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COMPUTERS AND DENTAL RECORDS

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SUMMARY

What is done today, though becomes history tomorrow, will not have any value if not recorded. This is why, even in clinical medicine and dentistry, a **history** is a prerequisite for diagnosis and subsequent treatment. The writer has explained in this thesis how information could be easily stored, processed, analysed and retrieved in a dental practice by the use of a computer.

Computer science is fast becoming a popular subject from a career point of view, and since almost all business systems are computerised it has become necessary that the present generation should be exposed to computers at an early age so that they will develop a liking to this subject. In this context it can be safely assumed that before the turn of the twentieth century most of us will have some sort of a computer in our homes if not for business at least for our children to play games.

Those of us who were not exposed to computers in our childhood are frightened to learn about computers, in the same way as one would be frightened to water if one has not learned swimming in his young days. This thesis, therefore, starts by introducing the terminology and the basic principles on which the computers work so that it will be easy reading for some one who has absolutely no previous knowledge on computers.

The writer is of the opinion that, it is always better not only to have a knowledge of computers, but also some knowledge of popular systems such as WORD PROCESSING, LOTUS, dBASE before making a decision to computerise a business establishment. It is then only a person will be convinced as to what extent things could be made easier if a system is computerised.

In a dental practice some of the many areas that can be computerised are described in detail in chapters 2 and 3, classified under the following four different categories:

a. Clinical records
b. Non clinical records
c. Inventorising
d. Practise management

Though the introduction of a computer system to a dental practice will undoubtedly have a tremendous effect on the efficiency, it is in the best interest that before one decides to spend time and money to computerise a dental practice very clear objectives should be selected preferably on the following guidelines.

To improve access to patient data, clinical records, & medical histories
To find time to attend on more patients
To decrease clerical and administrative effort and costs
To be less tired at the end of the day
To improve recall system and thereby improve the practice image
To study disease and treatment patterns

After selecting the objectives the dentist should decide: which computer should be purchased, which software package used; whether he wants to computerise the entire system or part of it; and where records should start if he has being in practice for some time.

Organisations do not become efficient overnight if computerised, but the armed services are generally more organised than most civilian departments and financial and manpower resources are more freely available for the armed services in most countries. The writer has described the importance of maintaining records and computerisation and has taken the armed services of Sri Lanka as an example.

The reader can also have an overview of some of the available dental software packages in Australia as their features are described without changing individual and specicific informations about the packages.

The writer stresses that it is possible, with a basic knowledge in dBASE plus and LOTUS 123, for a dentist to have his own method of recording data initially before purchasing expensive software packages which will undoubtedly stimulate further interest in computing.

2 ACKNOWLEDGMENTS

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DEDICATED

TO MY

BELOVED FATHER

WHO PASSED AWAY

TWELVE YEARS AGO

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1 INTRODUCTION

1.1 DEFINITIONS

It is not everybody who will be interested in learning about new technology though most of us would like to utilise the benefits, provided we could afford the technology. A suitable example to introduce this subject would be to consider the food processors that are used in almost every kitchen today. Was the situation the same a decade ago? Definitely not. These kitchen wonders were very costly then, and only a few could afford them, and that too was not a priority.The position today is changed. There are now many different designs at affordable prices and they undoubtedly make the work in the kitchen a lot easier.

The time is not far away for computers to become essential equipment in the dental surgery, like the X -Ray machine. By that time literature on computers and dentistry may be outdated, but the dentist who has made the effort to acquaint himself with the current status of the computers in his profession will have nevertheless benefited. The knowledge of the past helps us to understand the present, and a knowledge of the present will help us to understand the future.

"A Computer can be defined as a device that stores and manipulates data, that can control other devices as a result of its manipulation and storage of data, and that communicate with other computers, with other types of devices, and with human beings." (Hill 1988)

Of the four basic functions of the computer, which are calculations, storage of information, communication and control, the emphasis in this thesis will be on storage of information and the information will be **DENTAL RECORDS.** Sometimes the value of clinical dental records do not die with the individual in that these have been used as valuable identification methods (FORENSIC ODONTOLOGY).

1.2 HISTORY AND DEVELOPMENT OF COMPUTERS

Evolution of information processing, maintenance of records, and development of symbols led to standard alphabets thousands of years ago. Counting was done by fingers and toes, then by sticks and stones and then it was the abacus, which is still in use in the orient today. Ancient Greeks innovated records and audits, and the Romans budgets and banking systems. These made the trade industry flourish which increased the need for further record keeping and information processing.

In 1642 Blaise Pascal invented the first ever mechanical calculator which was not a commercial success. Charles Babbage, a professor of mathematics at Cambridge University designed a huge machine which he called the analytic engine. This could have been the first ever "general purpose computer" had the finances and the engineering techniques were adequate at that time.(Hill 1988)

The available methods of information processing could not keep up with the rapid growth and development in the second half of the nineteenth century and it was during this period that the typewriter and the electromechanical punch card equipment were innovated. These cards could record information in coded form by punching holes. This information was initially decoded mechanically and then electrically. Tabulators were developed which could not only rearrange them but also could summarise information concerned with accounting and numerical calculations not involving multiplications and divisions. To summarise, the punch card could capture and store information fast and accurately and could add and subtract.

During the second world war powerful processing machines were needed for:

a. Calculating bomb trajectories which required solution of complex simultaneous equations.

b. Breaking of enemy codes.

The new machines that were developed in this era could manipulate stored information much faster through electronic switching, but was limited to three basic operations namely additions, subtractions, and comparisons. These could store a programme in the memory and on execution of the programme the coded instructions could be fetched from the memory, decoded and translated into action.

The very first electronic computers were huge and very costly and a few years later the innovation of transistors and integrated circuits made possible the development of more compact machines, and by 1960 the computers had to a great extent replaced the mechanical tabulators.

Second generation computers arrived in late 1950s, these could process text in the form of letters words and numbers. High level computer programming languages were developed, which provided a simpler means of communicating instructions to the computer, to produce an action. This action produced the output and the information to be processed was the input. These programmes are called the software, where as the computer and its peripheral items are called the hardware.

In the 1960s the development of smaller but powerful versions of these machines took place taking advantage of the newly developed technology of integrated circuits, and they were appropriately called minicomputers in contrast to the mainframe computers which kept on developing in response to the various needs.

In the late 1970s most of the electronic components could be replaced by a small slice of silicon, the microprocessor chip, which was used as the central processor for small computers. Since they were so much smaller than the minicomputers they were called microcomputers.

1.3 CONCEPT OF COMPUTERS

The purpose of this thesis is not to give a detailed account of the concepts of computing but to provide the basic fundamentals in their simplest form.The aim of this thesis is to create an interest in the reader to learn adequately about computers to enable them to utilise these machines in a dental office to make their work easier. Brief explanations of a few terms that are commonly used are included in this section.

a. DATA

This is not strictly information but will become information if processed. In the old mechanical calculating machines a datum was represented by a wheel with digits 0 to 9, which revolved to give a desired reading, and in abacus the number of beads in each string represented a single datum.

The computers work with the binary numbering system (base -2) and use the digits 0 & 1 usually represented by an electronic switch in the computer. The smallest unit of storage is called a bit. The minimum number of bits required to represent the numbers 0 to 9 will be 4. In a practical input device it will be necessary to represent the alphabet, both upper and lower case, the digits, punctuation marks and other characters required for control. This requires a code comprising seven bits and the code known as the ASCII has now been standardised for this purpose. However it is customary to use eight bits, called a byte, to represent characters in computers: the eighth bit is used for control and error checking, or if necessary to represent an extended character set comprising 256 characters. A string of eight bits which can represent any one of the 256 characters of binary digits is known as a **byte**,and the computers can handle from 8 bit to 32 bit words. This will decide the speed of the computer.

b. PROCESSING

Computers should be able to represent and interpret instructions which tell the processor which actions are to be performed on the data. By using the three operations namely the

additions subtractions and comparisons, any required processing of information could be performed by using suitable coding methods. Therefore the types of instructions are :

(1) Instructions for the processor to determine which operation to perform on data.

(2) Input and output instructions to communicate between the processor and the outside world.

(3) Retrieval and storage instructions to communicate between the processor and the various storage devices during processing.

ie both data and instructions are presented to the processor as a sequence of binary digits, if the computer is to process data rapidly it should be able to access and transfer items at very high speed. Therefore storage requirement, speed of access and financial constraints decide on the type of the computer.

c. MEMORY.

RAM - Random Access Memory is volatile and is available only when the power is on. In RAM there is a sequence of contiguous memory locations, each location can hold 1 byte representing a character. The contents of any location can be written and read.

ROM - Read Only Memory is non volatile, which holds the information computer needs, only to read: for example, the most common type of data stored in ROM is the data necessary to start or boot the computer. This consists of several files that link or connect the various components ie CPU to memory, monitor, printer, and secondary storage devices. Both data and programmes - a sequence of instructions - are stored in memory as strings of 0 s and 1: binary digits.

The amount of RAM in a computer deals with the upper limit to the complexities of applications it can deal with. The smallest unit for measuring the size of the memory is the byte, a Kilo byte (KB) is 1024 bytes, and a Mega Byte (MB) is 1024 KB. The text in an A4 size page will require about 2 KB of storage. Today microcomputers have at least 640 KB of RAM and business computers about 2 MB.

RAM determines the size of the programme and not the speed of execution which is determined by the type of the processor ie whether it is 8 bit 16 bit or 32 bit, and the clock speed which varies from 4.77 to 8 to 16 to 33 Mhz.

d. PROGRAMMING LANGUAGES

A language is simply a means of communication. The first generation of software was written entirely on machine language ie 0 s and 1 s. The instruction had firstly a COMMAND or an OPERATION stating what function to perform, and secondly an OPERAND stating where to find data, to store data or find other instructions which are to be processed. This was a laborious and a tedious task.

The second generation of software was the development of the assembly language where mnemonic operation codes were substituted for the numeric machine language operation codes: These mnemonic codes used familiar words like ADD for addition and MULT for multiplication. Both machine code and assembly language are referred to as low level languages.

The third generation was the development of the high level languages. Programmes written in these languages resembled a combination of ordinary English and Algebra. These programmes have to be translated into a machine language which could be done either by a compiler or by an interpreter.

A compiler takes as input the programme and translates it to executable code, whereas an interpreter carries out the translating process line by line. A compiled version of a programme would execute about ten times faster than the interpreted version. Interpreter has an advantage as one does not have to translate the entire programme to remove a slight error. Some of the common high level languages are **BASIC; COBOL, PASCAL and PROLOG.**

BASIC (Beginners All-purpose Symbolic Instruction Code)

This is a user friendly language developed in 1964 and is usually interpreted, as the most commonly used language. Early versions of BASIC did not have many of the features of the more powerful languages but different versions were developed in later years. The disadvantage of this language was that large programmes tend to become unwieldily and unstructured.One could easily get used to BASIC and its simplicity resulted in lack of discipline. This language when compiled could run acceptably fast.

PASCAL developed in 1971, especially for teaching purposes, is a structured language. It has become popular after the introduction of Pascal compilers such as Turbo Pascal for IBM PC: this language was a major advance in structured programming.

COBOL, Common Business Oriented Language, difficult to learn and tedious to write, it is the most popular for commercial data processing. The language was developed in 1959 and the most recent version was in 1985.

In spite of the advancement of the high level languages which could provide efficient expressions of instructions to the computer they still require a considerable amount of programming and it will take a long time for the development of computers to understand the spoken language and not until then will programmers become a redundant species.

PROLOG, which belongs to the class of high level languages known as declarative languages, is a recently developed language used mainly in the area of artificial Intelligence. The Japanese are concentrating on PROLOG as the language for their fifth generation computer development efforts.

In the mid 1980s the programming language ADA was developed; it was sponsored by the United States Department of Defence. It has become the standard for the armed services of the NATO as well.

The currently most popular language is C, a product of the Bell Laboratories. With the advent of object oriented programming the language C++ appears to become the language for the 90s.

e. OPERATING SYSTEMS (OS)

A dentist need not necessarily know what languages the programmes are written but it is good to have some knowledge of the operating systems the programmes are run on. An OS is an integral set of programmes. Operating System is the middle man between the user and the hardware.

The functions of OS are:

(1) Controlling access to the computer
(2) Allocating the resources of the computer such as the processor, and the printer
(3) Managing input and output from storage devices and the peripherals such as keyboard,
(4) Maintaining the file system. The programmes written for a particular operating system will run on all computers that run the same operating system

The first popular operating system for microcomputers was CPM (Control programme for microcomputers) designed for 8 bit machines in 1970 s. In 1981 Microsoft Disc Operating System (MS DOS) was developed which was for 16 bit machines. The latest machines of IBM ie PS/2 which came to the market in 1987 are run on OS/2 which could also be run on MS DOS.

Another popular system is UNIX developed 20 years ago for minicomputers. It is finding increased acceptance, for microcomputers, as their power increases. An operating system that presents a graphical user interface was developed by the Apple Computer Company and incorporated in its Macintosh series of computers. The most distinctive feature of this OS was the use of icons for user interaction.

f. INPUT DEVICES

The key board has replaced the punch card system. When a key is pressed pulses are sent using the familiar ASCII code. The keyboard that is used is QWERTY which is user hostile, though it is universally accepted. Another device is the mouse which has a tracker ball at its base; it is commonly used with the WIMP software. (Windows, Icons, Mice, Pointers.) Mouse is preferred to a key board where the menus can be chosen by moving a pointer and by pressing a button desired action or the function represented by the selected item could be initiated. The mouse cannot be used exclusively all the time.

g. OUTPUT DEVICES

The monitor and the printer are the most common out put devices. The monitor is referred to as the VDU (visual display unit). This could be monochrome or colour. Monochrome monitors cost less and cause less strain to the eye though the coloured ones are preferred as they are more useful in applications such as patient education programmes, differential diagnosis procedures and graphic displays. The earliest VDU s could only display upper case letters and digits but later it was upper and lower case letters and digits. The latest ones have the capability of displaying high resolution graphics, without which it will neither be possible to use WIMP based software nor display dental charting or business graphics. Though a television could be used as an output device it is very strongly discouraged. A VDU is useful to see what is being typed and also to confirm or check on previous records.

