Information technology and management in dentistry - The 21st century challenge

Wanga C. L. and Mugonzibwa E. A.
Muhimbili University College of Health Sciences, Faculty of Dentistry, P.O. Box 65014, Dar es Salaam

Summary

Delivery of effective healthcare in the 21st century will be dependant on the availability, quality and accuracy of information; on the ability of healthcare professionals to produce, access, use and manage information about individuals; on access to, and use of, information management tools for Evidence-Based Care; on effective systems for communication and good communication skills; and on ensuring safe, secure, ethical and confidential handling of data and information.(Severs and Pearson, 1999). Ever since the introduction of computers, communication and flow of information has never been the same. Nowadays, communication links and database connects us with information resources far beyond the surfaces of our desks. No matter what career you choose, information technology will affect your life. Knowledge of information technology and the effective use of information technology can make difference between whether those effects are positive or negative or none at all!

Information, as applied here, is data that has been processed by a computer system. A collection of computers, people, data and procedures that work together to produce information essential to running an organization makes up an Information system.

"IM&T" (Information Management and Technology) is a term which covers the use and management of information and information systems. This applies to organized systems of all forms, whether based on human endeavor, paper methods or information technology. The emerging electronic world offers enormous benefits to organizations of all types.

The application of new information technologies to dental practice, education and research is called Dental Informatics.

Informatics is a formal discipline in an academic setting and it is the key to health care organizations meeting their business goals. Dental Informatics is the application of new information technologies to dental practice, education, and research.

Dental Informatics can assist with strategic planning, setting goals and objectives, and decision making, with regard to management applications in dental practices, computer labs, simulations, equipment, and more. Modern information management technology is making its way into every corner of dentistry.

The main objective of this presentation is to bring in to our attention the importance of information technology and its application in dentistry. The presentation also aims at providing a comfort zone when using computers, especially the internet, easing the apprehension about the subject matter and on practice management modalities that can be adopted with this amazing information superhighway.

Introduction

Health care is being changed dramatically by the marriage of computers and telecommunications.[1] Delivery of effective healthcare in the 21st century will be dependent on the availability, quality and accuracy of information; on the ability of healthcare professionals to produce, access, use and manage information about individuals; on access to, and use of, information management tools for Evidence-Based Care; on effective systems for communication and good communication skills; and on ensuring safe, secure, ethical and confidential handling of data and information.[2]

Ever since the introduction of computers, communication and flow of information has never been the same. Nowadays, communication links and database connects us with information resources far beyond the surfaces of our desks.[3] The Internet, the World Wide Web and other developments of the information revolution are slowly redefining patient care, referral relationships, practice management, quality, professional organizations and competition.[1] No matter what career you choose, information technology will affect your life. Knowledge of information technology and the effective use of information technology can make difference between whether those effects are positive or negative or none at all![3]

Information, as applied here, is data that has been processed by a computer system.

Information technology (Information system) refers to the collection of products and services that turn data into useful, meaningful, accessible information.[4]

Information system

[A collection of computers, people, data and procedures that work together to produce information essential to running an organization makes up an Information system.][3]

The information technology industry has several major facets: computer hardware, software, people, data and procedures that work together to produce information essential to service provision and in the running of an organization.

The application of new information technologies to dental practice, education, research, and management is called Dental Informatics.[4]
Informatics is a formal discipline in an academic setting and it is the key to health care organizations meeting their business goals. Informatics is also called information management, information science and information technology. The health Informatics emergency as a discipline is due to the growing awareness that biomedical knowledge and patients' clinical information can not be properly handled via traditional methods, and that the process of knowledge recovering and expert decisions made on the basis of that knowledge are fundamental to the modern medical science.

Informatics History
-In the beginning information was passed along by speech.
-This was followed by writing, which was first in picture form, and resulted in written script.
-Art or graphics was used to store and transmit information. This evolved to the use of vocal recording, film and video.
The rapid development of the computer and communications resulted in a methodology for quick and prolific communication of information. Enter the Information Age, just like the industrial revolution entered at the beginning of the 20th century.

