Review Article

Modern Dentistry@Computerization Dot Com; An epigrammatic sketch of the present scenario

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ABSTRACT:
Common use of computers and ready access to the internet is changing the way of the dentists all over the world in managing information and communication. Computer systems and internet have also helped improve the standard of dental practice by opening up a wide range of online professional information and resources. It facilitates communication among dental practitioners and with other health care providers. Computer software which could easily inter-relate photographic images and esthetic and cosmetic measurements would be a dynamic clinical tool and it is also beneficial in research to be conducted on cosmetic and esthetic canons. It is so common place that authors no longer give any details of the procedures. Thus a computer is becoming very popular in dentistry and it should not be less to say "The Future is coming and it will be Amazing".

Key words: Computers, dentistry, software, technology

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INTRODUCTION

Just a few years ago one does not know much about computers. Computers aren't just for sending bills they are multi media education and communication centres. Some of these ideas seem pretty extreme at first, but once onyone understand why and how, the progression is inevitable, and it will transform the way we manage our dental practices forever. Dental management experience have led to a number of

unexpected opportunities, which are coming together into a Comprehensive System to help our profession learn about and use technology. This includes Seminars**,** Users Groups, Newsletters, Books and Articles, Internet Groups**,** Consulting**,** Training, Technology References**,** Hardware, Room Design and more.[1-4]

All of this is designed to show regular dentists how to use advanced technology and sophisticated practice management techniques in an effective manner. 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. Dental office computer systems with chair side terminals are not just gimmicks using fancy toys but they will increase efficiency, save money and quickly pay for themselves.[5-6]

Computers in the treatment rooms, 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:

DEVELOPMENT OF COMPUTERS

Computer technology has undergone a significant change over a period of 4 decades. Prior to 1946, the only machines available for data processing were desk calculators and punch card system. In 1946 the world's 1st electronic computer viz. Electronic Numerical Integrator And Calculator (ENIAC) was developed. This has undergone various changes to become a present day microcomputers which are far more powerful and cost very little. The advances in computer technology are usually talked in terms of generations.[7-8]

The 1st generation computer started in 1945 contained 18,000 small bottle sized valves which constituted its CPU. This machine did not have facility to store and is complicated. The 2nd generation computers found the way for development with the invention of the transistor in 1947. Such computers appear in market in the early 60s. They are much smaller and more reliable. The 3rd generation computers followed the invention of integrated circuit (IC) in 1959. They appeared in the market in the 2nd half of the 60s. The 4th generation computers owe their birth to the advent of the microprocessor in

1972. This device has enabled the development of microcomputer, personal computer and portable computers. The 5th generation computers which are in developing stage may use switch like high electron mobility transistor and will be 50 times more faster than the present day superfast machines.[9-15]

The computer can be a digital computer or it can be an analogue computer. A digital computer is one which operates essentially by counting (using information, including letters and symbols, in coded form). The analogue computers operate by measuring rather than counting. Digital computer handles information as strings of binary numbers that is zeroes and ones. Analogue computer converts varying quantities such as temperature and pressure into corresponding electrical voltages and then performs specified functions on the given signals. Thus analogue computers are used for certain specialised engineering and scientific applications.[16-19]

HISTORICAL PERSPECTIVES 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.

