1989

Patent Registry Database

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PATIENT REGISTRY DATABASE

BY
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An Abstract Presented to the Faculty of the Graduate School of Lindenwood College in Partial Fulfillment of the Requirements for the Degree of Master of Business Administration

1989

ABSTRACT

The purpose of the study is twofold. First, to demonstrate the ability of a database to handle a large number of patients and accompanying medical information to allow the clinician to diagnose and treat them with greater efficiency and rapidity. Secondly, to create a patient registry database for children with growth problems (St. Joseph's Hospital group study).

Computing trends indicate that over the next few years, computer stored medical records will become technically and economically feasible on a broad scale. Many clinical databases are already becoming available for doctors and hospitals to use. The benefits of computer-based medical records out-weigh the paper records. The main benefits are (1) improved logistics and organization of medical records to speed care and improve doctor's efficiency, (2) automatic computer review of the medical record to limit errors and control costs, and (3) systemic analysis of previous clinical experience to guide future practices and policies.

Paper reports may often be out of date in hospitals or in medical clinics where the patient's status can change rapidly. Furthermore, unlike terminals, turnaround paper documents cannot provide reminders or error checks as data is recorded on them.

The database that is chosen for this project is called Paradox for IBM PC computers. Computer stored medical records associated with each patient is best managed under a unified database structure.

Of the available non-medical databases, Paradox has been proven to be cheaper, easier to learn, and maintain. Since it is a relational database, the tables are interlinked to produce the desired results. This database should help the clinician in adding new patient data and, in updating the previous patient's information by using less time.

In conclusion, the Paradox database has been shown to be an effective management tool for doctors to perform fast entry and easy storage of medical records, updating files simultaneously and instantaneously with the added assurance of data accuracy and efficient memory utilization.

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1989

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ACKNOWLEDGEMENTS

I wish to thank Dr. Jim Swift, my chairperson and Faculty Advisor, Sister Margaret Jackson, and Dr. Arlene Taich for their guidance in this culminating project.

I would like to express my appreciation to my family for enduring the long hours needed to complete this project.

I would like to thank Dr. Kissell Director at the St. Louis Regional Hospital for his advice and encouragement.

I would also like to thank Barb Collins for her assistance in typing and proof reading of this report.

Finally, I extend my special thanks to Dr. Spaulding for giving advice towards the clinical part of this project.

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INTRODUCTION

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The purpose of this study is to show how a clinician can improve the efficiency of service and have quality care for his patients by maintaining patients records in a relational database. The author also discusses the advantages of computer stored medical records compared to paper files.

At present the software which is available for hospitals and physician's offices are more administratively oriented. Most hospital computer systems in use these days are for reduction of manual- effort relating to patient orders and responses or results. These systems are directed at replacing, or at least reformatting, the manual effort required to build the medical record.

There has been little emphasis on changing the basic structure of the medical record to take advantage of the computer's power. As a result the present day hospital information system may be characterized as a semi-automated version of existing manual procedures. Less emphasis is given to keep patient's progress notes, illness histories, surgical operation reports, and referral notes in the information systems.

The data collection mechanism is deficient in the manner it is investigated at the hospital or clinicians's office, and there is a need to automate this procedure. This need was not taken into consideration for lack of awareness concerning how automation might be beneficial.

The author describes the history of computer technology and the use of computerized information systems in the hospital environment and emphasizes the effects and advantages of a relational database. In addition, a case study will be presented from the Pediatric Endocrinology Department in St. Joseph's Hospital to evaluate the benefits of information retrieval systems.

Different available databases will be discussed and the recommended database advantages will be presented. Specific examples will be given to retrieve the data in different forms. Results will be printed, and interpretation of the data and results will be explained. The amount of time saved to read these records and personnel time to input the information will be compared, by both manual and database procedures.

The creation of the database and maintenance of this data will be discussed. In summary the significance of a database for clinical environment and monitoring of patient care will be emphasized.

Problems in clinical settings:

Accountants use computers for almost all their tabulations and increasingly for judgmental work, such as tax planning. Architects and engineers use them for drafting and designing. Scientists use them to collect and analyze their research data. Even the legal profession has embraced the computer. Everywhere, case law begins with a computer search (McGowan,1987).

