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Dental informatics: Current challenges and expanding opportunities in India

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Abstract
Dental informatics is a new and distinct specialty area in its budding stage emerging on the global public health platform within the broader discipline of health informatics. 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. The potential role of dental informatics in diminishing oral health inequalities in underserved populations has been recognized by a number of reports from all over the world. Critical scientific and social obstructions can change the day by day exercises and the future scope of professionals associated with the related field. This review article discusses the difficulties challenges in Indian setting. The articles were searched in Pubmed and Google scholar database and a total of 15 articles were reviewed from 2003 to 2018. The rapidly developing scenario of dental public health and the future of the oral health in India would depend upon laying down the foundation for a multidisciplinary and flexible realm of dental public health informatics. Planning an effective oral health information system model, proper training, online research community, government funding, an automated dental treatment planning system for all diagnoses, and comprehensive electronic oral health record would remove critical barriers for solving important problems in dental informatics in India.

Keywords: Dental informatics, Indian informatics, health informatics, barriers, solutions

Introduction
Information technology has developed very rapidly in a short span of 40 years and touched almost every aspect of the society in expanding and altering modified economic and social activities all over the world. Governments of developed countries harnessed this power of computers to initiate "e-health" projects in their respective systems. ICT is powerful that it very well may be outfit from numerous points of view; however its actual potential is constrained just to the human mind [1].

The history of "informatics," the integration of this scientific field in public health, and the asserted informatics potential to revolutionize public health all point to a requirement for understanding the interplay among the sciences of information, computing, and public health. Based on 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. Dental informatics (DI) 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].

Dental informatics is rationally a field in its budding stage. It has immense potential for upgrading patient care at the clinical settings. Majority of dentists are new to the objectives, goals and accomplishments of dental informatics and how they can contribute towards it [3]. It is getting exceptionally unrealistic for the health workers 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 behaviour. Hence health professionals along with the understanding of health informatics ought to guarantee that these applications are developed, applied & evaluated properly [4].

Once the barrier between the dentist and the technology is resolved, the bridge connecting innovations such as decision support, real-time data diffusion, and proceeding illumination in the context of practice will be opened [5].

Thus, the challenges facing the field of dental informatics as specific, precise and scientific that would expel critical barriers to tackle significant issues in dentistry [6].

Although there is sufficient literature which explains what dental informatics is all about, still there is lack of information about its implementation. This article is an attempt to highlight the important points of challenges, solutions and its expanding opportunities in a developing country like India.

Materials and Methods
The articles were searched in Pubmed and Google scholar database, a total of 15 articles were reviewed from 2003 to 2018.

Currently the challenges faced by the emerging discipline of dental informatics to prosper for the well-being of the underserved population in India emerge out of some public health governance issues, unaffordibility, inaccessibility and some digital divide related with e-health.

There are many major challenges and barriers that hamper Dental informatics from establishing itself as a discipline in its own right
1) Size and Geography
A requirement for an actual oral health information management system arises in India on account of the harsh irregularities in affordability and access to oral healthcare between urban and rural populace. Inappropriate financing by the administrations; Lack of labor and assets; alarming situations such as disasters, famine floods, earthquakes, epidemics of diseases, increasing burden of oral diseases etc. The number of experienced and trained Dental Informatics researchers is negligible and growth is also very slow and stagnant [7].

2) Professional under Representation
The next most significant challenge is the lack of the trained manpower in inaccessible rural areas for establishment and maintenance of the ICTs required for health informatics.[3] Majority of the public (government) dental health-care setups are poorly equipped, understaffed, and oral health is not a priority in budgetary allocations. For instance it can take a long time to fix any technical snag as technical support is hard to come by in local rural areas prompting to a disintegrating tele-consultation center. Moreover, the field of informatics is strange to most public health workers [7].

3) Lack of Literature
Not many articles have been published in India till date prompting to lack of source of information. There are around 4266 informatics related articles. Dental informatics literature is similarly scattered: one study of 620 DI papers determined that the topic was spread over 176 different journals across the globe and India accounts for less than 10% of the total publications. However, the representation of India toward Dental Informatics research on the international platform is negligible The International Journal of Computerized Dentistry is the only periodical devoted solely to the topic of Dental informatics. However, this journal is not fully inclusive and reflects the focus of its parent association, which is centred on CAD/CAM technology [8]. This lack of data hampers the scope of Dental Informatics in India.