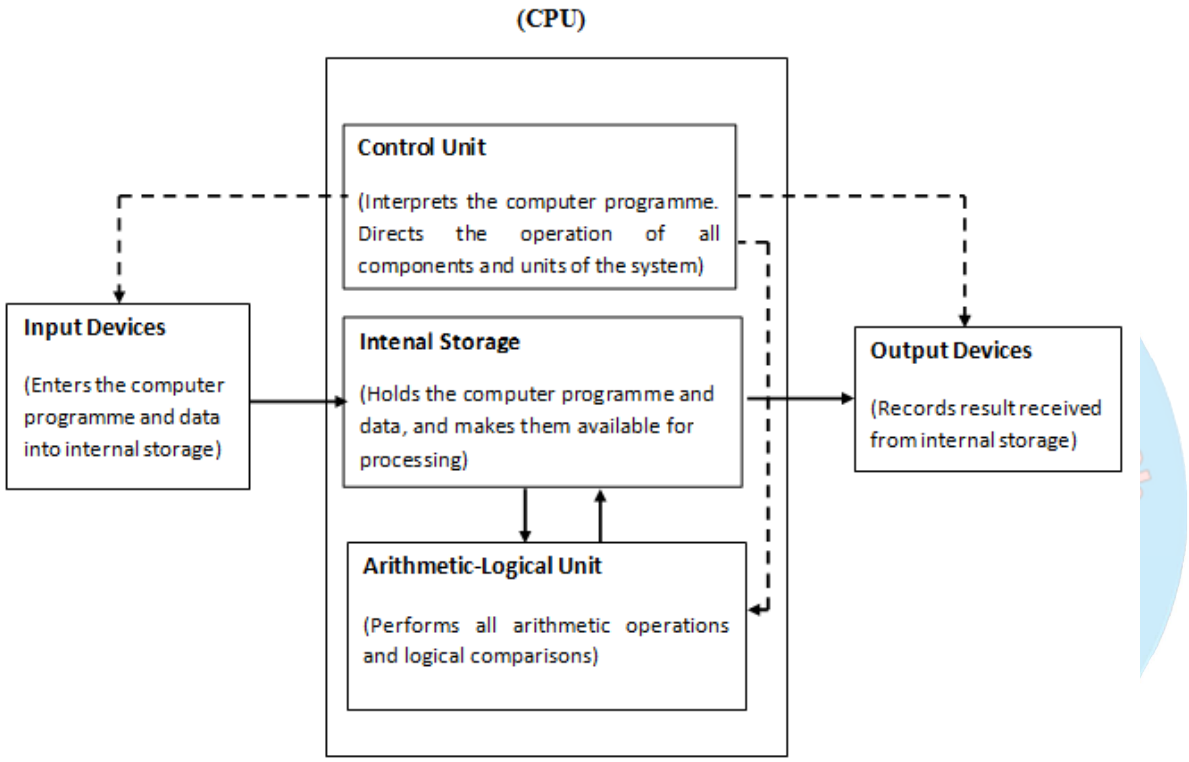
The hypothesis that dentists, in all disguises, are "gadget mad" and were a natural group to become computer enthusiasts will be explored. This has resulted in dentistry being in the forefront of the development of computer uses in universities and dental practice was ahead of medical practice in both 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.[20-25]

THE COMPUTER SYSTEM

In general all computer systems can be described as containing some kind of input devices, the CPU and some kind of output devices. The function of the input-output

devices is to get information into and out of the CPU. The input devices translate the characters into binary, understandable by the CPU. The output devices translates them back into the familiar character i.e. the human readable forms. CPU has 3 segments viz.

1. Internal storage
2. Control unit
3. Arithmetic logical unit



USES OF COMPUTERS IN DENTISTRY

The practical application of computer systems in clinical dental practice includes office management, digital imaging, radiography, and tale-consultation. The emerging discipline of dental informatics is derived from such applications, and is sure to tremendously affect the practice & development of dentistry. A dental establishment can use computer for a number of purposes:[26-27]

1. Administrative applications –
   a. Patient appointments and recalls
   b. Billing
   c. Accounting
   d. Correspondence
   e. Inventory control and supply orders
   f. Dental insurance claims
   g. Document preparation & word processing

h. Referral information
i. Missed appointments follow-up

2. Clinical applications –
   a. Patient record storage & retrieval
   b. Clinical diagnosis and treatment planning
   c. Computerized cephalometrics
   d. CAD-CAM
   e. Computer assisted densitometer image analysis system
   f. For special purposes like computerized spirometers, blood chemistry & gas analysers, ultrasound scanners and CT scanners.
3. Other applications –
   a. Controlling the circulation of books and journals and their availability in the library.
   b. Creating a data base of survey information.
   c. Case presentation
   d. Reviewing of literature
e. Entertainment & family use

EPIDEMIOLOGICAL DATA MANAGEMENT BY COMPUTERS

The problem of analysis of dental epidemiological data is the amount of data which has to be collected to make any study worthwhile. After collecting a data it has to be looked under various ways and to be compared them with the results of the previous studies. If such a study is to be undertaken by hand several months are required to obtain the results and the analysis is abandoned simply because of the time factor. In the last few years, almost every published reports of the dental epidemiological work indicate that computer facilities have been used for the analysis.