To get a hard copy of the output a printer is required. There are different types of printers and the most popular is the dot matrix type. These, though quite noisy, are less expensive but versatile. Graphics can be printed as well as text, different fonts of characters can be produced easily. In spite of these advantages they are continuously criticised due to the poor print quality and the less visual acceptance. Another device is the daisy wheel which is a plastic disk which can be changed to give different typefaces or print sizes. These are less noisy and produce a letter quality print at a much slower rate(30 characters/sec).

Another example of modern printers is the ink jet printer. Ink jet printers spray or squirt small quantities of ink (dots) out of a nozzle or jet. Early models were not very successful since the jet eventually clogged with ink. This problem was finally overcome by making the jet disposable ie each disposable ink cartridge now has its own ink jet. These printers are quiet, inexpensive and have the same resolution as laser printers (300 dpi). The disadvantages being that the ink is water soluble and these are quite slow particularly with graphics.

The most recently developed type of printer is the laser type, where by control of heat and pressure or both, ink particles are placed on paper. That is fed from a tray at the bottom of the printer. The mechanism of this being the use of a photosensitive drum, on which an image pattern is written using the computer controlled light beam which scans across the drum by the use of rotating mirrors or photographic plates that can bend the beam, which is turned on and off by the computer. Ink particles are brushed on to the laser charged parts of the drum surface and are subsequently transfered to the paper. These are comparatively expensive.

h. SECONDARY STORAGE DEVICES

Typically data is stored in memory. There are two types of memory: volatile (RAM) and permanent (ROM). Data in RAM is lost upon powering down and data in ROM is read only. Therefore in order to save information from one session to the next, some means of secondary storage is required. There are different devices for storage. Earlier it was the punch cards and today they are the magnetic tapes or the disks where magnetic charges are placed at different positions. Ordinary cassette tapes were used earlier and these were cheap and freely available. There was no requirement to spend additional money and an one hour tape could store several megabytes whereas the RAM of these computers were about 64K. The disadvantages were that the transfer of data was very slow which could be accepted for a home computer but not for a business or a dental practice. As the need is to get quickly from one source of data to another, based on the same principle as in a

long playing record in contrast to a cassette, the magnetic disks were evolved as a mode of storage. Information is stored in bits represented by very small areas of varying magnetic polarity. There are two types of magnetic disks, namely the floppy disk and the hard disk. The floppy disk is flexible and removable, and the hard disk is fixed and not removable. The floppy disks are cheap, easily transferable and the best way of distributing software. Information can be written on one or both sides, and the average capacity of a floppy disk is about 1 MB. The most important type of hard disk is the Winchester which is a sealed unit permanently housed in the disk drive. Their average capacity is 40-120 MB for microcomputers, and the time taken to access data is ten times faster than that for a floppy disk.

The data in these disks are stored in tracks numbered from the outer edge. These disks are rotated in the case of a floppy disk at 300 - 400 RPM and in a hard disk at 3000 - 4000 RPM. Data is recorded as magnetic areas on the track which is read from, or written to, the disk by one or more read/write heads (similar to the tape heads) which can overwrite and therefore these disks have limited life unlike the hard disk. In the hard disk the head does not come in direct contact with the disk. It in fact floats in a cushion of air as the read / write head moves around 100 miles an hour over a height of less than 20 millionths of an inch. It is because of these reasons that hard disks are in sealed units as they should inevitably be dust free. Depending on individual cases, data can be stored either in floppy disks or in tape streamers in cassette form which are capable of reading and writing data at very high speeds.

The need for ever-increasing capacities in the storage of data has led to the development of optical disks. These disks have very large capacities - a disk of the size of a normal 5.25" floppy disk can store up to 100MB of data. However, their disadvantage is that they are not easily erasable and therefore are really suitable only for storage of large voluminous data such as encyclopaedias.

1.4 PRACTICE ADMINISTRATION

Principles of practice administration applies equally to the government, private, university, and services dentists with the only difference being that the private practitioner spends his own money and makes profit for himself whereas the others are wage earners and their practices are maintained and controlled by state funds. The private practitioner basically is a businessman who has to make sure he gets good value for the money he spends, when ever new equipment is purchased. This is based on two broad criterias: one to provide the best patient care possible; and the other to make profit.

Computers, if not presently at least in the very near future, will be used in assisting the dentists in, clinical decision making, suggesting appropriate treatment plans, and providing accurate diagnosis of radiographs.

There are a large number of clerical processes each corresponding to a particular function in any business organisation. These involve correspondence, invoices, accounts, wages in addition to those particular to a dental profession.

To illustrate this when a patient attends a dental practice, he should be registered, patient record cards initiated, agreement forms signed, dental charting done, treatment carried out entered, the charges sorted out, depending on whether the patient pays partially or fully or whether a claim has to be made from another organisation, and further appointments given if the patient has to be recalled.

A dental practice is a **SYSTEM** concerned with inputs, processing and outputs. The inputs are oral or written communications between patients, staff and dentists. Processing of this input, for eg: takes the form of scanning the appointment diary finding a suitable space, and storing the patient's name in the appropriate space in the appointment diary and producing an output in the form of a printed appointment card.

The dental practice has three principal sub systems, which overlap to some degree. These are the **management, appointments, clinical records**. There is interaction between the main system and outside systems, such as laboratory and health insurance.

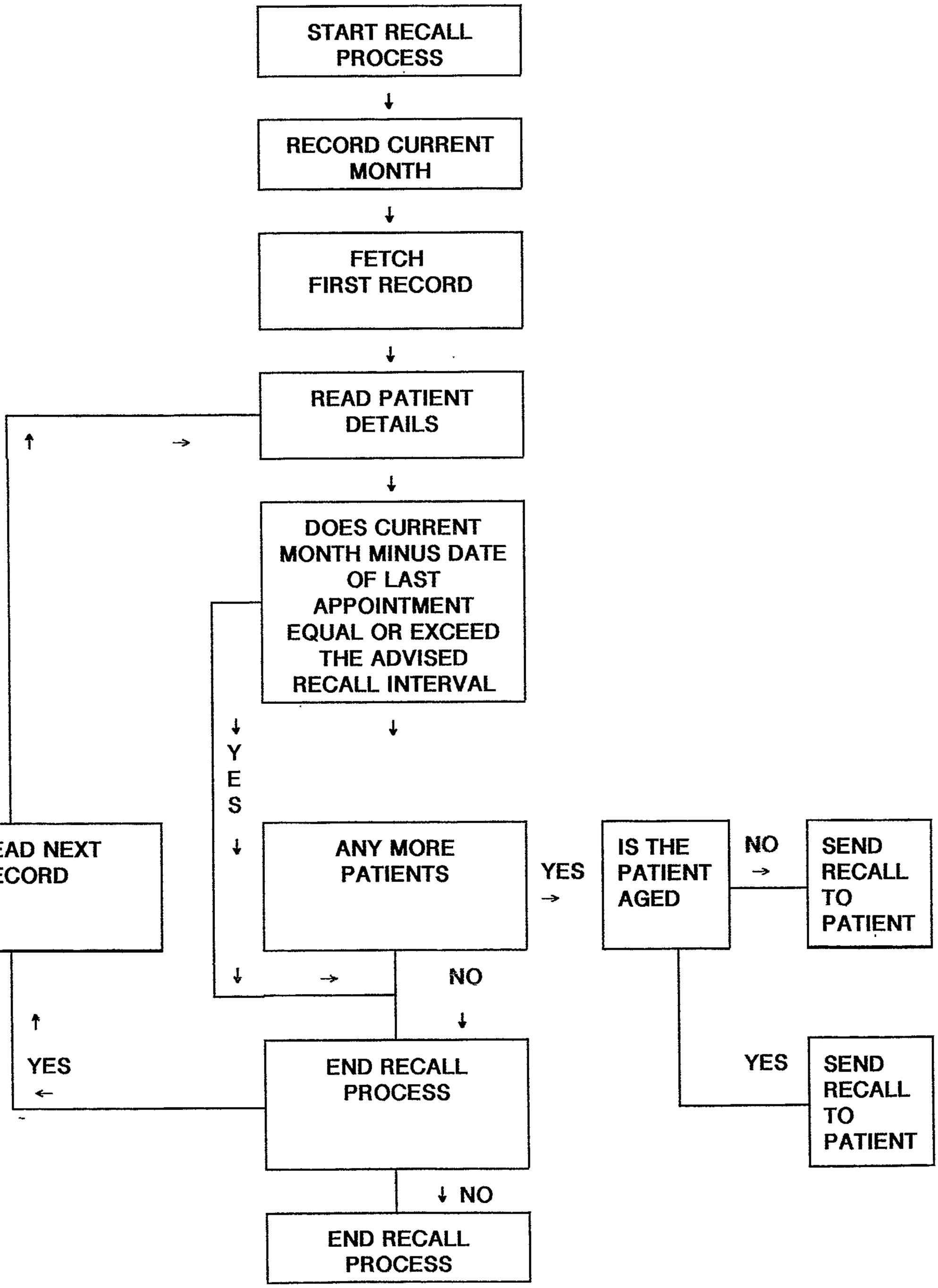
A **SYSTEM** can be defined as a network of interrelated functions or procedures joined together to form an activity, and a **procedure** is defined as a series of instructions that explain what is to be done, who will do it, when it will be done and how it will be done.

The main system can be broken down to different sub systems containing a number of entities and each entity has a collection of attributes.

Once the major entities in a sub system and their attributes are established and identified, the relationship between them can be determined through a detailed consideration of the functions of that system. An effective method of analysing functions is through **FLOW CHARTS** as shown in Fig 1(From Hill 1988).

Flow charts help the understanding of problems encountered in practice management by showing clearly what tasks are performed at the most basic level. These also helps to identify most time consuming or difficult tasks, postulate alternative methods, based on which they can redraw to produce better results.

Figure 1 Flow Chart - Recall process
(Source: Hill 1988)



The following classification of sub systems gives an idea of the minimum level of information a dentist might require access which may have slight variation depending on the practice.

(A) MANAGEMENT

1. Accounts
   - Practise income
   - Practise expenditure
   - Patient's debts
   - Receipts Medical Insurance
   - Receipts Private

2. Health insurance
   - Current - awaiting submission for approval
   - Current - submitted not yet approved
   - Current - approved
   - Completed - awaiting submission for payment
   - Completed - submitted not yet paid
   - Completed - paid

3. Dental materials
   - Current stock levels
   - Stock currently on order
   - Recorder levels

4. Management information
   - Income received for each dentist
   - Hours worked by each dentist
   - Break down of treatment performed by each dentist
   - Patient debts owed to each dentist

5. Laboratory information
   - Analysis of work by each dentist
   - Current stage reached in each case
   - Work due in

(B) APPOINTMENTS

1. Current appointments
   - Type of appointments
   - Linked or single

2. Day list creation
   - List for each dentist or hygienist

3. Failure rates
   - For whole practise
   - For each dentist or hygienist

4. Recall
   - 3 Monthly,
   - 6 monthly
   - Yearly/ Other interval /no recall

(C) CLINICAL RECORDS

1. Registration details
   - Name
   - Address
   - Date of birth
   - Telephone No (Home)
   - Telephone No (Work)

2. Dental charting details

3. Medical history

4. Treatment details
   - Past
   - Current
   - Date of last examination

5. Financial
   - Past debts
   - Current debts
   - Current treatment - total cost to date
   - Current treatment - patient's charge
   - Current treatment - amount paid to date

In a manual system information could be derived by referring to individual records. Whilst most of these information can not only be stored, but also be easily retrieved, by using either an adaptation of the basic **DATABASE** or a software package, which will make the practice management easy and effective.

Database is a filing cabinet containing a number of records of different types. A record is a grouping of data relevant to one entity in the system and at all instances a given record type contain the same fields. A field is a reserved space for an individual piece of data.

The cost of operating manual office systems arises through wages and the time spent will depend on the individuals, their attitudes and their efficiency. **Time management** is the keynote for efficiency, where neglect and human error will be two important retarding factors. Most of the staff are hostile towards computerisation for two reasons. One they feel that they will not be able to manage them and the other they feel that they may become redundant.

Both these are not true as these personnel could be educated on computers and could also be used to perform the role of health educators who could reassure patients which will improve the image of the practice.

The current computer systems can be made use of to help the dentist to save time by by not getting himself involved in most of the mundane administrative tasks. This will directly enable him to spend more time on the patients and possibly make more profits indirectly.

The aim of this thesis is to make the reader aware of the advantages of a computer in a dental practice, the proper use of which can make his work much easier. In this thesis few references are made as most of this work includes the writer's own experiences, his own modifications used for maintaining records,and on information receieved from dental software dealers.

2 DENTAL RECORDS (Clinical)

Clinical dental records can be categorised as those data that are recorded pertaining to the patient in a dental office, which are important both to the dentist and the patient.

Unfortunately in most countries in both government and private dental clinics a duplicate copy of clinical notes is not given to the patient, though clinical records are maintained at the dental office.

The writer considers this to be an important shortcoming in patient awareness and education as the patient has a right to know what dental treatment is required, when it is required and at what cost, so that he could plan according to his finances and other relevant factors.

Maintenance of proper clinical records is a statuary requirement in certain countries.These records have to be maintained whether or not the patient is accepted under any health insurance scheme. The rules governing these requirements vary from country to country. Generally forms are either given by the state or the dentist is permitted to use forms of his choosing provided there is no loss of information. The question arises as to how long one should keep such records.

