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RESEARCH ARTICLE

INFORMATION TECHNOLOGY AND DENTISTRY

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ABSTRACT

"Information technology (IT) is defined as capabilities offered to organizations by computers, software applications, and telecommunications to deliver data, information, and knowledge to individuals and processes." IT has made a tremendous impact on how we carry out our personal and professional work effectively and efficiently. IT is promising in many ways as compared to traditional methods used in clinical care, education, research and can also provide many innovative approaches to overcome barriers. IT will always be exciting and one will adapt to this ever-changing landscape. This review focuses on applications of IT in dentistry for clinical care, dental education, patient education, research, administration, electronic dental records, tele-dentistry, design and production, digital radiography and digital photography.

INTRODUCTION

"Information technology (IT) is defined as capabilities offered to organizations by computers, software applications, and telecommunications to deliver data, information, and knowledge to individuals and processes (Onn, 2013)." Over a period of time, IT has changed the study and the practice environments in dentistry, as in other disciplines. In the last fifty years, IT has advanced precipitously (Schleyer, 2012). IT comprises electronic systems that help to generate, process, store, retrieve, transform, and disseminate data which may be of vocal, pictorial, textual or numerical type. IT is increasingly being used in dentistry for clinical care, dental education, patient education, research, administration, electronic dental records, tele-dentistry, design and production, digital radiography and digital photography.

The rapid development of IT has enabled us with the networked system to access shared information databases capable of transmitting data anywhere in the world.³The present review article focuses on various potential applications of information technology in dentistry.

The Applications of Information Technology in dentistry:
The inception of computers took place in the mid-1940s to their establishment as an unequivocal market success in 1964 (Schnaars, 2004). Since then the computer has become more & more affordable and accessible globally. Internet was originally developed by the military of the USA in the early 1960s to ensure a workable communication system (Kumar, 2010). The combined use of computers and the internet has enabled shared information databases, is an important part of information technology. IT has made a tremendous impact on how we carry out our personal and professional work effectively and efficiently (Yip, 1999).

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The following applications of information technology in dentistry are part of dental informatics.

- Clinical Care
- Dental Education
- Patient Education
- Research
- Administration
- Electronic Dental Records (EDR)
- Teledentistry
- Design and Production
- Digital Radiography
- Digital Photography

Clinical Care: Interactions between oral health & systemic health is now well established which are bidirectional, complex and involves many pathways (Johnson, 2006). Systemic conditions that are impacted by oral conditions are atherosclerotic disease, pulmonary disease, diabetes, pregnancy, birth weight, osteoporosis, and kidney disease (Kane, 2017). Volume of literature highlighting importance of oral & systemic health connection is increasing (Schleyer, 2012). While treating a dental patient, it is customary to take medical history to prevent any potential complication due to underlying medical disease. IT-enabled EHR systems accessible to different health care providers can help for Inter-professional collaboration in such scenarios. Such collaboration can help health care providers in understanding information received from others and ultimately developing a meaningful treatment plan (Schleyer, 2012).

Dental Education: Like the clinical care domain, dental education is also positively affected by emerging technologies for its own purposes (Mattheos, 2008). Many apps are available on the app store which makes dental education learning quite easy. Various applications have addressed the visual nature of dentistry through images, cases through videodiscs and CDs (Eaton et al., 2008). Use of multimedia teaching, computer-assisted training and learning tools are increasing for dental education. With the advancement of technology practice of evidence-based dentistry has become noticeable due to the availability of information at one's fingertips such as e-textbooks and journals. Emerging simulations support dental education by providing more realistic instruction for actual patient treatment in both preclinical and clinical areas.² Accessibility of continuing dental education programs has increased through e-learning, distance learning, broadcasting teaching and webinars. Certainly, information technology has added value to traditional teaching methods.

Patient Education: Nowadays, patients have also become tech-savvy and it has enhanced the patient's appetite for information beyond just asking advice from the doctor. Further, a variety of search engines, online journals, and glossaries, patient support groups on social media, apps, and even chat bots are widely available which answers patient's questions about health-related issues and also helps patients to do their own research before visiting to doctor. Many computer-based patient information systems have evolved to replace traditional forms of patient education brochures, leaflets, videotapes which are much more impressive (Stoop, 2004). Portable video technology is widely available for patient and family education which can be accessed via the Internet and viewed either on a personal computer or on a

handheld device (Abreu et al., 2008). IT can help in diagnostic education, virtual treatment display, patient motivation and consent, chair-side computing and analysis (Saini, 2016). Most IT enabled solutions are didactic in nature and are not intended to replace but rather to enhance interaction between providers and patients (Skinner, 1993).