Preparation of epidemiological data for the computer

One of the methods of entering the data is in the form of punch cards but the data collected in a dental survey cannot be recorded by punch cards so it is necessary to decide how the information should be recorded. All the qualitative information (male or female, good, fair or poor) to be collected in a survey has to be coded in a numerical or alphabetical characters (male=0/m, female=1/f, good=g/1, fair=f/2, poor=p/3). Quantitative data are already numerical so do not need to be coded. In edition to the coding it is necessary to decide the position at which each item of information is to be punched on to the card. Some items will require only a single column eg: sex, while some such as DMF scores will require more than one. The total number of columns designated for each item is known as a field. It is necessary that each field is always in the same position in every card and care must be taken during the preparation of the data.[28-29] Ones the position

and code for each field have been determined details should be fully documented. The field length and the details of the coding should be arranged to suit the users requirements and the computer programme accordingly.

The preparation of the data consists of the 3 phases – the collection, coding, & punching. Dental data are normally recorded on a chart in a diagrammatic form which has to be coded and to ensure accuracy at the punching stage this coding is usually recorded on the second form. At the clinical examination, the examiner calls out his findings in code rather than in the usual manner. After the collection of data they are punched as previously described. The cards are passed through a verifier in which a similar sequence of events takes place to ensure that the holes are in correct place. Any errors detected are corrected before the analysis begins. Using this method of collecting data it is possible for a skilled punch operator to prepare the data for computation at about the same rate as it is collected.

The dental data collected on punch card is analysed in two steps:

1. The abstraction of the data according to the various epidemiological indices.
2. The analysis of the results of the groups of individuals using these indices.

The Abstract programmes are arranged so that they may abstract details from the fill mouth, or from any named quadrant or quadrants, teeth or tooth groups. In this way the programmes are very flexible and can be used for partial as well as complete analysis. The output of the analysis is usually in the form of tables giving detailed results for each group. When required the necessary statistical test between groups can be undertaken. It is also possible to produce bar charts giving details of the DMF of each group. Many analysers have reported that this system was easy to use and many have indicated that in the absence of the computer they would not have considered starting their surveys.

COMPUTERS IN AESTHETIC AND COSMETIC DENTISTRY

It is essential to realize that facial and dental aesthetics is not just components of parts of skin, teeth, gums and lips in isolation that are important, but it is a collection of complex visual processes and interpretation i.e. subconscious phenomenon. Professional people such as surgeons, dentists, painters and sculptors concentrate on individual facial details like facial patterns, configurations of facial components and their contours.

COMPUTERISED RESTORATIVE DENTISTRY

For more than 15 years, there are about 10,000 dental users of computer-aided design/computer-aided manufacturing, or CAD/CAM, systems, and about 7,000 of those use the CEREC system. The concept of computer-driven milling devices for inlays, onlays, crowns and fixed prostheses is excellent. Computerized systems for accomplishing restorative dentistry have made a significant impact on dentistry worldwide. Of such systems, only the CEREC system has remained on the market for a period of years. Use of computerized restorative dentistry in private offices is growing, and other methods of using this concept in dentistry are continuing to improve.

HIGH TECH DENTISTRY

1. **Digital Photography** - Digital photographs can be modified by using readily available photograph editing software (such as Adobe Photoshop, Adobe Systems, San Jose, Calif.). When digital photographs are modified to demonstrate possible changes in patients' appearance, treatment plan acceptance is increased and patients are educated more easily about their treatment. This concept is one of the most indispensable of all of the high-tech choices.

2. **Digital Radiography**- The advantages of immediate image observation, image storage, image transfer by electronic means and the ability to enhance images make most users of digital radiography pleased that they have changed from conventional radiography to digital.

3. **Intraoral television** - an intraoral television scanning of each patient's mouth should be accomplished by a staff member at each recall appointment. The findings should be recorded and the patient education continued at each subsequent recall appointment concerning the previously observed needs. Intraoral television is highly useful for patient education, and most dentists use this concept.