From a dentist's point of view it is advantageous to keep records up to three or four years depending on the patient. Statutarily in certain countries these records have to be kept for a minimum period of three years so that they could be produced on request, particularly for medico-legal matters.

Basically Clinical Dental Records can be subdivided broadly into the four categories of:

Personal Data

Medical and Dental History

Dental Charting

Records Pertaining to Treatment

2.1 PERSONAL DATA

Patient's personal data is the most important thing in a successful practice as it is common knowledge that one of the significant features of behavioral patterns is the liking that all humans have towards personalised care. This is possible only if such data is available for the dentist to act accordingly.

If a personalised letter is sent regarding the next dental appointment it appeals much more than a routine postcard ie sent with the same instructions. So is a birthday card sent in time which also serves as a measure of goodwill. These little things, when taken together, based on individual needs have a cumulative effect in improving the practice image.

Personal patient data generally includes the following:

Title	Date of birth	Occupation
First name	Marital Status	Telephone Number Res /Office
Last Name	Number of Children	Source of referral

In situations where the dental record forms are supplied by the state a dentist will have to furnish only pens and filing cabinets to maintain these records. With these filing systems it is also possible to store any radiographs and any correspondence regarding a particular patient.

The files after a few years will inevitably become bulky and this will create storage problems. These systems will still work though retrieving manually for patient data will be a time consuming exercise. On the assumption that a dentist sees around two thousand patients per year, then for a period of three years we can reasonably presume that he will have around five to six thousand records. This number would be more in a group practice.

The disadvantages of this system, such as the time factor that is spent for retrieval, the varying degrees of the legibility of the handwriting of different individuals entering records possibly due to staff turnover, the space that has to be used for the storage of these records, can be easily overcome with the use of a computerised system.

2.2 MEDICAL AND DENTAL HISTORY

In a busy practice one has to assume that around two to three thousand patients will be seen by one dentist for an year which theoretically has to be multiplied by the number of dentists in a group practice. The storage capacity of the computer and the period that an individual wishes to keep patients' records after the last visit will decide the quantity of data should be stored in the computer. Whatever records that are excluded from this list such as referral letters, X-Rays, could well be stored in an appropriate form for easy access.

Generally the practice is to have a detailed dialogue with the patient in the first visit and either by a YES / NO question and answer system, or by informal questioning, get all the necessary details of their medical history.

Depending on the type of software ie used, all these details regarding the medical and dental history of the patient, can either be entered, identicaly as in filling an application form or only those answers from the patient that are of significant importance could be recorded, by using an appropriate system. These could be reviewed at every subsequent visit of the patient, which would encourage the clinician to check whether there has been any change since the last visit.

Unlike in a manual system the dentist will be in a position to swiftly run through the medical and dental histories of the patient with ease merely by pressing a few keys, if the system is computerised.

In the case of patients with a serious medical condition, where the dentist should take precautionary steps in the treatment procedures, a computer could well be programmed either to display prominent messages in lurid colours, or flashing on and off to draw attention to the hazard, or to give adequate warning sound signals. In a manual system one has to physically go through the previous records.

2.3 DENTAL CHARTING

This has been a changing process from organisation to organisation within a country, and from country to country. Even in internationally accepted organisations, like the FDI, the methods of charting have changed from time to time and with each such change the system has improved providing more information than its immediate predecessor.

In spite of frequent mistakes of Left/Right transposition, incorrect notations and low degree of legibility, the manual systems provide sometimes up to 9 historical charts in each card which could maintain a chronological record of charting. However, in most present computer systems provision is made only for three charts.

This is important as the information recorded in a previous chart should be cancelled automatically against current charts whilst it being input, either during an examination or a treatment session, which should prevent mistakes such as accidental charting.

In a standard notation three elements are involved.

(a) Notation for the position of a particular tooth within the mouth, and the surfaces of the tooth concerned.

(b) A notation for the various types of treatment applicable to the whole tooth or the surfaces

(c) A grid representation relating the above two types of notation to each other.

Tooth surfaces can be defined either using numbers or using letters. Till recently there was no universally agreed method of indicating either the type of restoration or what is prescribed. Methods of tooth notation have evolved over the years, and what is required in today s context is a system which offers clarity, precision, and compatibility with typing and computing requirements. There are four basic available methods which had led up to the accepted FDI Version:

A. The Palmer notation
B. The Haderup notation
C. The Universal system
D. The FDI Two digit System

The Palmer Notation

The permanent dentition

Upper Right 8 7 6 5 4 3 2 1	1 2 3 4 5 6 7 8 Upper Left
Lower Right 8 7 6 5 4 3 2 1	1 2 3 4 5 6 7 8 Lower Left

The permanent teeth are recorded with arabic numbers 1 - 8 from the central incisor to the third molar. The deciduous teeth are recorded in three different ways (from the central incisor to the second molar) though Palmer did not extend his system to include these. viz:

(1) Letters A - E

(2) Letters a - e

(3) Roman Numbers I - V

(4) Arabic Numbers 1 - 5 followed by a D

The teeth are described as upper right seven (eg 7/). A grid system is used to indicate the quadrants, a central vertical line and a horizontal line representing the sagittal and the occlusal plane respectively. This grid is viewed from the prospective of the observer looking at the patient from the front. Difficulties arise as these notations are incompatible with word processors and some typewriters.

The Haderup notation

U Right 8+ 7+ 6+ 5+ 4+ 3+ 2+ 1+	+1 +2 +3 +4 +5 +6 +7 +8 U left
L Right 8- 7- 6- 5- 4- 3- 2- 1-	-1 -2 -3 -4 -5 -6 -7 -8 L left

This system is similar to Palmer with the only difference being that they can be typed easily. In this system (+) and (-) signs are used for the upper and the lower jaws with the sign in front and behind the arabic number for the left and the right teeth respectively. For the deciduous teeth they are numbered from, 1 - 5 with a zero after the number. Eg 8 + would be permanent upper right third molar, and 30 + would be deciduous upper right canine.

The Universal system

Permanent Dentition

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17

Deciduous Dentition

A	B	C	D	E	F	G	H	I	J
T	S	R	Q	P	O	N	M	L	K

In this system there is a unique number given from (1 -32) to every permanent tooth & either (1 -20) with a D in front, or labelled (A - T) for every deciduous tooth.

The numbering starts with 1 for the upper right third molar up to 16 for the upper left molar, and from 17 ie the lower left third molar to 32 the lower right third molar.There are numerous variations of the universal system, for both permanent and deciduous dentition, in which different orders and combinations of Arabic or Roman numbers and alphabetical letters are used. All variations have the advantage of being acceptable to computers and of not requiring the typing of grids. Further having a unique number to represent each tooth, leaves little room for confusions of identifying the individual teeth, once the method has been learned. However the use of the alphabetic letters in connection with the deciduous teeth may lead to confusion with the letters used to describe the tooth surfaces, and the use of the Roman numerals may lead to confusion with equivalent numerals that are also used to describe carious lesions according to Black's classification.

The FDI Two digit system

Permanent dentition

18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28
48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38

Deciduous dentition

	55	54	53	52	51	61	62	63	64	65
	85	84	83	82	81	71	72	73	74	75

This system was initially adopted at the FDI in 1970, and has gradually replaced the universal system particularly because of its simplicity of having one digit to indicate the quadrant followed by a second to indicate the tooth within the quadrant. This system is simple to understand, teach, easy to pronounce in conversation, readily communicable in print, easy to translate into computer input, and easily adaptable to standard charts in general dental practice.

Starting with the upper right quadrant as 1, and continuing clockwise around the mouth (as looking at the patient or the chart from front), the upper left quadrant is labelled 2, the lower left quadrant 3, and the lower right quadrant 4. The deciduous quadrants are numbered 5-8 in the same order. The designations for the individual teeth are from 1 - 8 for the permanent and 1 - 5 to the deciduous starting from 1 for the central incisor to 8 for the third molar.

This system has been accepted by various bodies including the British Standard Institution International Standard Organisation, World Health Organization, International Association for Dental Research, and by Interpol. It is not only the methods of charting that are important but also methods of easy and fast retrieval systems for which computers serve as the only available and the effective tool (Elderton 1989)

Forensic odontologic methods based on dental charting which could range from complex and expensive software packages to the simplest type of programmes based on dBASE or the sole use of the dBASE as explained in detail in Chapter 6 of this thesis could sometimes well be the only method of identification available when the remains of the most murder victims are severely decomposed with partial or complete skeletonisation and little or no personal effects are recovered.

2.4 TREATMENT RECORDS

Dental treatment can be recorded as information on the following guidelines

a. Date the current course of treatment commenced.

b. Date most recent course of treatment finished

c. Total cost of treatment provided in this case

d. Payments made by the patient

One patient may have different courses of treatment. Therefore these can be linked to a single patient record so that any number of treatment records can point to a given patient record and vice versa. This system enable the dentist to retrieve patient records, treatment records, independently which means that any existing course of treatment cannot exist in isolation.

This will enable a dentist to identify all unfinished and unpaid courses of treatment which is of paramount importance particularly when the dentist has to brief either a locum or a partner in a group practice before taking leave for a particular period.

The decision as to how long one should maintain records relating to treatment of patients is an individual choice, the advantages of computerising clinical records in treatments relates to the improved capacity, for the retrieval of summary statistics on treatment patterns and patient profile.

For example, if full details of all treatments were maintained in the computer system, suitable query programmes would allow the practitioner to compare average life span of restorations carried out using different materials or assess the success and failure rates of various forms of endodontic therapy. In a group practice the prescribing patterns of different dentists could be compared.

Certain problems are encountered in these processes of computerising clinical records. Most arise from the vastly increased amount of information that needs to be stored , and manipulated by the computer system when full details of patients and current treatment are monitored. There are three direct consequences of increasing the amount of information held within a computer system.

1. More information requires more storage and more powerful processor to maintain response times at an acceptably low levels.

2. More information requires more effort to be input

3. The more information held in a practice computer system the greater the extent to which the practice relies in that system.

Maximum benefit from computerisation in large practices can be obtained by having terminals at each surgery and the one with the hard disk at the reception so that each surgery will have independent access to the records. The only disadvantage in this system when two people concurrently attempt to update the same record some of the data may get erased, but this situation can be avoided technically.

Input of data takes time, whether to enter in a card or in the computer, and the problem arises when one start to computerise a system, regarding the data already entered on cards. This cause a very powerful disincentive to the computerising of a system and in this aspect the writer firmly recommends IT IS BETTER LATE THAN NEVER.

Storing of radiographs and correspondence is another disadvantage more so if X Rays are taken on a regular basis. With the advancing technology it will not be wishful thinking to presume that the day is not far away when radiographs could be stored as digitised images.

The last and not the least problem would be once the system becomes entirely dependent on the computer, the entire system will come to a grinding halt, when a major hardware fault occurs. In this regard a compromise would be to have both the manual and the computer system, with more chances for discrepancies to occur.

3 DENTAL RECORDS (Non-clinical)

Meticulous planning is the keynote for success for any organisation. This could be done only by studying the past, monitoring the present, and make changes accordingly wherever necessary for the future. This process cannot be accomplished without proper records. Therefore records and their maintenance are important and essential features for the efficient functioning of an organisation.

A dental office is no exception to this universally accepted rule. Traditional manual record keeping may be adequate if the number of records to be maintained are small, but if there are large numbers of records to be maintained the procedure may be time consuming and sometimes not cost effective.

Computers could be used to make this task a lot easier and more efficient. Whether computerisation of non clinical dental records is required will depend on, the type of practice, their size, location, patient profile probability, attitudes of the different dentists, and lastly on the current hardware, and personal preference of the dentist.

There is only one reported study carried out in the United Kingdom regarding computer use in dentistry, by Scicon in 1981 in association with the B.D.A. The purpose of this study was to:

a. To guide the dentists who are potential users of computers and to prevent them from getting into pitfalls, as amateurs.

b. To provide a guidance to the type of computers, size, and scope that are benefit to users.

Due to the advanced technology, the 1981 report may appear to be outdated, but it must be stated that some of those observations are still relevant.

3.1 APPOINTMENTS

An appointment can be defined as an agreement made in advance between two parties for each others convenience for the performance of a specific task, at a specific time. In fact it is a type of contract. Since these are made in advance a record has to be maintained for easy reference and for possible alterations.

Most dentists see patients by appointment. This is for the convenience of the dentist enabling him to plan out his work and make the maximum use of the surgery time and dental auxiliaries, which are his available resources. This is beneficial to the patient as he can plan, and need not waste his time in a waiting room for treatment. On the other hand a strict appointment system might make it difficult for a patient to see a dentist.

This happens in two situations:

a. A patient may have the need to see a dentist urgently due to symptoms such as pain or discomfort.

b. A patient's need may be routine and non-symptomic, then his preference would be to see the dentist at his convenience.

The choosing of an ideal appointment system will depend on the type of practice, type of dentistry practised and on the behavioral patterns of the patients, ie to say that if a dentist sees patients as and when they come, he may have a larger and probably a disorganised practice than one who has a strict scheduled practice, if the patients feel happy to go at any time depending on their convenience and the particular need for their dental treatment.

This creates a doubt as to whether a dentist should strictly follow a schedule or not. A more flexible system would be to allocate a time either daily or weekly depending on the practice for the benefit of those who will like to come for treatment without a prior appointment, outside emergencies.

The views expressed in this work will be on the assumption that generally a dentist will see his patients by scheduled appointment. The conventional way of maintaining an appointment system would be to have one page for each day with modules of 10 to 15 minute intervals for each patient for routine treatment, and to have this by the reception and to allocate times as and when they are requested either personally or by telephone.