Research: As compared to clinical care and education, the use of IT in dental research is not much developed. Microsoft Excel is the most commonly used tool for entering, managing and analyzing research data. Research has become more complex so the need for IT support has increased. Reuse of clinical care data for research is feasible and useful as it reduces the need for expensive primary research. In dentistry, the reuse of clinical data for research is in infant stage (Schleyer, 2012). Multidisciplinary collaboration between computer science, information science, statistics, biomedical informatics, and other fields is need for the hour for analyzing and processing data in a meaningful manner.

Administration: In an academic setting, clinical management systems can be used to record and analyze students' clinical performance. Performance criteria can be incorporated which can help the latter to understand student's performance and also helps students for self-evaluation (Yip, 1999). In a hospital setting, the role of IT is varied and it can help in managing many administrative tasks such as communication with other departments and laboratories, scheduling activities/work, human resource management, marketing of hospitals, financial and accounting procedures, supply chain management, purchasing and inventory control (Singh, 2016).

Electronic Dental Records (EDR): The electronic dental record management system can be used as a practice management system that enables dentists to capture patient demographics and clinical data digitally. It also allows dentists to quickly and easily view and analyze the patient's dental conditions and clearly explain and show their diagnosis to the patients. While doing oral examination in the first visit, a dentist can use a thin intraoral camera which takes photographs and stores images in an electronic dental record system, later at any time, the dentist can use these images to analyze or diagnose the patient's condition and formulate a treatment plan (Hsieh, 2005). Other than imaging, electronic dental record systems can be used for appointment and scheduling of patient, insurance claim processing, e-prescription, medical alerts, interdisciplinary collaboration and expert opinion (Saini, 2016).

Teledentistry: Teledentistry has been made possible due to the use of computers and the internet. It is a combination of telecommunications and dentistry involving the exchange of clinical information and images over remote distances for dental consultation and treatment planning. Teledentistry has the potential to improve access and delivery of oral health care in remote areas for underserved patient populations at lower costs.¹⁶ It provides an opportunity to supplement traditional teaching methods in dental education (Chen, 2003). It can also be used for extension of education beyond geographical reach, global information exchange, and public awareness campaigns (Saini, 2016).

Design and Production: During the last quarter of the 20th century, new technology CAD/CAM i.e. Computer-Aided Designing / Computer-Aided Manufacturing was introduced and the new age started with the appearance of this technology

(Abdullah, 2018). Combined use of 3D imaging and modeling technologies such as cone beam computed tomography, intraoral scanning and CAD/CAM technology helps in 3D printing which is used for production of drill guides for dental implants, the production of physical models for prosthodontics, orthodontics and surgery, the manufacture of dental, craniomaxillofacial and orthopaedic implants, and the fabrication of copings and frameworks for implant and dental restorations (Dawood, 2015). 3D Scanning is being used chair side in clinics which send clinical data to dental laboratory where prosthesis are made exclusively by CAM using modern dental materials. Computer-aided 3D scanning and milling replaces traditional impression materials and also reduces chair side time in subsequent visits.

Digital Radiography: Digital radiography which is also known as direct digital radiography, it directly captures digital data during the patient examination by using x-ray-sensitive plates and immediately, transfers it to a computer system without the use of an intermediate cassette (Allisy-Roberts and Williams, 2008). Earlier computerized analysis of dental images utilized intraoral radiographs which included temporal subtraction, caries detection, periapical disease detection and classification, and treatment follow-up evaluation. With the advancement of technology, computer-aided diagnosis (CAD) by oral radiologists and dentists, make a diagnosis using the results of the computerized analysis which is accurate and more efficient for the diagnosis of oral diseases (Fujita, 2017). Other benefits of digital radiography include image enhancement, reduced radiation exposure, and easy image retrieval and sharing (Saini, 2016).

Digital Photography: With the advent of digital technologies, imaging has now become much easier and readily accessible. There are many reasons why to use digital photography in routine dental practice which includes dental record keeping (Wander, 2014), diagnosis & treatment planning, enhanced patient education and communication, legal documentation, insurance verification, specialist consultation, laboratory communication, professional advertising & marketing, professional instruction, self-education/improvement, treatment philosophy, and work ethics (Kalpana et al., 2018). Intraoral or fibre optic cameras are also a useful tool for demonstrating oral health-related problems to the patient on a monitor which also helps in making an informed decision regarding treatment (Ahmad, 2009). Thus clinical photography has become an essential exercise in routine dental practice.

Conclusion

Like other disciplines, dentistry has also witnessed the positive impact of Information Technology in many ways and it has made the routine dental practice much easier than ever, so one cannot think of future dental practice without use of IT. IT has the potential to improve overall organization, efficacy, efficiency and quality care in dentistry. It is promising in many ways as compared to traditional methods used in clinical care, education, research and can also provide many innovative approaches to overcome barriers. IT will always be exciting and one will adapt to this ever-changing landscape.

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