"IM&T" (Information Management and Technology) is a term which covers the use and management of information and information systems. This applies to organized systems of all forms, whether based on human endeavor, paper methods or information technology. The emerging electronic world offers enormous benefits to organizations of all types.

Dental Informatics is a relatively new field that has significant potential for supporting clinical care.[5] Most dentists are unaware of what dental Informatics is, what its goals are, what it has achieved and how they can get involved in it. Dental Informatics can assist with strategic planning, setting goals and objectives, and decision making, with regard to management applications in dental practices, computer labs, simulations, equipment, and more. Modern information management technology is slowly making its way into every corner of dentistry.

In many parts of the developed world, Informatics and the use of computer-based tools and resources are now an integral part of progressive dental schools and dental clinics. Innovations within the industry, particularly with Internet, Internet and network based computing, hold exciting new opportunities for dental professionals, faculty, staff and students to support educational and patient care processes.

To respond proactively to the digital transformation of oral health care, dental professionals must become familiar with its technologies and concepts. They must learn what new information technology can do for them and their patients and then develop creative applications that promote the profession and their approaches to care.[1] Dental Informatics requires one to have basic knowledge about computer systems, how to organize information about a clinical problem, how to understand the system theory behind information system applications, and how to evaluate special dental applications.

An understanding of the principles of Information technology is now as essential to the delivery of effective healthcare as is knowledge of grammar to the production of effective written communication **(Stephens 1999)**. Bauer, Brown and Zimnik (1998) have identified the technological foundations for Informatics:

- **Computers**; offering immediate access to unprecedented computational power
- **Networks**; the combination of information and telecommunication technologies (ICTs) which allow information systems to be built and operated in new ways
- **Digitization**, the process of transforming real-world data into computer language

Goals and objectives

This presentation aims to:
- Educate us on Computer and Internet terminology, easing apprehension about the subject matter

- Briefly introduce us into the word of computers
- Allow us to develop a comfort zone when using the Internet
- Highlight on techniques for doing effective searches (research) for WWW-based material related to dentistry
- Show practice management modalities available online
- Elaborate use of E-mail to communicate with patients and E-presentations as an aid in bolstering case acceptance
- Show features that can be included in a dental office website
- Show to distribute information on their local computer network

Computers

History of Computers in Dentistry
The use of computers in dental education and practice goes back to the mid 1960's when they were used for specific and limited tasks in the administration of dental schools and large dental practices. An early educational use was in the marking and collating of multiple choice examinations in some universities. The widespread availability of both the Apple and PC computers in the early 1980's changed the emphasis and role of the computer and hence the relationship dentists had with them. The dentists became empowered at the expense of the so-called computer expert. The hypothesis that dentists, in all disguises, are "gadget mad" and were a natural group to become computer enthusiasts will be explored. This has resulted in dentistry being in the forefront of the development of computer uses in universities and dental practice was ahead of medical practice in both administrative and in office/surgery functions. In recent years, however, the lead has been eroded and there is now very little innovation that is specifically dental and we are using and adapting existing techniques, hardware and software or sharing developments in order to reduce escalating costs. Dentistry in all its many facets is not considered either different enough or a big enough market to be separately developed.

What is a computer anyway?

A computer is a device or a tool, which accepts data in one form and processes it to produce data or information in another form (i.e. in a more intelligible form). In other words a computer is a machine which stores and manipulates data in a logical manner.

Types of computers
Microcomputers

Desktop Computers-
Small enough to fit on a table yet too big to carry around. Two categories; Personal Computers, Workstations

Portable Computers-
Small enough and light enough to move easily from one place to another. four categories; Laptops, Notebooks, Subnotebooks, Personal Digital Assistants (PDA)

Minicomputers
Midrange, fall between microcomputers and mainframe computers

Mainframe computers
Large computers occupying specially wired, air conditioned rooms. Great processing speed and data storage. In Large organizations-Universities, businesses, banks etc.