If there is more than one dentist or if there are hygienists also included in the practice then separate sheets are maintained for each dental operator, with respective separate entries. If a patient's need is to alter his appointment then once requested the receptionist will either cancel the previous appointment by drawing a line or erasing, and a fresh appointment will be given. If appointments are requested both from the dentist and the hygienist then the two particular sheets are referred to and the records are entered accordingly.

In a busy practice the time ie spent to maintain the appointment system. The amount of paper work, and the understanding between the members of the dental work force will be factors that will favour the computerisation of the appointment systems.

In a computerised system the time factor taken either to give a fresh appointment or to make an alteration to an already given appointment, or to give a combined appointment will take only a very short time. If a patient wants to find out his appointment time or the name of the dentist in a multiple practice then, unlike in a manual system, necessary information could be given out very easily, in a computerised system.

The other advantages of computerising a system are:

a. The practice activity can be monitored,

b. The system can log which times and days are most popular,

c. The system can show a demand pattern,

d. Rescheduling of appointments if the need arises where patients can be contacted for changes in the appointments as all telephone numbers, addresses can be very easily retrieved.

The disadvantages are :

a. Some systems might not permit a terminal, to be used for appointments while another is used for something else.

b. If there are more than one terminal, and if two people try to retrieve and update the same record at the same time then there is a possibility of one such record being not saved.

c. If the computer fails either due to a machine failure or a power failure, the system can come to a grinding halt, if back up manual systems are not available.

3.2 RECALLS AND WORKLISTS

In a broader sense most of us do not go to a skin specialist, an ENT surgeon, an Orthopaedic surgeon, or an eye surgeon merely to find out whether everything is OK with our respective systems. However we do go to a dentist or to a heart specialist at certain ages just to make sure that there are no ongoing symptomless processes which could lead to disease without our knowledge. This is the reason behind regular dental checkups, which can very well prevent costly dental treatment.

It is important for the growth of a practice to ensure regular attendance of patients.In a recent survey done in the United Kingdom it was found that 75 % of the dentists felt that a recall system was essential. One method of doing this is to write the patients name and address at the time of the last appointment when he came for treatment, in a post card. These cards are then stored separately for each month and are taken out regularly and posted. The instructions given to the patients are very impersonal requesting them either to make an appointment or cancel the appointment given in the event of being unable to keep it.(Hill 1988)

This is a very cheap and effective method as long as these cards are written after every treatment and are properly stored. The management of this recall system will be easy if the period the patients are to be called is fixed for eg: 6 months intervals. If the recalling interval differs from patient to patient and if it is a busy practice the system will not be very effective and computerisation will not only be justifiable, but also will make the recall system more effective .

In a computerised system the appropriate recall intervals could be found by the patients records and instead of postcards a personalised letter could be sent out very easily , and in this letter, depending on the code of ethics, information such as facilities offered in the practice and any other relevant instructions to the patient could be included.

Recall letters can be made by selecting paragraphs that have being stored earlier which will have different texts depending whether a patient is young, old, anxious, or whether he has failed to attend on a previous occasion.

Using the utilities of either a dental software package or a word processor facility, documents, referral letters, appointment cards, post operative advice sheets, health education newsletters, wages slips, and laboratory instruction sheets could be printed quite impressively, which will have a better image of the practice.

WORKLISTS

The general practice is to maintain each day a handwritten or a typed list of all patients that are to be seen with a brief description as to the type of treatment and in a group practice the name of the dentist who will be attending on the patient.

If a system is computerised on any given day a hard copy of the days proceedings can be done within a few seconds.

3.3 INVENTORISING OF EQUIPMENT(Stock Control)

" Rome was not built in one day " is an old saying. Likewise unless the dentist has a very big capital to start a practice more often than not he will have just the basic requirements for a dental practice at the start, and with the growth of the practice gradually more and more equipment will be added onto the stock.

In the case of consumable items it is very unlikely that any dentist will purchase large quantities at the start of his practice, as he ought not know the extent to which the practice may grow in the future. In other words though the usefulness of maintaining a stock cannot be disregarded at any cost whether one should have a computerised stock control system will undoubtedly depend on the size of the practice and the type of dentistry that is practised.

Probably after a few years as a practice grows the time will come when one can safely assume that such a practice will probably will have all necessary equipment that are in vouge at a particular time with a very few exceptions depending on the location and the availability of the latest technology. From this point onwards the expenditure on consumable will take a fair portion of the annual expenditure.

An average dental practice at this level will have 100 to 200 types of dental instruments, and 200 to 300 different types of dental materials some of which will be very expensive with probably a limited life span.

Every time a new instrument is purchased from a dental supplier it is customary that receipts are maintained possibly filed and the item is taken into stock. As the practice grows these files also will grow with each purchase.

Records of purchases have to be maintained as one should be aware of:

(a) What is in stock,

(b) What type,

(c) What make,

(d) What specifications,

(e) When purchased

(f) From whom purchased

(g) For how much

(h) Whether there is a warranty period

If one has to purchase additional equipment for example, excavators either in a single or in a multiple practice it is a must that all the above details have to be known if one has to make the maximum use of the money spent.

The manual method of doing this would be to go through the file to find out the numbers you have in stock the different prices that you have paid for their purchases, whether any were broken, if so from whom those were purchased. These details are bound to help you to make the correct decision in your purchase.

To get this information either the dentist or someone who is knowledgable will have to spend quite a while going through these records, on the assumption that these are all kept safely.

Now let us see how a computer will tackle the same problem. Records of all previous purchases can be stored in a spread sheet application, even if sophisticated software packages are not available, and include information such as, number of equipment in stock, make, type, the cost, the date of purchase, the name of supplier. All these information can be retrieved very easily and hard copies could be obtained for study prior to the individual purchases. In a system of this nature all one has to do is to keep on updating records as and when items are purchased.

This will not only prevent duplication and wastage of valuable technical time but will also one constantly aware of what one has, the condition of the items available, what one needs etc, which are in fact factors that are considered in technical evaluations prior to purchasing equipment in large business establishments.

In the case of consumable items either in a small solo practice or in a busy multiple practice purchases are done either weekly, monthly, or at two three or four month intervals, depending on the size of the practice, as most of the consumable items will have a limited life span.

In order to purchase these materials one has to know the available stock, and the requirement for a specific period of time. If it is a very small practice it may be possible to glance through the cupboards and ascertain the quantity of materials needed.
This is not so easily done in a busy practice. Depending on the social backgrounds and the countries pilfering cannot be totally excluded. Based on how the materials are stocked every possibility exists for the misplacing of materials which may end up in unwanted purchases.

There are very many instances in most of the practices that material are thrown away due to the passing of the expiry dates, and materials are purchased whilst there are adequate stocks.

This is not particular to a dental practice. For any system dealing with consumables at the time of purchase, one must be aware of the present stock, minimum stock, amount required, and for how long and a knowledge of the previous purchases. This has to be done preferably by the dentist himself, who knows best about his requirement. Think of the time he is going to spend on this project if he does this manually. Isn't he spending time that he would have otherwise spent on clinical work? Is it cost effective to waste time on this type of work? Is it not required to find out whether there are any suitable alternatives?

Computers could provide answers to most of the above questions. The required information about consumables can be entered in a simple worksheet or in a table form such as when purchased, from whom, quantities available, expiry dates etc.

These information could be very easily retrieved and rates of expenditure, and qualitative analysis of the materials can be systematically done which will save a lot of money time and probably prevent potential wastage.

4 SPECIFIC USES OF COMPUTERS IN THE ARMED SERVICES

Computerisation will not by itself turn an inefficient system to an efficient one. In fact if an inherently unsatisfactory manual system is computerised, the outcome may well be that the efficiency is even reduced further. Most of the armed services are comparatively well organised, and resources are generally available, and it is reasonably safe to assume that services should have a satisfactory manual system and therefore will be ideal organisations where maximum efficiency could be derived by computerising.

Wars do a lot of harm to humanity, though is accepted as a natural way of controlling the population. Like every thing else in life, even wars, have their advantages. History reveals that there has been an incentive to increase the dental workforce during or immediately after the World Wars 1 and 2. There must have been specific reasons for this. Studies have shown that though dental diseases do not usually pose a serious threat to life, the number of military personnel who were forced to be away from active battle front due to dental diseases were not significantly less than those suffering from diseases of non dental origin. This was why the training of dentists probably had a direct relationship to the world wars.

After World War 1 the scientific basis for preventive dentistry was broadened for the first time and the nutritional background for caries was studied and stressed. In 1911 the Dental Corps of the US Army and in 1912 the Dental Corps of the US Navy were established. Government efforts assumed dental care for the military personnel. By the time of the World War 2 there were military dental services established all over the world.

Well planned Preventive Dental Health programmes have to be considered as the first priority in improving the oral health of the troops, though the increase of dental work force, and improvements of the dental facilities are also important in reaching this goal.

An armed service will be an ideal place to implement these preventive programmes for the following specific reasons:

(a) In most armies, it is a condition of service that the military personnel have to be provided with free medical and dental care.

(b) In the armed services any soldier having symptoms could report sick on a prescribed form which is called a sick report or (AFM 3) and will be attended to, depending on the condition, with the minimum possible delay.

(c) Unlike other types of practices in the government or private sector, in the armed services the clientele is limited and fixed.

(d) The consumers are grouped into different identifiable groups such as regiments or units.

(e) Instructions can be strictly enforced due to regimentation

(f) It is obligatory on the part of the consumer, in this case the soldier, to attend for dental treatment whenever requested.

(g) Failure to attend without a valid reason is considered as a breach of discipline, which is punishable under the military law.

(h) Promotions are always preceded by medical and dental examinations.

Under the medical and dental regulations in almost all the armies it is a requirement that all military personnel undergo medical and dental examinations at different stages of their military career and this, in the international military jargon, is called Pulheems. The different times a soldier has to undergo these examinations are:

(a) At the time of enlistment if the soldier is found unfit either medically or dentally he will not be enlisted.

(b) At specific periodic intervals, depending on the service, reffered to as routine pulheems.

(c) Prior to every promotion,

(d) Prior to foreign courses,

(e) Prior to any military punishment,

(f) Prior to retirement

These medical and dental examinations will not serve any useful purpose if they cannot be recorded in a way that they can be easily retrieved. The writer will now discuss, from his military experience, the different aspects that are peculiar to the services which could be modified to suit any type of dental practice.

4.1 CHARTING FOR IDENTIFICATION

At the time of enlistment all military personnel have to undergo a dental examination where their dental conditions are charted, and if they fail to satisfy the standards laid down they may be pronounced unfit for enlistment. The attitude taken towards those personnel needing dental treatment vary from service to service but more often than not they will be required to get all necessary treatment completed prior to enlistment. A soldier's initial charting is regularly updated during his tenure of service, either at treatment or during routine examinations.

This record of dental charting is vital information for the services because the chances are greater for service personnel, unlike their civilian counterparts, to end up in an unfortunate situation where a soldiers mortal remains may need identification. The need will arise when one has to sort out battle casualties after an incident where one will have to depend on certain indestructible parts of the human anatomy for possible identification of individuals. In any military operation the numbers are limited and because the total numbers involved are a known quantity it is much easier to identify than in a civilian disaster.

Dental charting becomes important again when one has to identify one dead body from another when other methods of identification become impossible either due to decomposition or disfiguring. In such an eventuality one has to go through the dental records of a number of personnel in a regiment or a unit. This will become a very tedious task even if records are very accurately and meticulously documented.

If on the other hand these records were computerised it will be very easy to scroll through these records, and if cross matching has to be done to identify a particular chart it will not take more than a few seconds to accomplish the task.

Entering dental records doesn't require either extensive knowledge or expertise in computing. With average intelligence, recording is quite a simple task, but the information that one can retrieve would have not been a simple task without the use of a computer.

To conclude, if dental chartings are computerised using either one of the available software packages which are individually described in chapter 5 of this thesis, or by a simple adaptation of dBASE III PLUS which is described in chapter 6 it will be very easy for any one to retrieve these charts either for cross matching or for any other purpose.

4.2 CLASSIFYING FOR ORAL HEALTH GROUPS FOR RECALLING

In the armed services groups of personnel can be identified into regiments or units and it is a prime responsibility of the commanders of such regiments and units to ensure all personnel under their command are medically fit, so that their state of health will not be a bar for their performance of active duty. Regular monitoring of oral conditions of the troops is a prerequisite to keep their oral health in optimum condition. This can only be acomplished by a regular appropriate appointment system.

Appointments could be either initial, regular or at a given point and also could be either for a treatment need or for continuation of treatment. An appointment given for continuation of treatment, is when one is instructed at the time of treatment when his next visit would be, as an appointment for a treatment need, will depend on individual priority and the comparative priority with the rest of the consumers. This type of dental appointments are generally done unit wise ie to say instructions are sent to unit head quarters to send personnel for treatment at a particular given time. If personnel are classified into different health groups like for example those needing immediate treatment as P1 those needing treatment in around a months time as P2 and those needing treatment in around 6 months time as P3, a very effective preventive programme could be very easily carried out if these soldiers are called up according to their classification groups of treatment. In the writers experience this is the procedure that is being carried out in the Sultanate of Oman 's land forces where the soldiers average literacy levels are low:

On an experimental basis the treatment need system was tried out in Sri Lanka and proved to be very effective. Now if this process has to be done manually even for two to three thousand personnel one can imagine the time and the effort for such procedures, not forgeting the human error factor and possible duplication.

But on the other hand if these results (the classification into different treatment groups according to different regiments or units) are done by a computer sorting out could be done very easily, and such lists could be sent to different unit headquarters well in time so that internal arrangements could be done at unit level to enable these soldiers to attend for treatment at the times specified.

