INFO,[17] have made the analysis of such an extensive data simple and easy to compute.

B) **Community health education**

Use of informatics for dental care in India is still in its infancy. Almost all dentists use computers in their daily life but very few use them to improve dental health of the patient by educating them through patient educating software and creating awareness towards improving the oral hygiene. Many patient educating software can be used to help and enhance patient's knowledge towards dental health under clinical settings. Software programs such as GURU,[18] PATIENT ORIENTED PROBLEM SOLVING,[19] CASEY PATIENT EDUCATION SOFTWARE,[20] ORASPHERE,[21] have been proven to be effective in a clinical setting. The feasibility of utilizing these software programs for community health education as well as developing alternate programs applicable in a community setting need to be evolved. The health education software programs, which are simple, may be installed at the primary health center level and these may be used for creating awareness on health as well as oral health by the primary health workers.

C) **GIS (Geospatial Information System) and Teledentistry**

Geographic information system (GIS) is a system designed to capture, store, manipulate, analyze, manage, and present all types of geographical data. The acronym **GIS** is sometimes used for **geographical information science** or **geospatial information studies** to refer to the academic discipline or career of working with geographic information systems. In the simplest terms, GIS is the merging of cartography, statistical analysis, and database technology. GIS uses map overlay techniques which view data pertaining to demographics, social infrastructure, health care institutions, and patient's geo-positioned points-all in one view. Public health applications of GIS include infectious disease surveillance and control, especially vector-borne diseases; to meet the demands of outbreak investigation and response (where prompt location of cases, rapid communication of information, and quick mapping of the epidemic's dynamics are vital); analyzing spatial and temporal trends; mapping populations at risk; stratifying risk factors; assessing resource allocation; planning and targeting interventions and monitoring diseases and interventions over time.[13]

For serving under privilege population where the access to dental care is minimum teledentistry is a desperate need. ―Teledentistry' si a synergistic combination of telecommunications technology, Internet and dental practice. It is a relatively new field and due to the extensive growth of technological capabilities, teledentistry possesses the potential to fundamentally change the current practice and the face of the dental care. Teledentistry can be defined as the use of electronic information and telecommunications technologies to support long-distance clinical oral health care, patient and professional health-related education, public health, and health administration. It increases patient access to dental care, improves quality of care and the cost effectiveness. For a typical teledentistry visit, special video conference equipment and a

video/internet connection is set up at both the hub site and remote site. Patient checks in at the remote clinic and before consultation fills out a questionnaire. Dentist or assistant at the remote clinic records a hand-on-examination. Questionnaire, examination and any imaging or documents that are included in the dental record are transmitted to the hub via the online electronic patient record system. With the review of the information in hand, the specialist starts an online consultation with the patient through video conferencing.

Telemedicine have been successfully implemented in many developed countries.[22] Whereas Teledentistry still needs to form its roots in developed countries. The scope of teledentistry in India is enormous. But, poverty, illiteracy, and lack of infrastructure, are major challenges to the implementation of teledentistry in our country. [23, 24]

Discussion

During the last quarter of 20th century, emergence and rapid evolution of microprocessor technology enabled developments in Information and Communication Technologies (ICTs) that heralded an information age, which widened and transformed economic and social activities all over the world.[24] Governments of many developed countries, have already channelled these technologies in the field of healthcare, including dental sectors. In India the need for a proper oral health information management system arises because of the glaring disparities in equality and access to oral healthcare between urban and rural regions; increasing burden of oral diseases; difficult terrain for the reach of health services especially in north and north-eastern states; alarming situations such as disasters, famine floods, earthquakes, epidemics of diseases, etc. In 1988, All India Institute of Medical Sciences (AIIMS) developed open source software called Health Management Information System (HMIS). It is a process where information is recorded (input) stored, retrieved and processed for decision making (output). [25] This software is used for aspects like planning, organizing and control of health care at national, state and institutional levels. Till now no such software programs has been developed for oral health care sector in India.

The web-based portal Global Oral Data Bank by WHO has emerged from the gathering of information from surveys on the growing burden of disease particularly in industrialized countries.