Supercomputers
Most powerful type. Special, high-capacity computers used by large organizations e.g. NASA

Hardware

Computer hardware is the physical equipment or machinery that constitute a serviceable part. The hardware consists of the equipment: Keyboard, mouse, monitor, system unit, and other devices. Hardware is controlled by software. It actually processes the data to create information.

Comprises of the:

- Monitor
- Console – also called the system unit or CPU
- Motherboard – contains microprocessor, memory, expansion slots and expansion cards, computer chips
- BIOS (Basic Input/Output System) – found on the Motherboard; allows the microprocessor to communicate with other parts of the computer; starts the computer
- Keyboard
- Mouse
- Drives:
  Hard drive- large plate inside the computer where loads of data can be stored and

accessed quicker; has largest data storage capacity.

Floppy drive – for floppy disks which are great for transporting and making back-up copies of info, but can't store as much as a hard disk (hard drive) or CD-ROM.

CD-ROM drive - for CD-ROMs which look like music CDs and store megabytes of data that can be accessed just like a hard disk or floppy.

Software

Software is another name for programs. Programs are instructions that tell the computer how to process data into the form you want. In most cases the words software and programs are interchangeable.

- **Operating system**
- **Application programs**
- **Other programs**
- **The information stored on floppy disks and CD-ROMs**

Implementation of New Technology into Dental Practice.

Major concern today is not whether to computerize and add some of the new technology into the practice, but how to implement and facilitate this process.

Major areas of concern:

A. Practice management.

Maintaining patient records, insurance claims, tracking payments, marketing, etc.

B. Recording and management of clinical data.

Patient history, medical alerts, charting periodontal disease and caries, treatment planning, monitor treatment progress.

C. New technological areas.

Imaging technology using the intraoral camera and digital x-rays, pre and post-treatment simulation and robotics.

What Is Driving This Sudden Technological Upheaval And How Is Technology Affecting Dentistry?

The technological upheaval is due to:

- availability of high performance PCs.
- Enhanced telecommunications.
- Simple and affordable networking (easy to install and maintain).
- Ability to digitize information into an electronic form (scanner technology).
- increase in Internet use

The development and integration of these technologies enable the application of Informatics in the dental office. This allows for decision-making answers to be obtained from all aspects of information available within and outside of the dental office. It includes computerized data obtainable from clinical, financial and managerial information.

Technology is here to stay. Computer skills will provide far-reaching opportunities for improving all aspects of Dentistry.

Networks. Shared computer resources.

Dental Office Intranet

Most dental offices have at least one computer. Offices with more than one can establish a computer network, which is more than one computer connected in a way that files or computer resources can be shared. Traditionally, dental practice management software is the main purpose for the presence of this network. If you add software features like those used on the Internet, then this becomes your office Intranet.

Concepts are emerging that merge Intranets onto the Internet. This affords the benefit of using your Intranet from different locations. File sharing through Internet file storage is becoming available, and challenges the definitions of Intranet and Internet.

While the Internet is a collection of computers that share resources all over the world, your office Intranet is a capable of sharing your computer resources all over the office. At least everywhere you place a computer.

Printers

Many different types of printing jobs are required for business office tasks. In addition clinical needs such as photographs, clinical progress notes, computer generated prescriptions, and periodontal charting may need to be printed out at times. Various printers may be set up to specially handle these tasks. Different locations in the office may be required for printing as well. With computer networks, all the office computers can have access to each of these printers. The trend is toward paper reduced offices, but there is still a place for printed forms.

Your computer data files

Computer networks give you an opportunity to have one computer act as a dedicated server for all your computer (not used to run programs. only to serve the others), or as a server in a peer-to-peer environment (still can be used for running software). This is important as to share clinical information from room to room, you need one central storage area and master file that can be shared. Clinical software could be moved from room to room on one computer you would loose the ability for multiple users to work simultaneously, and would not have network resources at your disposal.