4) Academia Unfamiliarity
Dental students, faculty, and administrators are not familiar with Dental Informatics as an area of scientific inquiry, because the field is not merged into the dental curriculum in India. Dental graduates lack awareness and are unable to perceive the importance of community oral health. Defiance to the development of ICT systems by associates such as health professionals, managers, and even the handlers of the systems can create further issues once programs are implemented and may limit its use. For example, need of large mass of patients who will use the telemedicine facility at a PHC. Morever, the cultural barriers, the low literacy rate and diversity of language across different states in India act as barriers for acceptance of Dental Informatics in India. Lack of basic amenities such as connectivity, modes of transportation, electricity in rural areas worsens the condition [7].

5) Lack of Financial Funding and Investment
Financial investment problem is of utmost importance as it is required to develop, implement, and maintain e-health initiatives to fluorish public health informatics. The start-up costs, involving both manpower and expensive technological equipment are substantial. WHO has recommended around 5% of GDP as an investment in public health expenditure by any state is far less with the present less than 1.2% percent of GDP investment in India; a goal that needs enormous political interest to be reached in the near future [6].

6) Paucity of Lack of Development of National Public Health Information Systems
Framing integrated and logical national public health information systems will be the next challenge for Dental informatics. Precise explanations of public health data needs and their sources, data collection and communication standards-to facilitate data quality, comparability, and exchange; and establishment of policies for accessing and distributing data in a useful manner-thus to have a common health information system framework, are the basic necessities of a good public health information system. Developing interoperability standards and provision of sufficient bandwidth among many stakeholders in Indian scenario of health care delivery, e.g. government and private health care providers for data sharing, is a overwhelming task [9].

7) Confidentiality, Privacy and Security Issues
Privacy, confidentiality, and security are important issues which persistently need to be addressed with the application of an informatics system in India where the security issues still remain prority [6]. For authentication of accessing and using data, definite guidelines and policies have to be framed. Proper patient data and security of the systems are crucial for prevention of the mishandling of the data especially in the country like India [9].

8) Universal Access to Computers and High-Speed Internet Connections
Access to computers with high-speed Internet connections is the foundation for the growth of Informatics in India. Access must increase for both patients and dentists. The so-called "digital divide" will continue to hamper all efforts to develop these advanced systems. A digital divide is any uneven distribution in the access to, use of, or impact of information and communication technologies between any numbers of distinct groups; these groups may be defined based on social, geographical, or geopolitical criteria [10].

9) Collections of Large Databases of Patient Information
India is the second most populated country in the world with the population of 1.38 billion. The burden of the oral disease still remains very high in India due to the negligence of the oral health. Large collections of patient information will be required to be developed by many of these systems. Up to this time, there has been a enormous public outcry against such efforts to automate data capture, unification, and synthesis to create real-time, knowledge-based, clinical surveillance systems based on both continuously and intermittently available analogue and digital data. Such systems must include data from multiple input sources of widely varying degrees of precision and authenticity [10].

Results
Clearly, building up all the innovations required to make this scenario possible will require researchers and dental professionals to address multiple grand challenges. Dental informatics is like an "encyclopaedia for dental health and disease". For the easy accessibility of all the information to people worldwide and enhance its capability to bring about its research goals, some of the proposals put forth are:

A) Planning an Effective Oral Health Information System Model
Petersen P.E *et al* explored data on oral health status for monitoring disease patterns and trends over time represent a crucial component of the system [5].

1. Risk factor surveillance:
WHO has recommended that regular oral health surveys should be conducted every 5-6 years in the same community or setting for effective and successful oral health surveillance. Surveillance provides continuous (i.e. continuous or periodic) collection, analysis and interpretation of oral health data, and the ideal dissemination of such information to client. The objective is to design oral health indicators to prevent and quantify the outcome of the disease. A stepwise initiative 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 and can be applied in Indian settings if planned properly [11].