4.3 SUMMARISING OF RECORDED DATA FOR FUTURE PLANNING

Planning is basically a process of projecting and selecting alternatives for the future.(WHO 1971). The aim of planning is to achieve efficient and effective use of scarce resources to achieve predetermined goals. What are our predetermined goals? These are:

(a) To minimise the oral diseases of military personnel.

(b) To maintain a state of good oral health.

(c) To provide treatment, as and when required, with the minimum possible delay

(d) To ensure that the materials and the medicaments needed for treatment are readily available.

(e) To ensure that wastage is completely eliminated by proper and timely use of consumables during their shelf lives.

(f) Indents are made for the correct quantities of materials to be purchased.

(g) Constant vigil is kept on the quantity and the state of the materials that are in stock.

To achieve these predetermined goals planning has to be done by a series of logical steps. Where do we start? Obviously to plan for the future we must have a knowledge of the present and the past. To determine our needs we must know the numbers that came for treatment, type of treatments carried out, and the quantities of materials used for the different types of treatments.

An example of this type of treatment data would be 2000 patients who were seen during three months over 60 working days. Of these 350 were for routine examinations,150 were for extractions, 150 root canal treatment, 300 composite fillings etc .

A summary for a period of the year and quantity of the consumables spent for this period on a daily average basis can be easily obtained by knowing the differences of the stocks at the beginning and at the end of the period under review. This will also enable us to evaluate the trends in the use of a particular material, and decide whether changes should be made for future orders.

Allowances have to be made for possible variables as the current and the future commitments of the service, and the possible deployments. If these records are summarised it will be possible for us to reasonably assume the quantities that we may require for the next three or six months depending on the frequency of financial allocations for purchasing.

This type of planning is vital and to show its importance one item, periapical x-ray films, can be considered as an example. If we order 1000 films for a period of six months when the assumed requirement based on previous data is 600 ± 30, and if they become unusable in the seventh month then we have not only failed to make use of the product effectively but also wasted money that could have been profitably used on another commodity. Therefore it is necessary that feed back regarding the treatments performed and numbers treated are periodically obtained. In a manual system it will be time consuming to maintain these records and also will be difficult to retrieve them for analysis.

But if these treatments and the quantities of the consumables were computerised it is very easy to summarise the quantities used for different types of treatment procedures based on the different time periods. These types of surveys will undoubtedly prevent a lot of surgery wastage and over a period of years one may even cover the cost of the purchase of a computer by using money that otherwise would have been wasted.

4.4 MAINTENANCE OF RECORDS FOR EQUIPMENT STATUS AND REPAIR

Dental practices are either solo, partnerships or institutional. Institutional ones are either Government, Universities or Armed Services. Irrespective of the type of practice with the advancing technology more and more sophisticated equipment are being used in dentistry. In the writers opinion it is a universally accepted fact, with no exception to any race or ethnic group, that there is a significant difference in the attitude and the care exercised when using personal equipment and equipment belonging to an institution. The reason could be because it is not personal finances that are spent either for repairing or replacing of any damaged item. It is of paramount importance that every possible attempt must be taken to maintain the equipment in the best possible state. This could be achieved by servicing and attending to repairs at the initial stages of defects, which will save money in the long run. These measures are more important in institutional practices particularly the armed forces where there may be no financial constraints for replacements.

As there is always a significant allocation for defence expenditure in most countries, finances are readily available for the armed services. Service Dental Clinics are generally established in major military camps depending on the number of troops, and their deployment. These dental establishments are manned either by one or more military dentists depending on the demand for treatment and availability of staff. In the normal organisational patterns the indenting, maintaining, repairing, condemning, and replacing of equipment are done by headquarters staff with whom the dentists in command of different peripheral centres will have to liaise regarding their requirements. It is the responsibility of command dentists to keep the headquarters staff informed in all matters regarding equipment status and breakages.

Broadly, dental equipment can be subdivided into two groups;

(a) Mechanical or Electrical equipment

(b) Non mechanical / or Electrical equipment

Very little or no repairs can be effected to non electrical type of equipment like forceps and hand instruments when they are damaged. The requirement will be correct maintenance of numbers and their distribution, and accurate inventorising which has already being discussed.

Therefore in this chapter the records of the dental equipment of a mechanical or a electrical nature will be considered. These items are fast becoming more and more sophisticated and expensive. A listing of some of these will make it easy to emphasise the need for proper maintenance of records about their status and repair.

Any modern dental unit will include a variety of equipment such as, the dental chair, operating light, air compressor, a different types of hand pieces, electronic scalers, X ray equipment, X - ray developers either mechanical or electrical, amalgamators, pulp testers. In an institutional practise with n number of clinics, the number of equipment of this category will be n times the number that were listed in the preceding paragraph. Since almost all these have a limited life span and the potential to break down, it is essential that not only a few spares are kept in stock but also repairs are done with the minimum possible delay in order not to disrupt the services.

The practical way of doing this will be to instruct all peripheral units to report the equipment status periodically, and to keep headquarters informed of all breakages. A book form can be maintained to record the two types of information, ie status and breakages. All periodical equipment status not only can be summarised in a book in a chart form as given below, but all relevant details regarding individual equipment can be very easily stored in a database file as shown in Fig 2.

The breakages when reported can also be recorded in a separate form with the following details :

(a) The date received
(b) The type of equipment
(b) Date of purchasing (whether covered by the warranty period)
(c) The type of breakage (whether due to negligence or fair wear and tear)
(e) Action taken
(f) Who effects the repair (whether military or outside agent)
(g) When expected
(h) Replacement given

Figure 2 Equipment status

CAMP ALPHA	CAMP BETA	CAMP CHARLIE
Dental Chair FAULTY	Dental Chair	Dental chair
Operating Light	Operating Light	Operating Light SENT FOR REPAIRS
Air Compressor	Air Compressor	Air Compressor
X - Ray	X - Ray TO BE CONDEMNED	X - Ray

Even if there is adequate staff to maintain this type of work it is very unlikely that one will go through all these records daily to find out what individual action has to be taken.

On the other hand these records, ie the equipment status and the breakages may be computerised by making use of either Lotus 123 or dBASE III PLUS, even without spending money on an expensive software package. Without a basic computer knowledge, and at the press of a button, one will be able to know exactly what equipment need to be repaired or serviced and what needs to be replaced. There are also very simple programmes that will even make entries blink. For example if the **dental chair** in **camp alpha** is faulty, then that particular cell in the chart will blink to attract more attention of the officer every time the programme is switched on. This will be a constant reminder until the equipment is finally repaired.

5 RESUME OF DIFFERENT TYPES OF SOFTWARE PACKAGES IN THE MARKET IN AUSTRALIA

In Australia there are dealers of dental software packages, who will send out information regarding their products, possibly with a pre arranged demonstration when requested. This will enable one to get first hand information regarding the main aim of this thesis ie how you can make work easier by the use of a computer in a practice. Only the following six organisations responded to a formal written request made, to furnish information about their respective products, to be included in this thesis.

ATS,
P.O.Box.373,
EPPING NSW 2121.
Mr.Doug Cotton.

Caseg Medical Systems,
7.Warren Road,
Double Bay NSW 2028,
Dr. Eric Caspary.

K9 Quidnunc Australia Pty Ltd,
Bray House / 60 Hutt Street,
ADELAIDE SA 5000.
Mr.Leigh Wilson.

AMFAC, (DENTICS)
822 Elizabeth Street,
WATERLOO NSW 2017.
Mr.Mark Ryan.

Dr.Do Little,
32,Atkin Avenue,
SPEERS POINT NSW 2284,
Mr.Peter Rickford.

Lion Dental,
1. Sylverly Grove,
Caulfield VIC 3142,
Mr.Barnard Saw.

ATS DENTAL SYSTEM

The main features of this system are :

1. **Patient accounts**
2. **Correspondence**
3. **Appointments**
4. **General ledger**
5. **Front desk modules**
6. **Patient record and pay roll modules**

Patient accounts
Patients may be billed individually and / or in families, avoiding the need for multiple entry of the same address and the phone number, etc. Third party accounts may be sent to insurance companies, solicitors and the like.

Whilst entering billing details pop up windows are available for account enquiries, entering new services or displaying existing ones, looking up codes for suburbs and towns, note pad calculator, and " what's on today " reminders. In fact most of these windows are available throughout the system and it is also possible to interrupt any function, produce a combine account, and receipt and then return to where you left off.

Integration of the billing functions with the general ledger functions means that totals on bank deposit listings are automatically written up in your General Ledger and transfered to your Income and Expenditure report. The bank deposit listing is produced as you enter details of payments received on patients accounts, although there is also facility for splitting payments between accounts or entering a payment only on the account or bank deposit listing. Any services may be altered or deleted with the security of password, a list of such alterations being kept until checked by the practice principals.

At the end of the month various reports and statements are produced automatically, including analysis of services, full daily listings, aged debtors reports, (with columns up to seven months overdue, and on screen details to 99 months overdue), and a separate report on long overdue accounts.

The aged list and the overdue list may also be produced at any time during the month, (without closing off the month) and collection letters printed automatically so that patients receive either a letter or a statement every fortnight or once the account is 60 days overdue. On screen bar graphs will show the dramatic reduction in outstanding balances which this can achieve.

Correspondence

Reports and letters may be written with an easy to learn built in letter writing system which incorporates features such as the ability to move blocks of text (cut and paste) or search and replace. Margins may be set for various sizes of stationary and different styles of print. Individual letters may be automatically addressed, for example, to other practitioners simply by entering two or three initials. Letterheads may be printed with frequently used phrases such as " Thank you for your letter."

Production letters include recall or reminder letters, overdue collection letters, letters to a selection of other practitioners, etc. and mail merge letters such as for, all new patients, all patients who have not been seen for a year, all pensioners, all patients in a given street, suburb or locality, or within a certain distance and so on.

Letters may be inserted in window envelopes or address labels used. Other labels (with more information) may also be printed for use on the cards. Though the letter writing could be done without any other word processing software built in windowing function enables one to switch into another system at the press of a function key and then to return to the ATS System just as easily.

Appointments

This system allows you to enter appointments as far ahead as you wish with this quickly learnt appointment system. To change an appointment simply move to the required name using the arrow keys, press the delete key, move to the new time and press the insert key with no more rubbing out.

If some one is on the phone waiting to know when the next appointment is you can easily interrupt what you are doing, type in a name and in a fraction of a second you will see the details on the screen far quicker, and in a more reliable way than searching through appointment books.

You may also schedule appointments automatically at regular intervals, taking into account the time of the day and the days of the week that suit the particular patient

General Ledger

The practice income system allows you to keep books and produce Income and Expenditure (Profits and loss) Reports and Balance Sheets. Bank deposits are entered automatically, so most of the work is entering cheques and this is streamlined. The system keeps track of the last used cheque number, so you won't have to enter the next number. In fact all you do is type in a simple three character code (such as ELE for electricity) the payee name and the account.

Copy of the general ledger program will be provided free of charge, for the use of the accountant who can summarise the accounts using standard double entry accounting. (either cash or accrual) and print the final reports.

Front desk modules

The front desk enhancements ($500 extra) include a clinical record system which enables you to keep notes (such as textbook or journal references) under key words such as " composite resins " These notes can be displayed and added to at any time.

There is also a form writing module designed to let you complete any printed form once you have set up the template recording where the lines and the spaces are positioned in the form.

Large fees may be automatically broken down into instalments using the instalment module. Payment vouchers may be printed and projections for individual families or the practice as a whole are available.

Stock control (inventory) is also included in the front desk system enabling you to know year to date usage, re-order levels, quantities on hand and supplier details.

A" suppliers " system keeps further details on your suppliers (creditors) and the products they supply. There is an associated job list and follow up list with automatic cross referencing.

Patient recall and payroll modules:-

Previous systems are available but it is recommended to await the release of the new systems which are currently being rewritten and significantly enhanced for release with the next update in Sep 92.

Caseg 2000

The main features of the system are :

1. **Accounting**
2. **Patient details**
3. **Patient history**
4. **Integrated word processing**
5. **Printing**
6. **Appointments**
7. **Prescription**
8. **Research,**

Accounting

See the whole patients account on screen.

All alterations to the accounts are hidden but can be made to appear by pressing one key, an important security feature.

Generate an invoice/receipt with as few as four keystrokes.

Handles a single cheque paying many accounts or many cheques one account.

Medicare batch payments built in.

Search for service items alphabetically or numerically while you are generating an invoice.

Automatic allocation of payments to invoices with manual override if required.

Check and correct banking on screen.

Full reporting including patient reports, banking reports, earning reports, accounts outstanding, research analysis, service item listing or analysis, referring doctor report, audit trial report, and total practice report.

Patient details

Generate patient labels up to two types for each classification. Configure them in one way. Used for applying pathology forms, X-Ray requests admission forms, history sheets etc. Reminder system, special days, birthdays, important meetings, conference dates etc. and be reminded automatically as you enter the programme. Any number of messages may be repeated at any interval.

Patient history

As much information as you wish to save about each patient.

Important details of the patients history can be highlighted, so that these details are visible immediately.

Automatic date and time stamping of entries.

Ideal for case histories, operation notes test results etc.

Integrated word processing

Powerful functions allow standard letters to be set up with patient information appearing automatically.

Letters automatically addressed to the patient's referring doctor, insurance company, employer and the solicitor.

Bring the standard phases and paragraphs into your documents with the touch of a key.

Built in spelling checker with a 100,000 word dictionary, which can be expanded to meet specialised requirement.

Printing

Generate attractive practise letterhead on a laser printer, for silent elegant fast, and cheaper output. Print all documents, invoices, receipts, statements transactions listings, appointment lists, operating lists, reports, medical certificates, prescriptions, word processing documents onto A4 plain copying paper.

A letterhead can be changed in the event of a change in address or telephone numbers.

Appointments

A very fast and elegant appointment system,

Appointments can be of any duration depending on personal requirement

Double and triple booking are feasible.