Central storage (hard drive)

Clinical data, such as digital photographs and radiographs can occupy a lot of storage space. Fortunately, in recent year hard drives (internal storage units) have increased greatly in capacity without an increase in price. The amount of data that can be stored has increased dramatically. Early home/office computers (circa 1986) had hard drives that stored 20 MB of data. Today 20 GB drives are common place. In all likelihood this trend will continue for the foreseeable future.
We are going to be afforded the luxury to have central data storage in our office that is up to the challenge of meeting the needs of our e-tools.

Internet access

The Internet is an excellent medium for storing and quickly disseminating large amounts of information on a global basis. Modern medicine requires a rapid access to information including clinical data from medical records, bibliographic databases, knowledge bases and nomenclature databases. This is especially true for university hospitals and medical schools for training as well as for fundamental and clinical research for diagnosis and therapeutic purposes. Therefore, the Internet with its constantly increasing offers plays a more and more important role in scientific research.[6]

Previous version of the Windows operating systems did not allow for the sharing of Internet access. The most recent version, Windows NT 200 Professional, according to their website, Connects your home network or small office network to the Internet, using a dial-up or broadband connection. From a single computer, you can provide network address translation, addressing and name resolution services for all computers on your small network.

Electronic staff manual resembling a web site

Creation of electronic staff manuals that can be viewed throughout the office becomes possible. This can created resembling a web site that is accessible to all staff on your Intranet. Imagine being able to pull up clinical guidelines for quick reference from anywhere in the office. No more old versions of paper forms floating around the office in out-dated fashion.

Single location to back up data

Your data is your livelihood. It is paramount to back up your practice management and clinical data files daily. These files may be large and tape backup, or CD-R (recordable CD media) may be used. CD-R is helpful since the data can be read on most CD-ROM drives. Internal tape back up drives work nicely (and quickly), but if it is an internal tape drive (installed in the computer) you need another unit to read the data at another location. When working in a paper-reduced practice where most clinical procedures are executed and recording digitally, think of the great security one has against a hazard loss such as a fire!

Phone access from home

There are times when you would like to be able to view your data from home. Patients do have after hour emergencies. Imagine having a dial-in program where you could view the account or clinical history from home. A computer server and programs such as PCAnywhere allow for this to occur. Note that if you are using telephone modem access, then viewing items like images and digital radiographs may take too long to be practical. Your office computer network moves these files quickly, but remote phone access will not. There is hope.

Messaging from room to room

Software like Winpop2000 and Winpop Plus allow computers in different rooms within the office to serve as remote communicator like devices. Not lights or digits, but messages can pop up on the screen along the intranet/computer network. Clinical uses abound for this feature.

Practice Management on the Net

In recent years, a wave of new technology has opened a new frontier in dentistry that profoundly affects the ways in which dental professionals can interact with patients, undertake chairside routines, perform clinical procedures, and manage the business aspects of a dental practice. With the rapidly expanding use of the

Internet and the World Wide Web, the perception of what constitutes timely and effective communication has the potential for changing dramatically.

Dental professionals (much in the developed world) can now watch clinical procedures for the first time via live satellite transmission, perhaps thousands of miles from the clinician who is actually performing the procedure. This newfound efficiency requires staff to be computer-savvy, thus expanding traditional roles as dental assistants, practice administrators, office managers, and front-desk personnel.

Now digital and wireless technologies provide new ways for people to connect with one another. For instance, we can read and send e-mail from any place in the world. It is not uncommon for patients to give cellular or digital phone numbers, or e-mail addresses as their preferred methods of contact. This is indicative that some dental patients are adopting and accepting this new means of information exchange, yet many dental practitioners have continued to resist these new forms of communication.

Ultimately, the use of digital information technologies will serve as the cornerstone of a successful dental practice. The flourishing practice of the future will use digital tools to revamp the practice of dentistry. At least two of the currently available digital tools are increasingly becoming essential: a customer-oriented web site and a comprehensive, yet research-friendly database (i.e., the practice management system).

Clinical implications: The Internet appears to support clinical practice mostly indirectly, by helping users keep up in general, rather than by answering specific clinical questions[7]

E-mail program features and compatibility

Many e-mail programs are available for use. Microsoft users have Microsoft Outlook available. Netscape Communicator with Messenger is a Web browser and e-mail package. Eudora is another program available to send and receive e-mail. E-mail is sent on the Internet with the aid of programs like these. The online or Internet service provider stores e-mail which is sent to your e-mail address, until you use a program to download for viewing.