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.[26]

1. **Risk factor surveillance**: For effective oral health surveillance, WHO has suggested that regular oral health surveys should be conducted every 5-6 years in the same community or setting. Surveillance provides ongoing (i.e. continuous or periodic) collection, analysis and interpretation of population health data, and the timely dissemination of such data to user.

Properly conducted, surveillance ensures that countries have the information they need to control disease immediately or to plan strategies to prevent disease and adverse health events in the future. The goal is to frame oral health indicators to prevent and measure the outcome of the disease. A stepwise approach for effective risk factor surveillance (eg: data on Socio economic status, tobacco usage, sugar consumption etc) has been suggested by WHO. The approach has been designed in such a way that it adapts to the local and international needs.

2. **Oral health status:** organized and periodic oral health surveys are an approach in determining the oral health status of a country or community. Data obtained from oral health surveys can be stored in database so that it is accessible worldwide and, measures can be taken to prevent dominant and highly prevalent diseases. In developing country like India changing life style and the increased consumption of sugars continues to have a negative impact on oral health and the amount of dental caries tends to increase particularly in young children. To reduce the burden of disease use of public health software programs on community level can be an initiative which will help in creating awareness and educating people about maintenance of oral health care.

3. **Care and intervention:** Once prevalence of a disease is established through database collected from various surveys, the type and amount of public health services provided through public health system has to be quantified, for example number of fillings, extractions, prosthesis delivered in a year. Information Technology (IT) can help at this stage by making use of electronic oral health records (EOHR) for maintaining data related to oral health.

4. **Administration of care:** The primary purpose of HMIS is to support health workers in delivering health care services to the population. The other important objective is to support program managers in monitoring and supervision of the workers. An effective management is essential to scaling up the quantity and quality of health services and improving population health. Similarly, in OHIS monitoring and assessing the health worker's performance in a more objective manner can be done. The recording and listing of activities in work plan makes supervision easier. A six monthly review of program performance using oral health indicators can be generated which will make the workers understand the need for the data collected and also to take timely action if needed.[27]

5. **Quality and outcome:-** measuring outcome from a oral health care program is an essential component as it decides the effectiveness of a program. Outcome can be measured through ORHQOL (oral health related quality of life). It takes into account both social and psychological impact of oral disease on an individual. It includes the following domains:-

survival of the individual (i.e. absence of oral cancer),

absence of impairment, disease or symptoms,

appropriate physical functioning associated with chewing and swallowing,

absence of pain or discomfort,

emotional functioning associated with smiling,

social functioning associated with performance of normal roles,

perceptions of excellent oral health; satisfaction with oral health; and

no social or cultural disadvantage due to oral health status.[26]

Oral health information system is important in the evaluation of public health initiatives and program and for the assessment of achievements of goals for health. Over the past two decades, there have been significant achievements in oral health in India, but, it still remains a challenge to achieve the establishment of a database for monitoring and surveillance. The software used in clinical dentistry will improve the oral health related quality of life.

Conclusion

―There is nothing more difficult to take in hand, more perilous to conduct, or more uncertain in its success, than to take the lead in the introduction of a new order of things. ‖ Niccolò Machiavelli‗s words describe the challenge to dental informatics appropriately. Computer technology has reshaped our lives already. The question is to what degree it will reshape dentistry. Improved quality of oral health information systems worldwide may help to strengthen health systems and operational research may assist in translating sound knowledge about prevention program and health promotion for the benefit of the poor and disadvantaged population groups. Putting the theories and concepts of informatics into practice requires significant effort and investment. Many projects on this road will 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.