4. **Orthodontic tooth movement** - conservative, planned movement of teeth, as directed by computerized approximation of movement required and effected by a series of carefully planned trays, has become popular. The most popular system, Invisalign (Align Technology, Santa Clara, Calif.), continues to grow in acceptance, and other companies are now entering the market.

5. **Computerized shade selection** - Several automated shade determination devices are available. Some shade selection devices are relatively simple, while others require several steps for colour determination.

Shade selection devices appear to be a useful elective high-tech item.

TELE-DENTISTRY

Teledentistry is a relatively new field that combines telecommunication technology and dental care. Most dentists and dental educators are unaware that teledentistry can be used not only for increased access to dental care, but also for advanced dental education. Teledentistry in education can be divided into two main categories: self-instruction and interactive videoconferencing. The interactive videoconferencing method has had better results because of its ability to provide immediate feedback. Teledentistry can extend care to underserved patient populations, such as those in rural areas, at a reasonable cost.

DENTAL INFORMATICS

Dental informatics is the application of computer and information science to improve dental practice, research, education and management. A common misconception is that informatics is the same as IT. Informatics is focused primarily on research, development and evaluation of information models and computing applications.

A number of models, methods and applications can be shared, transferred or both between the two disciplines. For instance, the National Library of Medicine's, or NLM's, MEDLINE is the world's largest biomedical literature database and is equally applicable to all health care disciplines. The main goal of dental informatics is to improve patient outcomes. Thus, the discipline must support and improve diagnosis, treatment and prevention of disease and traumatic injury; relieve pain; and preserve and improve oral health.

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SELECTED COMPUTER APPLICATIONS IN CLINICAL CARE, EDUCATIONRCH.		
AREA	**APPLICATION**	**DESCRIPTION**
Clinical Care	OralCDx	Method for the screening of oral lesions that involves a brush biopsy and computerized analysis of the histologic slide, allows for screening of more patients for premalignant or malignant lesions earlier.
	Digital Radiology	Equivalent to traditional film for many diagnostic and therapeutic tasks; advantages include reduced radiation exposure for patients and dental personnel, reduced development time, automation of quality assurance processes and the potential for immediate digital analysis.
	Tuned-aperture computed tomography	Example of a three-dimensional imaging modality; applications include primary caries detection and assessing bone defects at implant sites.
	Decision support Systems	Aid for dentists to make decisions about therapeutic approaches or complex or rarely encountered conditions; oral radiographic differential diagnosis, for instance, supports the diagnosis of radiographic lesions.
	MEDLINE	Database that makes a significant portion of the dental literature accessible to practitioners to help answer clinical questions.
	CEREC	Fabrication of machine-milled crowns and bridges during the course of an office visit.
	Dental practice Management	Automation of many routine tasks in a dental office, such as electronic claims submission, scheduling and financial management
Education	Oral manifestations of HIV	Computer-assisted learning package on the oral manifestations of human immunodeficiency virus of relevance to general dental practitioners.
	Dental diagnosis and treatment	Interactive program to provide students or practicing dentists an opportunity to develop and practice their critical-thinking skills for diagnosis and treatment.
	Simulations	Educational programs designed to closely approximate clinical situations for teaching, continuing education or performance evaluation
	Complete distance education programs	Integrated educational tracks, certificates or degrees offered at a distance
Research	Data mining tools	Analysis of large sets of data to generate new knowledge or findings.
	Collaboratories	Infrastructure to make it easier for large, geographically distributed research groups to work together
	Computerized data analysis	Complex analyses of research data

FUTURE OF COMPUTERS IN DENTAL PUBLIC HEALTH

In the wider field of dental public health the computer ought to be playing an increasingly important role. Some local authorities have used large main frame machines for their medical records and for operating a recall system for vaccinations and immunizations. Such a system would form a hierarchical system for the handling of patient records. This could establish locally from the epidemiological system and eventually the machines central to an area might be linked, forming a national network. If this were achieved, then records could rapidly and easily be passed from ane health authority to another when patient moved. The fields of dental epidemiology and dental public health have expanded and developed quite considerably over the last few years. If these subjects are to continue to expand at a similar rate, then the workers in the field cannot afford to ignore the computer. They must be prepared to understand these machines and keep abreast of the technological developments, so that they can be used to their maximum effect and potential.

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