Components that e-mail programs may include are areas for e-mail address for recipients, electronic carbon copies **(Cc)**, electronic blind carbon copies **(BCc)**, subject line, body for mail message, auto insertion of electronic signature, address book (to save e-mail addresses and names), assigning priorities to mail, ability to send html coded text in the body of the e-mail, spell checking, selectable fonts, text alignment and the ability to send file attachments.

Using e-mail to enhance practice

E-mail can be used to enhance dental practice. This can be powerful when integrated into practice-management software, and as a feature on a Web site. The potential for task completion through automatically generated tasks such as recall/recare reminders exist. Many patients find e-mail to be a more convenient venue for contacting your office, and being contacted.

Patients who are avid e-mail users may appreciate being contacted with information about the dental office and staff. Traditional methods of contact such as newsletters can be used in sync with a Web site to offer much more material with online support of these marketing tools.

Issues to be considered include the percentage of regular e-mail users, your patient demographics in terms of computer use, the lack of personal touch in using e-mail, etc. The future may bring new consumer devices with a convergence of e-mail, pagers, cell phones and other wireless technologies. Convergence could make e-mail usage more universal in the future.

E-mail attachments, the good and the bad

Text based e-mail messages can be accompanied by computer file attachments. This allows for transmission and exchange of files such as data, images, music, sound, and video. Large files may take a long time to transmit on conventional telephone modems.

Attachments are an opportunity for viruses to enter your computer. When opened viral attachments can erase files, destroy data and infect computers. Recent viruses have had a file extension of .vbs and .exe. Note that files with extensions such as .doc (word documents) can carry virus also (using "macros" or short cuts). Never open an attachment from an unknown source. Make sure to have updated virus protection software on your computer.

E-Communication venues

The future may bring changes in technologies such as telephony, television, the Internet and computing. With convergence e-mail may be transformed into an e-communication multi-media experience with sound and video.

Enhanced e-mail

E-mail is still undergoing an evolution in design and usability. More features are possible. Currently the mail is sent, resides at the recipients' mailbox on a mail server in a static fashion, and is picked up by the user. Enhancements are being pursued to make this a more dynamic situation, where updating and modification is possible.

Usually when you receive or send an e-mail, it is identified by your mail address (i.e., you@me.com). There are that allow users to log on and send anonymous e-mail. There may be a time when confidentially is needed (think about patient e-surveys).

In addition to e-mail capabilities, dentists can take further advantage of the Internet as a communication tool for sending patients reminders and practice news. Dynamic, customizable electronic newsletters are available via the Internet with interactive linking capabilities that can direct patients to a variety of services, education, and oral health resources at virtually insignificant cost to the dentist when compared with printing and mailing patient newsletters[8]

By building a web site for a dental practice and submitting information about the dental practice to search engines (e.g., Pubmed, Medscape, Google, Yahoo!, Excite, and Lycos, and the digital Yellow Pages, dentists can turn the Internet into a valuable marketing tool.

The Internet also provides a powerful research tool.

Dental professionals can access a number of journals, periodicals, suppliers, and other sites for learning about case studies, sharing ideas with other dental specialists, and gathering basic patient information.
For patients, the Internet provides access to information about clinical procedures and maintaining oral health, adding value to the care provided by professionals. However, dentists need to direct patients to quality web sites with accurate information to ensure they access the appropriate educational tools.

From a practice management standpoint, the ability to share patient records with other dental professionals, such as dental specialists and other generalists, is paramount. Transferring patient records via e-mail to referral partners is not ideal because of their vulnerability to viruses, limited attachment size, lack of security and privacy even if encrypted, and because it's not interactive. It is more desirable to use a secure Internet server, such as an Application Service Provider (ASP) which is a type of system that stores the information on the Internet.