Appointment list for any particular day can be produced.

An operation list could be generated.

Finding and changing an appointment takes only a few key strokes.

Prescriptions

Produce and record for future references clear safe legible prescriptions with as few as 4 keystrokes.

Select from the patients previous prescriptions or from a list of your own favourite drugs.

Automatic warning for old or young patients, as well as patient allergies.

Research

Analyse your patients data

Automatic transfer of patients details

Any number of projects, any number of patients, any number of fields could be set up in any way.

Data verification is built in.

Using the paint the screen method any number of reports could be set out in any way.

Research data can be left on the system indefinitely.

K 9 DENTAL SOFTWARE

K9 adds value to your dental surgery. It allows you to enter and maintain personal records for each patient. The patient's treatment is followed throughout the surgery as the system automatically sends electronic messages based on:

The patient's arrival in the surgery

The status of the patient's treatment

Future appointments

Payments made.

Patients' personal records include full mouth charting. Standard notations are supported, including: Palmers, FDI with occlusion details, Periodontal Charting, Paedodontic Charting, and 3D tooth imaging. K9 offers full graphic charting live, on-screen and is updated faster than via the card and pencil format.

Patient dental history is maintained in full, including Periodontics and Orthodontics, complete with notes on each tooth. Automated forensic searches can be made throughout the system.

K9 has a multimedia system of voice, sound and high resolution graphics for reception area displays on dental hygiene, basic dental terminology and cosmetic advances in dental science. This communication / education system may be activated via a touch screen.

Administration of your dental practice is accomplished easily on the system, incorporating time and appointment management with an integrated, single entry accounting system.

Video imaging allows live capture of jaw/teeth images with photographic quality, in colour. The camera is approximately the size of a lipstick, yet captures CCD quality images. The images are saved as part of the patient's dental history. K9 allows editing of these image captures by enlarging, retouching, recolouring or reconstruction. This allows the patient to visualise completed treatment, prior to its commencement. This treatment may be as simple as restorations (eg. in different materials) or as complicated as major crown and bridge work.

Integrated voice recognition allows you to talk directly into the dental charting and patient dental notes, using a tiny microphone attached to your collar.
Your voice instructions are converted to signals and then to text and graphics, eliminating the need to click and type, thus creating a handsfree charting system.

Scanning of x-rays, with high resolution magnification of up to 8 times, allows you to examine x-rays with greater clarity and ease than by traditional means. These x-ray images are also stored as part of your patient's records.

Full graphics interface

1. Ease of use
2. Short learning curve, savings in time/training
3. No previous computer skills required
4. People like using Mackintosh

Patient records

1. Charts as fast as manual card based system
2. Multi restorations per surface supported
3. Supports
   - Palmers Notation
   - FDI
   - Deciduous Notation
   - Occlusion Details
4. Full Periodontal Charting
5. CPITN (Periodontal) charting
6. Paedodontic charting
7. Differentiate between restoration materials
8. 3-D Tooth Imaging

Charting incorporated - Single entry initiates integration with treatment planning, the plan, and invoicing

Dental history - Visual dental history complete with notes on each tooth

Medical history - Automatic warning for all medical alerts

Forensic search - Automated search by current or past treatment history (charts) or patient name

Practice administration/management

1. Appointments and day planning

- Appointment system that is as fast as a manual system, looks and works like a diary and gives complete time management control

- overbooking/family booking

- multiple treatment bookings

- pop-up appointment alerts

- multiple diaries (per dentist)

2. Waiting room status

3. Co-ordination of reception and clinical areas

4. Recall system

5. Automatic letter/report listing, based on examination or treatment complete, can also be issued based on a clinical condition

6. Daybooks

Individual control of the surgeries' daybooks

7. Reports

Over 60 reports with in-built search and sort functions. Reports can be sent to the screen, printer or to export (merge) files. Mailing labels can be printed on a multiple of formats

Accounting

Integrated,single entry accounting

Saves time, reduces chances of errors

Aged debtors

Better control, reduces outstanding debts

Credit control

Individual patient credit control

Statements

Easier reconciliation of accounts

Manual or automatic invoicing

Non-charting billing system, with reprints

Full records

Full financial history of patient/dentist/practice

Free form receipt system

Payment can be made in any format, accepts deposits and payment plans

Full statistics

Better control "keep your finger on the pulse"

Multiple practise integration

Standardise and simplify, multi-practise accounting

Patient communication and education

Patient communication

1. Desktop publishing, surgery newsletters etc.
2. After examination, option to provide patient with simplified graphical tooth charts/treatment plan-method has shown better treatment plan acceptance
3. Reception area multimedia (voice/sound/graphics/animation in high resolution colour) workstation (with optional touch screen) displaying:
   - oral hygiene instruction
   - basic dental terms
   - Latest advances in dental science

   Multi-user/electronic mail

   Up to 120 users sharing data, in Multi User mode. Full messaging and appointment system, allowing users to send/receive "pop-up" reminders, arrivals, telephone messages etc. from other network users

"Right thing, right way"

1. This system will keep your solution well maintained, reliable, fun to use and constantly updated to cater for user suggestions and dental developments
2. Support through 22 national locations, four hour turnaround on all hardware or software problems, free loan equipment and on-site attendance
3. The unique modem remote dial-in facility allows our engineers or TAFE School of Dental Studies, to control your computer and clarify problems or questions directly as they arise

Training

1. On-screen help, well prepared manuals, multimedia computer based simulation training system
2. Comprehensive training course prepared and run by TAFE School of Dental Studies, designed to have your users up to speed as quickly as possible

DENTICS MANAGEMENT SYSTEM

1.ACCOUNTING

The accounting system can cater for any number of dentists working individually or toge ther as a practice. "The Dentist" also performs functions such as:

Reception accounting including, walk out bills, bulk billing and banking

An open item system allowing both automatic and selective reconciliation of item's

A payment by instalment system for selected patients

An on-line patient ledger inquiry for the updating or monitoring of patient information

Monthly accounting including automatic statement production

A cash book system that automatically posts patient receipts and practice expenses to the cash book, so you can keep an up-to-the-minute account of your cash balance

2.PATIENT

MANAGEMENT

Patient record information includes summary information required on all patients as well as detailed dental records

Patient recall calculation is automatically performed by period and date, with automatic label printing or letter printing

Selective deletion of transient patients, or past patients according to flexible criteria

3.PRACTICE

MANAGEMENT

When required, "The Dentist" system will print out the report you require immediately, detailing: your patient lists, and records; trial balances, daily, monthly, or annual analysis of services; summary audit trails; dental/surgery reports; referral dentist reports or even your appointment schedule, for today, tomorrow or next year.

4.TEETH CHARTS

Teeth are displayed diagrammatically which allows you to chart the teeth of any patient. With this system, you can chart the treatment required on any number of tooth surfaces and schedule such treatment.

The chart displays all permanent and deciduous teeth labelled in the international numbering system.

THE DR. DO - LITTLE DENTAL COMPUTER SYSTEM

- The easiest to use, the most self-explanatory program on the market!

- Written by a dentist in private practice.

- Written using computer industry standard dBase formats.

- No modules, the program is sold complete, including multi-user.

- Continuously being improved and updated.

- Will run on any IBM PC,XT,AT or PS/2 compatible computer.

- Uses blank stationary to quarter your stationary bill.

- Stationary design can be modified according to your needs.

- Distributed by dental companies, not computer gurus.

- Account statements with running balance produced on demand.

- Account search, alphabetically or by account number.

- All previous transactions are permanently retained.

- General ledger, to calculate the costs of your practice.

- Practice profitability including projections for the financial year.

- Debt management, lists debtors, prints letters etc.

- Recall letters, recall period is variable for each patient.

- Banking, generates deposit form, lists cash, cards, cheques etc.

- Word processor, for writing referral letters etc.

- Inventory management, lists products purchased in your practice.

- Wages, tax and group tax management with 1988/89 tax scales in-built.

- Practice analysis - Analyse your practice street by street, by suburb, by health fund, by age of patients, by day of week, by item number.

- Dental tooth charting in colour if desired, with patient notes.

- Single or multi-dentist practices.

The cost of the Dr. Do - Little Dental Computer System depends on the hardware chosen, however a typical system with an EPSON AX2 computer with 20 Meg Hard disk, monochrome monitor, 1.2 Meg Floppy disk and STAR NX1000 Colour Printer costs $5800.

LION DENTAL SOFTWARE SYSTEM

-Reliable and accurate

-Highly flexible

-Extremely easy to learn and use

-Excellent reporting

1. Prints accounts on standard dental letterhead paper

2. Easy to correct input errors

3. Automatic creation of bank deposit slips

4. Prints duplicate accounts and bank deposit slips

5. Prints day sheet of transaction by dentist

6. Prints statements of overdue accounts

7. Prints quotas

8.Patients reports including transactions, services, and financial history

9.Customised recall system

10.Lists referrals to surgery

11. Lists patients by selected service

12. Lists patients by last treatment date

13. Lists aged debtors and patients in credit

14. Analysis of services by dentist with percentages

15. Financial summary by dentist for any period

CASH PAYMENT MODULE

Bank reconciliation

Payments summarised by expense type

Detailed list of payments by expense type

List payments by a selected supplier

Net cash flow for any period

6 ADAPTATION OF dBASE III PLUS TO MAINTAIN DENTAL RECORDS

The writer has used the method, described in this chapter, for storing data of dental patients in an army camp in Sri Lanka, to illustrate the treatment needs and the cost effectiveness of employing dental officers on a permanent basis. With no software package or a hard disk, it was possible to store and to retrieve lot of information, with a very basic knowledge, in computing.

In this chapter the writer will describe in detail different facilities of dBASE plus and their advantages for data storage and differential retrievals.

For the reader to understand the simplicity of this method, brief explanatory notes are given on basic computer terminology, used in dBASE plus such as:

a. Database file
b. Record
c. Field
d. Name of file
e. Types of fields

A database file can be defined as a collection of similar records in a secondary computer storage device. All database files should have a name which should begin with a letter, with a maximum of eight characters, which could be either letters, numbers or underscores (_).

Example: PER - INFO.

If personal data of patients are stored using dBASE III plus, it will create a database file that will look like Fig 3.

Figure 3 The appearance of a database file

Name	DOB	SEX
John Smith	22/MAR/45	M
David Barnard	03/JUN/67	M
Richard Wilkinson	09/DEC/75	M

In dBASE III plus, data is stored in tables of rows and columns and therefore is called a relational database. Each row in a database file is a record, thus a database file is a collection of records, and one such record will look like Fig 4.

Figure 4 A record in a database file

JOHN SMITH	22 /MAR / 45	M

Each column in a database file is called a field. These fields should be named for identification. The field names should begin with a letter, can have a maximum of ten characters which could be either numbers, letters, or underscores. Example - CODE_5

There are five different types of fields:

(a) Character type field (C)
(b) Numeric type field (N)
(c) Memo type field (memo)
(d) Logical type field (L)
(e) Date type field (D)

A character field can contain letters, numbers, blank spaces, and symbols . The contents cannot be used in arithmetic calculations. This type of field is identified by " C "

A **memo** type field can be used in a database file to enter a long text for each record, memo fields in a database are stored in a database memo file with file ext .dbt indicated by the word " memo ".

A **numeric** field can contain only numbers, the contents can be used in arithmetic calculations. Identified by letter " N "

A **logical** field can enter True/False or Yes/No values.Only one character can be entered into a logical field which is denoted by letter " L ".

A **date** type field has the format mm / dd / yy, is used to store a date, and is denoted by " D ".

The width of a field has to be defined by the user except for a memo field and is determined in a character or a numerical field by the maximum number of spaces that you think is required to enter all values into it. For example if the name of patient is a field then its length will be the number of characters that will be required for the longest name in it. For a date type field and for a logical type field, the lengths will be 8 and 1 respectively.

Data can be entered into a database either using the standard dBASE III plus data entry format, or a screen form file which will make the user enter data similiar filling up an application form. Both these types are illustrated in Figures 5 & 6.

Figure 5 Record entry format

Number	O/50545
Rank	Colonel
Unit	SLAMC

Figure 6 Screen format for record entry

Date: / /	ARMY DENTAL FORM	Number:
Rank:	DOB: / / Status	Unit:

Name :

Decayed	UR			UL
Missing	LR			LL
Filled				
DMF				

Remarks:

Ctrl - Pgdn to enter a note Ctrl - Pgup to return

A screen format can be set up using the simplest scr: format procedures which will enable one to maintain as much as 128 sets of data fed into different fields depending on ones requirement with the possibility of retrieving any desired amount of such fields, at any one time.

To maintain this type of data, a basic computer with two floppy disk drives [even without a hard disk] is sufficient.

Two floppy disks for the dBASE system and one floppy disk to store data are required.

STEP 1

In a microcomputer with two disk drives and without a hard disk, MS - DOS should be first inserted to drive A. Screen will appear for the entry of the current date and the time as follows:

```
Current date is Sun 10 - 09 - 1992
Enter new date :    27 - 09 - 1992
Current time is 0:00:06.44
Enter new time :          10.30
```

Once these are entered DOS Prompt A> will appear, in a computer with a hard disk Prompt C> will appear. When using the first type of computer, the MS - DOS system has to be replaced by dBASE III plus system disk #1, and dBASE has to be typed against A>. In a computer with a hard disk dBASE has to be typed against prompt C>. At this stage the screen will have the license agreement as depicted in Fig 7.

STEP 2

In a computer without a hard disk, System disk #1 is replaced by System Disk 2 and <Enter> is pressed where as in a computer with a hard disk the next screen will appear automatically or when enter is pressed, which will have the appearance shown in Fig 8.