References

1. Merriam Webster (internet). An encyclopedia brittanica company (cited 2013 March 20) available from:http://www.merriamwebster.com/dictionary/information+technology?show=0&t=1370172581
2. Schleyer T, Spallek H. Dental informatics- A cornerstone of dental practice. J Am Dent Assoc 2001;132(5):605-13.
3. American Dental Association Survey Center. 1997 Survey of current issues in dentistry: Dentists‗ computer use. Chicago: American Dental Association; 1998.
4. Merriam Webster (internet). An encyclopedia brittanica company (cited 2013 March 20) available from:
   http://www.merriamwebster.com/medical/informatics
5. Haux R. Medical Informatics: past, present, future. Int J Med Info 2010;79(9):599-610.
6. Schleyer TK. Dental Informatics: An emerging biomedical informatics discipline. J Dent Educ 2003;67(11):1193-1200.
7. Button PS, Doyle K, Karitis JM, Selhorst C. Automating clinical documentation in dentistry: case study of a clinical integration model. J Healthc Inf Manag 1999;13(3):31-40.
8. Schleyer TK. Dental Informatics: A work in progress. Adv Dent Res 2003;17:9-15.
9. Erstad TL. Analyzing computer based patient records: a review of literature. J Healthc Inf Manag 17(4):51-57.
10. Heid DW, Chasteen J, Forrey AW. The electronic oral health record. J Contemp Dent Pract 2002;3(1):43-54.
11. Emmot L. Choosing Practice Management software. Dental Products Report 2003;pg 66-68.
12. Yasnoff WA, O‗Carroll PW , Koo D, Linkins RW, Kilbourne EM. Public Health Informatics: Improving and Transforming Public Health in the Information Age. J Pub Health Manag Pract. 2000;6(6):67–75
13. Athavale AV, Zodpey SP. Public Health Informatics in India: The potential and the challenges. Indian J Public Health 2010;54(3): 131-6.
14. IBM, SPSS statistics 20 brief guide 2010, (cited on 22nd March 2013) available from : ftp://public.dhe.ibm.com/software/analytics/spss/documentation/statistics/20.0/en/client/Manuals/IBM_SPSS_Statistics_Brief_Guide.pdf
15. Sector P. An Introduction to the SAS System (internet),(cited on 15th April 2013), available from: www.stat.berkeley.edu/classes/s100/sas.pdf
16. MS- EXCEL (internet) , cited 15th April 2013, available from: http://www.hrdiap.gov.in/Downloads/04.MS%20Excel.pdf
17. CDC, Epi-Info Community Health Assessment Tutorial, published by: Centers for Disease Control and Prevention, october (2005) cited 17th April 2013. Available from ftp://ftp.cdc.gov/pub/software/epi_info/EIHAT_WEB/IntroductoryMaterials.pdf
18. Acharya. A, Wali.T, Rauch.J , GURU: Patient Education Software. J Dent Edu 2009;73(1):137-139.
19. Chiodo G, Tolle SW, Bartley M .Antibiotic prophylaxis for dental treatment. Review and update III, Dent J 1990;59(7):599-.60
20. Patterson dental system, CASEY SMILE CHANNEL user guide 2009, cited 12th April 2013, available from: https://pattersonsupport.custhelp.com/euf/assets/Tra

ining/CAESY/OnDemand/Smile_Channel_9_DVD_Users_Guide_091709.pdf?nointercept/1

21. ORASPHERE Dental Patient Education Solution (internet) cited 21st March 2013 . available from : http://www.orasphere.com/products/product.php?p=dvd

22. Rao B, Lombardi A 2nd. Telemedicine: current status in developed and developing countries. J Drugs Dermatol. 2009;8(4):371-5.

23. 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(7)(Suppl-2):1486-1488.

24. Chen JW, Hobdell MH, Dunn K, Johnson KA, Zhang J. Teledentistry and its use in dental education. J Am Dent Assoc 2003;134(3):342-346.

25. Krishnan A, Nongkynrih B, Yadav K, Singh S, Gupta V. Evaluation of computerized health management information system for primary health care in rural India. BMC Health Services Research 2010;10:310:1-13.

26. Petersen PE, Bourgeois D, Bratthall. D, Ogawa. H. Oral health information systems — towards measuring progress in oral health promotion and disease prevention. Bull World Health Organ 2005;83(9):686-93.

27. Bourgeois DM, Llodra JC. European Global Oral Health Indicators Development Project 2003 Report Proceedings. France: Quint Int; 2004.

Corresponding Address

Dr.Nitin Patwardhan
Proffessor
Department of Public Health Dentistry
Teerthanker Mahaveer Dental College & Research Centre