Some dental schools are beginning to incorporate using x-rays, charting, laboratory prescriptions and other documents on the Internet instead of manually moving records from one department to another. This solution to enhancing efficiency is a low-cost investment compared with purchasing, installing, and learning an entire computer system. The transfer of files and patient records from one office to another, or from offices to insurance carriers, will likely become one of the dental industry's most essential uses for the Internet. The dental profession has only scratched the surface in terms of capitalizing on the Internet's possibilities.

Digitization

The information and communication technologies evaluations has given place to deep changes in knowledge organization, in social organization forms and practices and even in human cognition, mainly in the inner self and the identity formation. Within this knowledge digitalization process, society behaves like a decisive proponent not only in innovation but also in technology spread and diffusion.

Digitalization assumes a root change in information treatment. It allows its storage in small places or, what's more revolutionary, releases it of its own objects and material characteristics making it stay in geographically undetermined virtual spaces (the cyberspace) accessible from everywhere in the world in real time.

Formerly, computer applications in the dental office were restricted mainly to administration and organization. The revolutionary potential of digital applications does not halt at other fields, however. Besides applications in dental therapy, computerized methods have entered all levels of classic dental diagnosis: acquisition of findings, evaluation, and categorization.[9]

No science can remain outside the evolving scientific-technical revolution, even less the health sciences. However knowledge society is not formed by machines but by people who are able to use them for Society's welfare. And this is only achieved including information and communication technologies within the reach of scientific knowledge.

All of this is designed to show us how to use advanced technology and sophisticated practice management

techniques in an effective manner. A great computer system won't overcome a bad dental office manager any more than a great hand piece will make you a good dentist. Training and developing the people in the office, including the dentist, to use advanced technology effectively is at least as important as the hardware and software components. Computers in the treatment rooms, frontdesklessness, the paperless office, digital images, CAD CAM, information management and much more are all coming to dentistry. And they are going to come because they will make the way we practice better. Just like the high-speed air turbine hand piece-changed dentistry forever; new dental computer systems will change how we practice forever.

Some dentists will hold back and fear change or even resent it. Others will embrace new technology and grow with it. However no matter what your attitude is one thing is certain: **"The Future is Coming and it Will be Amazing"**

Conclusion

Successful integration of IT in dental practice will depend on how well dentists leverage computer technology with their profession. Scheduling, consultations, and patient records are moving to the Internet. However, finding the time and resources to take full advantage of these powerful new tools remains a serious issue.[10]

Although electronic media are likely to play an increasingly important role, a clinician's skills, knowledge and ability to communicate with patients will remain the keys to successful practice for the foreseeable future.[11]

References

1. Bauer JC, Brown WT. The digital transformation of oral health care. Teledentistry and electronic commerce. J Am Dent Assoc 2001;132:204-9.
2. Severs and Pearson, 1999
3. O'leary TJ. O'Leary LI. Computing Essentials. Multimedia Edition 1997-1998. McGraw-Hill Companies, Inc.
4. Schleyer T, Spallek H. Dental Informatics. A cornerstone of dental practice. J Am Dent Assoc 2001;132:605-13
5. Schleyer T. Dental informatics: a new career in dentistry. Penn Dent J (Phila) 2000;67:31-2, 46-8
6. Reiss M, Reiss G. Internet. An introduction. Wien Med Wochenschr 2000;150:225-9
7. Schleyer TK, Forrest JL, Kenney R, Dodell DS, Dovgy NA. Is the Internet useful for clinical practice? J Am Dent Assoc 1999;130:1501-11 Erratum in: J Am Dent Assoc 1999;130:1700
8. Freydberg BK. Connecting to Success: Practice Management on the Net. J Contemp Dent Pract 2001;3: 050-061.
9. Ross S, Fasbinder D, Reiss B. Computer applications in dental diagnosis. Int J Comput Dent 1998;1:9-17
10. Farr C. Dentistry takes the cybercure: scheduling, consultations, records moved to the net. Dent Today 2000;19:107-113.
11. Eaton KA. The impact of the electronic media on primary dental care in the 21st century. Prim Dent Care 2000;7:31-4