2. Care and intervention
The sort and measure of public health services provided through public health system must be evaluated, once prevalence of a disease is established through database collected from various surveys for example number of restorations, extractions, prosthesis delivered in a year. Dental informatics can help at this phase by utilizing electronic oral health records (EOHR) for maintaining data related to oral health [12].

3. Administration of care
The main role of Dental informatics is to support health professionals in delivering health care services to the underserved population. The other important objective is to support program managers in timely monitoring and supervision of the workers. An effective management by the Indian government health officials is essential in scaling up the quantity and quality of health services and improving the health of the population in the rural areas [13].

4. Quality and outcome
Outcome from a oral health care program is an essential component as it decides the effectiveness of a program. It is measured through ORHQOL (oral health related quality of life). ORHQOL 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 pain or discomfort, absence of impairment, disease or symptoms, appropriate physical functioning associated with chewing and swallowing, 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 [14]

B) Training Dental Informaticians.
1. Dental Informatics Internship Program
These programs already exist in developed countries. Starting similar internship programs in developing country like India will bring awareness, open up new opportunities to learn, promote and practice dental informatics. Legitimate instructions, training and support systems ought to be created and incorporated in dental fraternity with good surveillance for best implementation in patient well-being [9].

2. Interdisciplinary Course
An information resource training (IRT) courses can be developed in India to make acquainted the students with the information technology accessible to them. For implementing such courses first assessment 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 introduced to students at under-graduate level in health institutions all over India [10].

3. Curriculum for Dental Researchers
The National Institute of Dental and Craniofacial Research (NIDCR) and the National Library of Medicine (NLM) co-sponsors a 2-year Fellowship in Oral Health Informatics (OHI). This 2-year full-time post-doctoral fellowship opportunity is for dentists interested applying informatics science as it relates to research, education, and clinical care in the broad area of public health dentistry. Several procedures of Dental informatics training programs for dental researcher; like single full time course or series of part time short courses, conference covered in short period of time need to be made available in Indian setting. In these part time or full time courses students are make acquainted with the core capacities of the syllabus, followed by application of the same. This basic curriculum includes: (1) In depth information of Dental informatics; (2) Acquiring skills about data management system; (3) Learning basics of handling the equipment [10].

C) Online Health Research Community
E- health communities are defined as an aggregation of health professionals of various specialities who interact around a common interest, where the interaction is at least partially supported and/or mediated by technology. E- health communities in India should utilize the global health databases to overcome various barriers faced by dental informaticians by bringing oral health researchers and policy makers together at a resource hub across the country. This

will enhance the knowledge and capabilities to face new challenges in dental practice [15].

D) Government Funding

Indian Government bodies should fund research and well deserved candidates should be recruited. Government has shown its willingness to invest 1.2% of GDP as a public health investment stepwise during government's fiscal budget which stands 1.13% of the GDP as of now. This investment seems to be allocated to general health and less towards the oral health. The Department of Information Technology and the Ministry of Communications and Information Technology launched a pilot telemedicine project through the Indian Space Research Organisation (ISRO) in 1999. Around 1,000 telemedicine nodes were established a cross the country by Government/Private/Charitable Trust agencies [16].

PHCs and CHCs should be equipped with public health infrastructure to widen the reach of speciality care, facilitate education, training and provide better services to the society. The plan also ensures budget allocation for computerization and networking of health care system, i.e. PHCs, rural hospitals, district hospitals, and super-specialties. Recommendations for inclusion of information technology under the dental curriculum, Integration of the infrastructure such as Central Bureau of Health Intelligence, National Institute of Communicable diseases, etc., are some of the welcome moves by the government that need to be considered [2].

Conclusion

The hypothetical patient-care scenario, combined with the specific informatics-related applications, highlight the challenges facing the dental informatics today. To overcome these challenges we need to identify them at first place. The implementation of the dental informatics should have an effective monitoring and surveillance system so that proper Information and Communication Technology (ICT) education, training and support systems is developed and incorporated in dental fraternity across the nation. India is an ideal setting for telemedicine and teledentistry assisted healthcare delivery. Dental informatics can embrace a whole new treatment opportunity for various dentists, specialists to work together. Under the rapidly evolving scenario of oral health, the future of the oral health governance and population health in India would depend upon constructing and bringing together all the domains required for the proper functioning of the Dental Informatics.

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