Figure 7 dBASE agreement form

dBASE III PLUS version 1.0 IBM/MS DOS
Copyright (c) Ashto - Tate 1984, 1985,1986.All rights Reserved
dBASE, dBASE III PLUS, and Ashton - Tate
are trade marks of Ashton Tate

You may use the dBASE III PLUS and printed materials in the dBASE III PLUS software package under the terms of the dBASE III PLUS software Licence agreement .In summary Ashton_ Tategrants you a paid up , nontransferable personal licence to use dBASE III PLUS on one microcomputer or workstation.You do not become the owner of the package,nor do you have the right to copy or alter the software or printed materials.You are legally accountable for any violation of licence agreement or of copyright, trademark or trade secret laws.

Insert System Disk 2 and press enter, or press Ctrl-c to abort

Figure 8 Menu to select a data base file

Set up Create Update Position Retrieve Organise Modify Tools

Database File
Format for Screen Query
Catalogue View
Quit dBASE III plus

ASSIST <A> Opt 1/6

- Select - Leave menu - Help -F1 Exit - Esc.

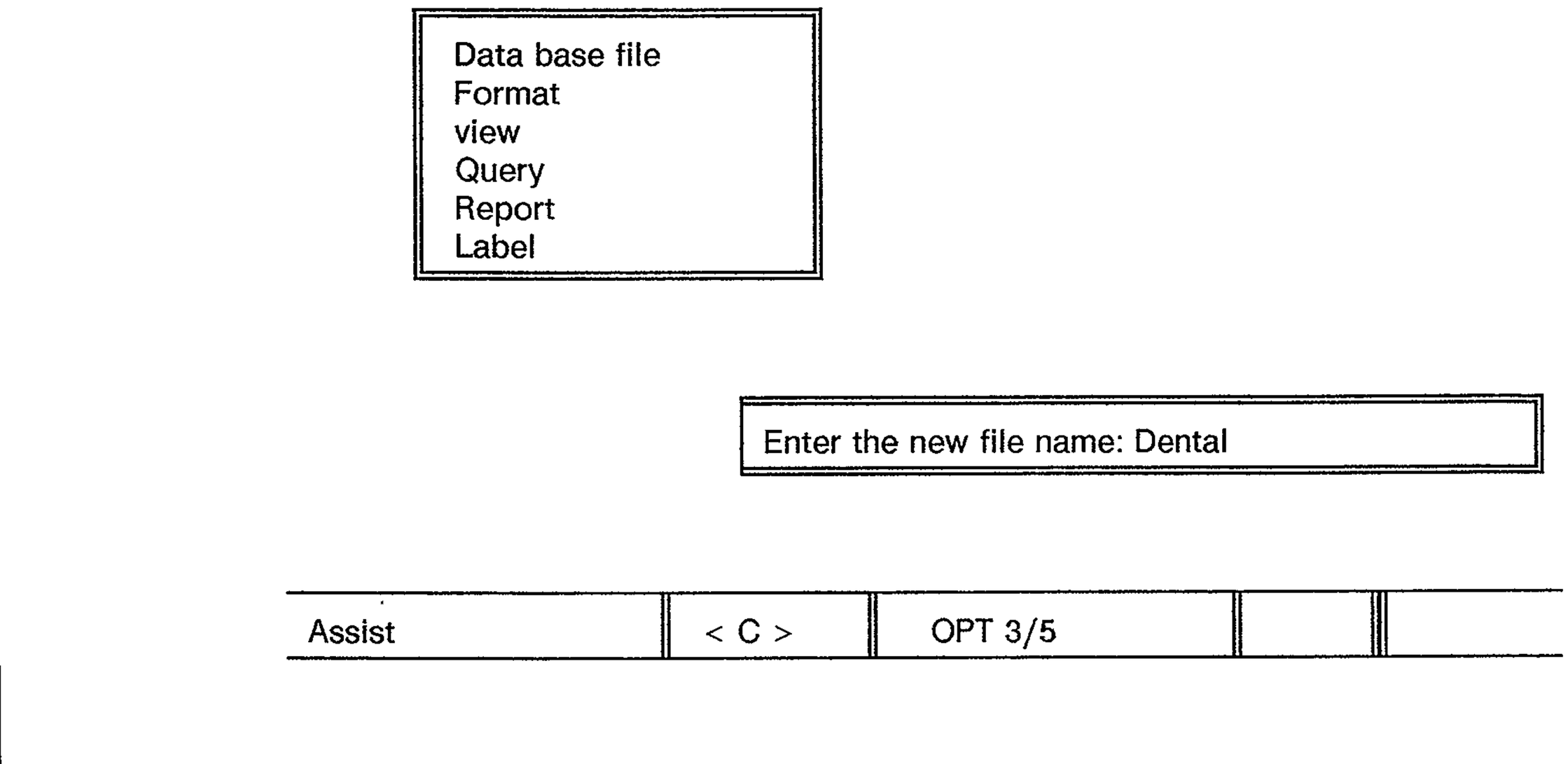
Select a database file

STEP 3

The highlight is first taken to the first row of Fig 8, ie database file, and the curser keys are pressed to move to the create mode, and <Enter> is pressed. At this stage the disk drives will appear in the screen.

After choosing the drive on which the data will be stored, <Enter> is pressed and the screen will appear as in Fig 9, prompting for a file name.

Figure 9 Menu to enter a file name



A file name (eg : Dental) could now be typed and <Enter> is pressed. Different field names are now entered defining the specific types and the respective lengths and once all the fields are entered <Ctrl> and <End> keys are pressed to save the format which will appear like Fig 10.

Figure 10 Menu to enter fields

Bytes remaining 3999

Char : ←--→	Char : Ins	Char : Del	Down a field: ↓
Word : Home	Field : ^N	Word : ^Y	Exit / Save : ^end
Pan :^← ^→	Help : F1	Field : ^U	Abort : Esc

1.DATE	Date	8	9.	LOWER_L	Character 8
2.NUMBER	Character	8	10.	LOWER_R	Character 8
3.RANK	Character	8	11.	DECAYED	Numerical 2
4.UNIT	Character	8	12.	MISSING	Numerical 2
5.NAME	Character	20	13.	FILLED	Numerical 2
6.DOB	Date	8	14.	DMF	Numerical 2
7.UPPER_R	Character	8	15.	STATUS	Character 2
8.UPPER_L	Character	8	16.	REMARKS	Character 2

MODIFY STRUCTURE || <A> || DENTAL || FIELD 1/16 ||

Figure 11 Format for data entry

Bytes remaining 3999

Char : ←--→	Char : Ins	Char : Del	Down a field: ↓
Word : Home	Field : ^N	Word : ^Y	Exit / Save : ^end
Pan :^← ^→	Help : F1	Field : ^U	Abort : Esc

DATE / /
NUMBER
UNIT
NAME

APPEND || <A> || DENTAL || EOF/ 1 ||

Field names begin with a letter and may contain letters digits and underscores

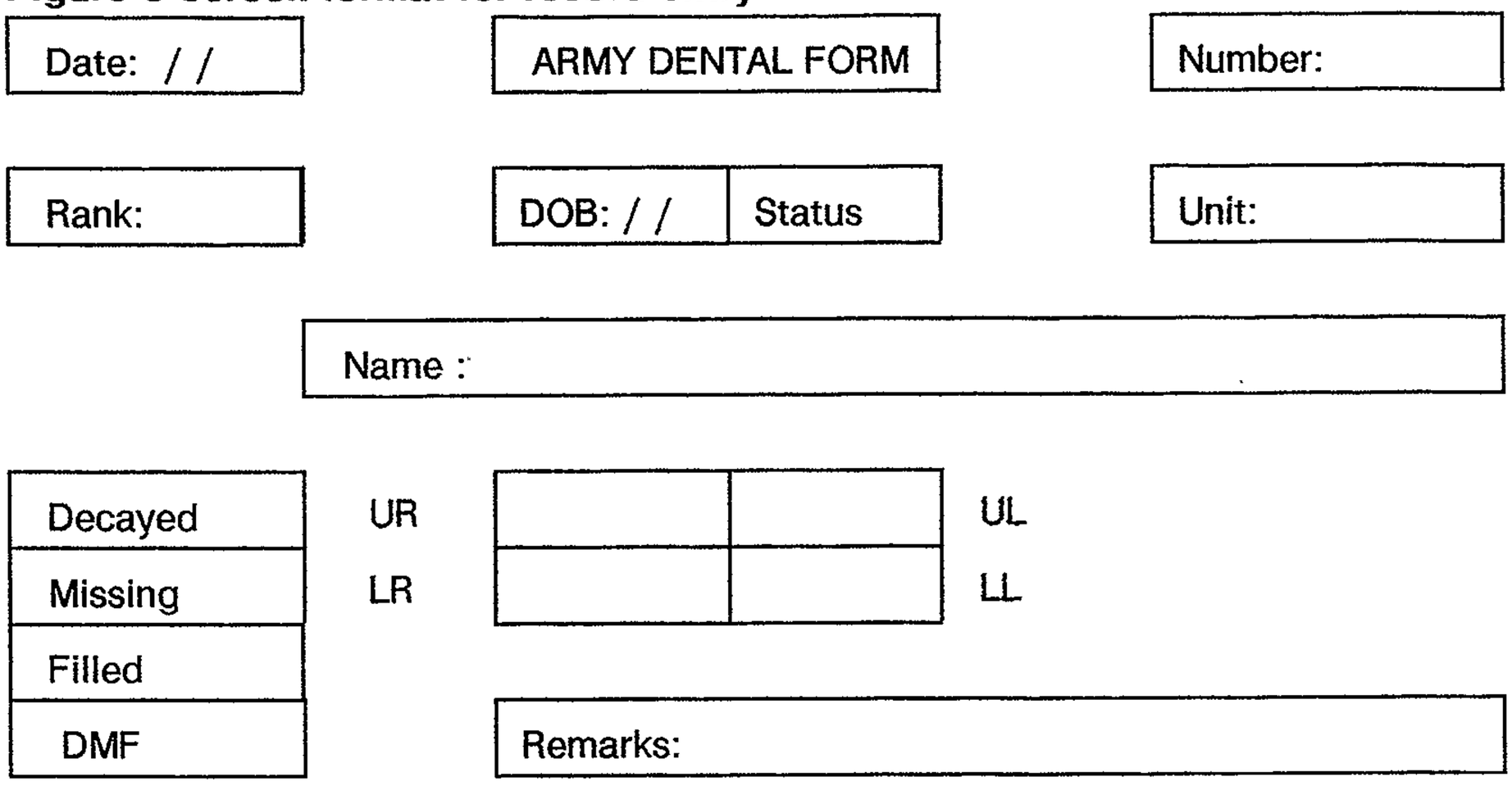
STEP 5

Now we are ready for entering data for which purpose the entry format would be like that shown in Fig 11. The notations used by the writer were :

Decayed : D	Filled : F	Denture : d
Missing : M	Normal : N	Crown : c

If the above format is not good enough and a screen form as depicted in the figure given below Fig 6, is preferred, steps 6 to 10 has to be followed.

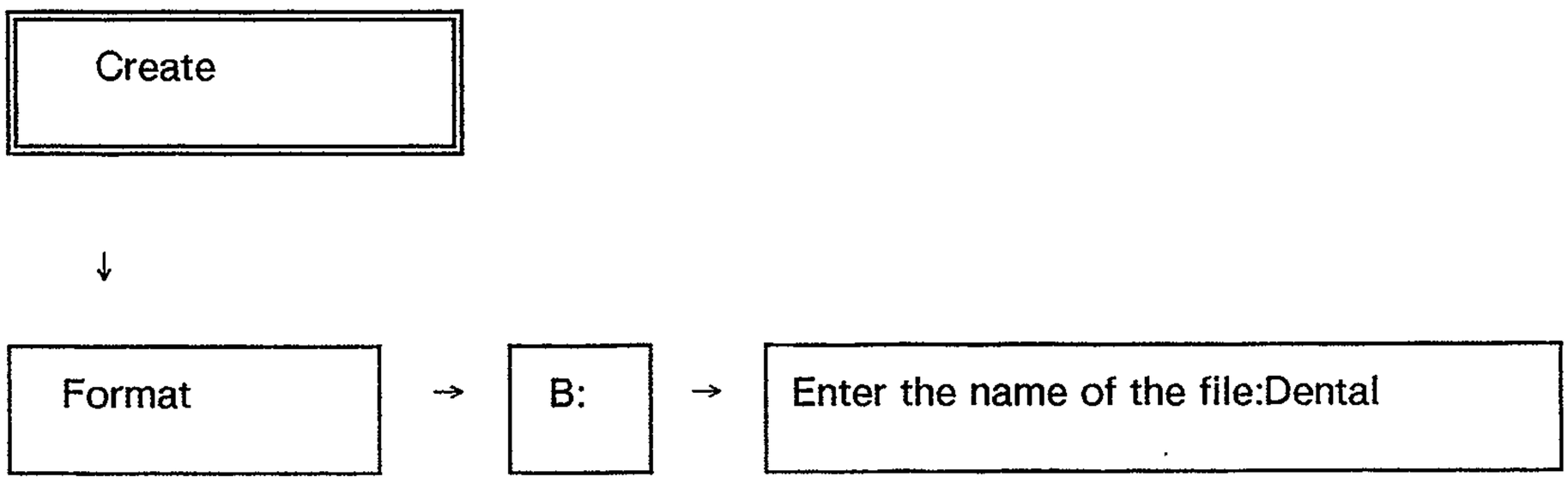
Figure 6 Screen format for record entry



STEP 6

Select the following option to create the screen form file as shown in Fig 12.

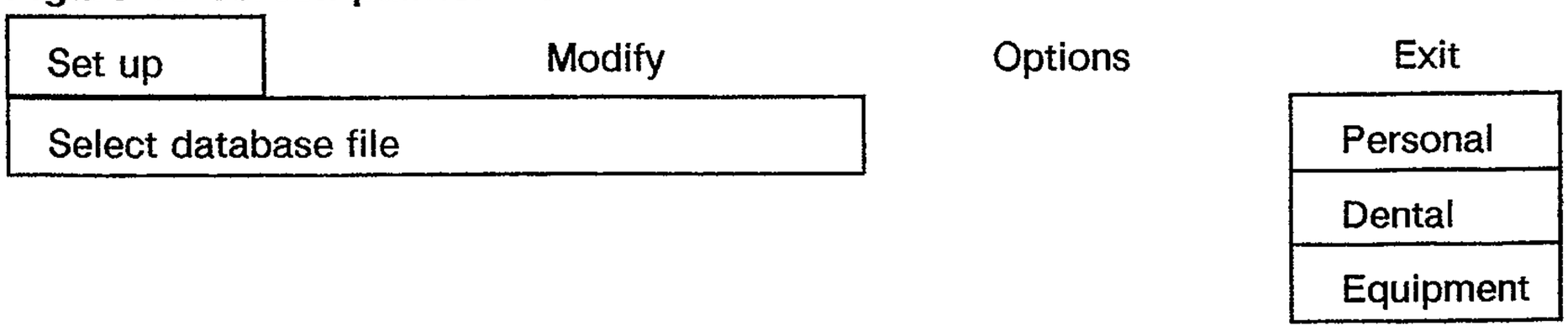
Figure 12 Menu for screen form



STEP 7

The menu in Fig 13, is called the "Screen Painter Menu", will appear on the screen, select database file Dental by moving the high light to this file and pressing the enter key.

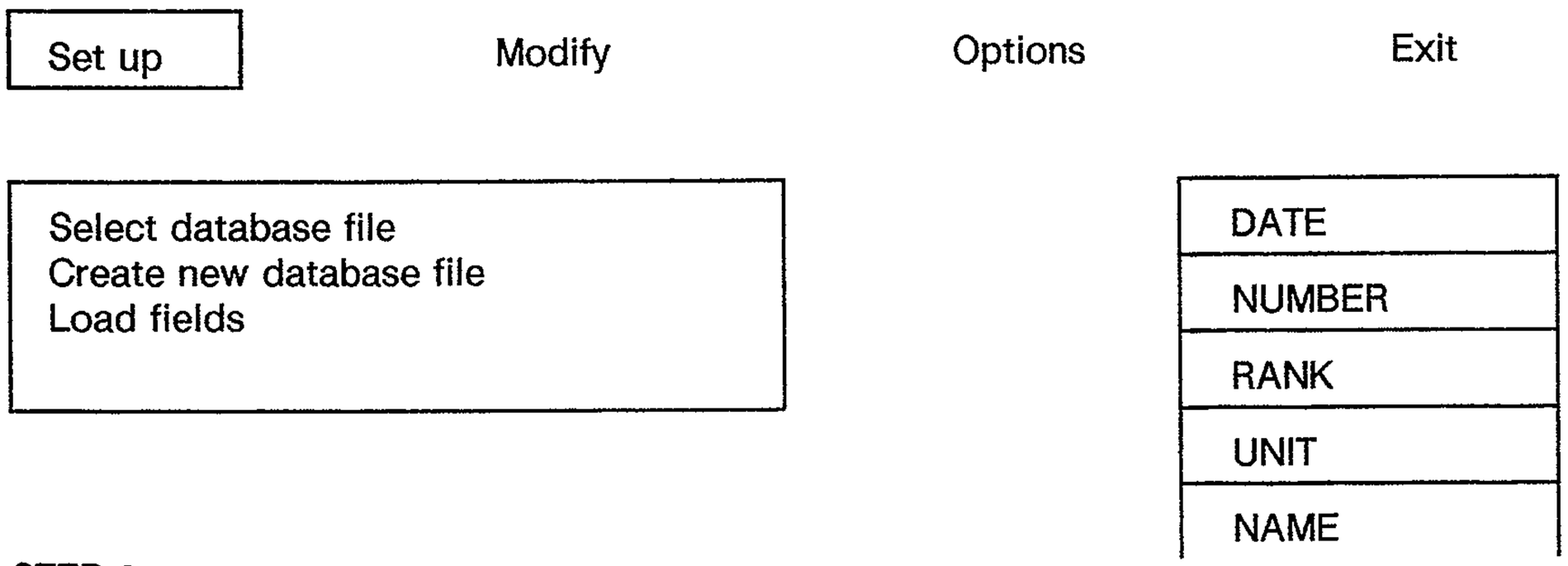
Figure 13 Screen painter menu



STEP 8

Select the option load fields from the database file dental, and press <Enter>. All the fields in the active database file will appear in a box, and the fields that are to be included in the screen form are selected by moving the highlight and pressing the <Enter> key. The screen will have the following appearance, as shown in Fig 14.

Figure 14 Load fields menu



STEP 9

Press F 10 key once. The fields selected will appear on the screen called Blackboard Menu as depicted in Fig 15.

Figure 15 Black board menu

Set up Modify Options Exit 03:26:56PM

DATE	99/99/99
NUMBER	xxxxxxxx
RANK	xxxxxxxx
UNIT	xxxxxxxx
NAME	xxxxxxxxxxxxxxxx
DOB	99/99/99
UPPER_R	xxxxxxxx
UPPER_L	xxxxxxxx
LOWER_L	xxxxxxxx
LOWER_R	xxxxxxxx
DECAYED	xx
MISSING	xx
FILLED	xx
DMF	xx
STATUS	xx
REMARKS	MEMO

STEP 10

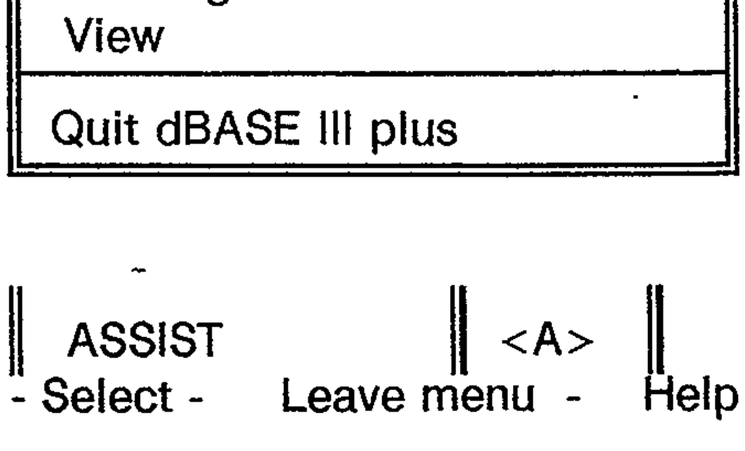
The field highlights are moved to any place by pressing the enter key initially with the curser under the beginning of the highlight space, then moving the cursor to the desired place and completing the action by pressing the enter key.

To make the format attractive either single or double lined boxes could be drawn by using the option and adopting the same procedure as previously. Once the screen form (as illustrated in Fig 6) is completed select F10 to display the screen painter menu and select the options to save the screen file on the disk under the name Dental scr as shown in Fig 16.

Figure 16 Menu to save the screen format

Different combinations of fields could be retrieved by simple dBASE commands, a few examples of which will be illustrated now. At this stage to make it easy for the reader the options shown previously in Fig 8 are reproduced below.

Figure 8 Menu to select a database



Pressing <Escape> key one can get out of the assist mode in Fig 8, and dBASE dot prompt will appear on the screen as given in Fig 17.

Figure 17 DOS prompt

dBASE dot prompt			
._Command Line	< A >		

By using the following dBASE PLUS commands new records could be entered:

. USE DENTAL

. SET FORMAT TO DENTAL

. APPEND DENTAL

The screen format (Fig 4) will appear and by pressing Pg Down, after each entry, data could be entered. Once entered they could be retrieved in any desired combination.

For example if we desire to summarise the names and the dental charts of the upper and the lower arches the following commands are entered,

. USE DENTAL

. DISPLAY ALL NAME,UPPER_R,UPPER_L,LOWER_L,LOWER_R { and enter }

Once enter key is pressed the names with the dental charts will appear on the screen.

RECORD# NAME , UPPER_R, UPPER_L, LOWER_L, LOWER_R

1. DICK SMITH FFMnnDnn FFnnMMnn DDmMMnn FFFMMMnn

If we desire to summarise the name age and the DMF the following commands are entered.

. USE DENTAL

. DISPLAY ALL NAME, DOB. DMF {and enter}

The data will be displayed as below:

RECORD# NAME, AGE, DMF

1. DICK SMITH 04/03/45 16

If we require the DMFs of all people with birthdays after 01/01/46,the following commands will give us our requirement.

. USE DENTAL

. DISPLAY ALL FOR DOB > CTOD ("01/01/46") {and enter}

In this CTOD is a ready made function available in dBASE to convert a character quantity to a date quantity. By knowing these few commands even an amateur can use a basic computer to store retrieve and analyse data with out much effort. This procedure will not cost anything more than the price of three floppy disks could store even more data than those listed in Fig 15,

The writer's main aim of this chapter is to develop an interest in the reader in computer science and how it can benefit a service in numerous ways. The charges were not included in this as this was designed for the armed service.

7 DISCUSSION

The different types of dental records, ways of their storage, and the role a computer could play have been explained in detail in the preceding chapters. In future with the advancing technology, maintenance of records only will not be adequate justification for a dentist to purchase a computer. Most of the clinical applications of computing which promise to affect our lives in the foreseeable future, ie within the next ten years, are concerned with their use in diagnosis, and treatment planning and therefore this concluding chapter will be confined to a discussion in this field.

If identical data is put, and an identical programme is run then a computer will produce the same output or the same answer. It then follows that computers do not or cannot think. But one finds it difficult to explain as to how the computer could possibly beat in a game of chess, the same programmer who made the programme. Before we proceed any further we should have a clear idea of what is meant by ARTIFICIAL INTELLIGENCE and EXPERT SYSTEMS.(Hill 1988)

Artificial intelligence is not a new concept.It is concerned with the designing of intelligent computer systems corresponding to the intelligence in the humans. Special computer languages had been developed for building **artificial intelligence** applications, and these had been directed mainly towards providing computers with a body of knowledge.The resulting computer systems are known as **expert systems.**

An expert system can be defined as a computer programme which has knowledge and inference mechanisms to solve problems which when tackled by humans, require significant expertise. Knowledge in an expert system is held in its knowledge base, in simple rules written in English. A rule has a condition and an action component. Action is to draw a conclusion.

This leads to further information being included in the knowledge base. It has an interpreter which browses through the rules testing them to see if conditions are met. In a knowledge base there are hundreds of rules where qualitative and quantitative data are stored which can be periodically updated. These rules are formulated by an expert or a group of experts on a particular specialty and are put into the knowledge base by the computer engineers.

Expert systems are different from conventional programmes. Expert systems can never be completed, it's always developing, unlike humans expert systems can never forget what they know. Therefore it is reasonable to assume that they will become acceptable with time.

Some of the recorded instances are enumerated below where Artificial intelligence based on expert systems had been used to aid in clinical diagnosis and treatment planning.

a. Distinguishing white lesions in the oral mucosa(Kramer 1971)

It has been established that the computers gave the correct diagnosis when detailed information concerning histological findings were given in a series of cases to distinguish between lichen planus and leukoplakia.

b. Expert systems have been developed to assist differential diagnosis of pulpal disease in endodontics (Hyman & Doblecki 1983) because of conflicting opinions due to, insufficient signs or limited experience.

c.Most valuable contribution of the computers have been in the field of orthodontics ie to forecast of the future craniofacial growth patterns from computer analysis of serial cephalograms(Sloan 1980) - Cephalometric analysis can be assisted by calculations of distances & angles by the computer. Three dimensional computer graphics techniques will allow simulation of future hard and soft tissue profile on screen, which will make it possible for a dentist to ascertain whether an individual case could be treated by removable appliances, or fixed appliances, whether its within his capability to correct the malocclusion or whether the patient needs specialist care. However, if the dentist has had little recent experience in orthodontics, he may not have the knowledge needed for such a decision. This had led to an increase number of cases referred to orthodontic consultants for advice, and also an increase in their workload due to cases where treatment by a practitioner has

been unsuccessful (Sims-Williams 1987). Therefore the computer based analysis will undoubtedly be of invaluable benefit to both the dentist and the patient and will prevent a lot of possible meaningless dental treatment.

d. Ralls et al(1986) described a comprehensive computer assisted dental diagnostic system, capable of diagnosing most dental emergency conditions, for use by physicians or other health care professionals in isolated environments not having access to a dentist. These systems could also be very useful in assisting a newly qualified dentist to gain confidence in decision making.

e.The current visual method of interpreting radiographs has many disadvantages, due to shortcomings in the human visual system. Small changes in image density are very difficult to detect and it is often not possible to see tiny irregularities. A considerable improvement can be obtained by means of digitised image processing techniques (van der Stelt 1985). These techniques are performed on a digitised image, obtained from the conventional radiograph.

f. A computerised chart should allow an accurate representation of the teeth as they appear in the mouth, with any angulations of rotations. With the advent of todays powerful computers, the provision of such high resolution graphics facilities it has become a practical possibility(McCormack 1985), unlike in the past, where dental charting had been limited to two dimensional representations which could show only the presence, absence, restored or not status of teeth. With the voice recognition facilities in some of the soft ware packages charting could be done by the dentist at the chairside.

Periodontal charting systems have been demonstrated which record bone depths graphically by the use of electronic pocket probes. The computers could also be very effectively used, to educate the dentist and his patients, the former by using scientific update programmes, which are freely available, and the latter by showing computer assisted oral health programmes in waiting areas. These are some of the many areas where a computer could be used as an effective tool to make the work of a dentist easier, in his day to day life.

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