Physicians however, generally do not use computers to assist their clinical work, although mundane information processing tasks constitute much of their effort, such as: when a new diagnostic study returns, are the results abnormal? Is the new test result different from the previous one? Did the change coincide with the start of new treatment? When considering the new therapy is the drug among those to which the patient is allergic? Does any current diagnosis contraindicate use of the drug? Is the patient treated with isoniazid due for another battery of liver function tests? Is it time for a flu shot for an elderly patient? Is it time for a woman to have a cervical papanicolaou test (McDonald,1988)?

To address most of these questions, one must first know certain facts about the patients. For example, to decide whether a serum urea nitrogen concentration of 16.0 ml/L (45mg/dL) represents a new abnormality, one must know the patient's past serum urea nitrogen and creatinine results. To decide whether the medication might be the cause of the abnormality, one needs to know the date the current treatments were started. The same requirements for patient-specific facts apply to most diagnostic and management decisions. But, as most practitioners can attest, the work of finding the needed patient's facts is greater than the work of making decisions about them.

Least visible to physicians are those medical charting functions that cross link many different sources and services in operations management of direct patient care. These tasks largely concern the nurses, who must spend up to half of their available time on these non-clinical activities (McDonald,1988). Numerous formalism have been devised to organize the cross links: card indexes, medication files, tickets, patient care schedules, etc. Data are transcribed onto a variety of forms and are kept in various cubbyholes, including pockets.

Present procedures however, are generally unsatisfactory. To compensate for this, redundant information is used to reduce the chance that important data might be lost. There are notes and notes about notes. Clearly, some new form of automation that can store and share information with the detailed accuracy such as in an airline scheduling system is needed. However, the operations support roles played by these myriad pieces of paper must figure prominently in any redesign, because automation must address these same issues (Korpman,1989).

Because existing computer systems in most hospitals and clinics do not contain these needed patient facts, they cannot help physicians with their clinical information-processing tasks.

A few institutions do have computer systems that contain needed patient facts in a computer stored medical record (CSMR) system (Korpman, 1989). However, these do not necessarily replace, the paper medical record. What characterizes these systems as medical records is their ability to store clinical information from a variety of sources in a common framework, to provide access to observations, and treatment records as discrete and "understandable" items and retain this information on-line for many years.

Because the clinical observations are stored in "understandable" chunks, these systems can find, organize, and "decide" about their medical record content.

Moreover, they can organize this content into various reports as required for clinical care, hospital management, and clinical research.

In the past, economic, technical, and organizational barriers have prevented the widespread use of such systems. The increasing capabilities of computers, their decreasing costs, and third-party incentives to store medical information on computers are gradually eliminating these barriers. The fact that many vendors of hospital information and billing systems are now developing medical record modules is a measure of the improving climate for medical record systems. The author believes that electronic medical record systems will be widely available in the near future.

HISTORY OF COMPUTERS

HISTORY OF COMPUTERS

For many years, the human race lived on earth without keeping records. But as social organizations such as tribes began to form, it became necessary for humans to adjust. Methods of counting, based on the biological fact that human beings have fingers, thus developed. However, the limited number of digits combined with the need to remember more facts posed problems. For example, if a shepherd were tending a large tribal flock and if he had a short memory, how was he to keep control of his inventory? Problems bring solutions, and the shepherd's solution might have been to let a stone, a stick, a scratch on a rock, or a knot in a string represent each sheep in the flock (Holvien, 1977).

As tribes grew into nations, trade and commerce developed. Stones and sticks, however, were not satisfactory to the early traders. In 3500 B.C., The ancient Babylonian merchants were keeping records on clay tablets (Holvien, 1977). An early manual calculating device was the abacus, which although over 2,000 years old, may still be the most widely used calculator in the world (Holvien, 1977). The evolution of machine assisted processing methods has gone through several phases. When compared with the manual processing of the late 1800's, machine-assisted manual methods have the advantages of greater speed and accuracy. However a higher processing volume is generally required to justify equipment costs.

There is some reduction in the flexibility of the processing techniques, and it is relatively more difficult to (1) correct or change data once they have entered the processing system and (2) implement changes in machine assisted procedures.

Although punched cards continued to be used in process control, it was not until the use of manual methods which led to great delays in the completion of the 1880 census count that punch cards began to be considered as a medium for data processing. The inventor of modern punched card techniques was Dr. Herman Hollerith, a statistician. He was hired by the census bureau as a special agent to help find a solution to the census problem.

In 1887, Hollerith developed his concept of the machine readable card and designed a device known as the "census machine", which could handle 50 to 80 cards per minute. Tabulating time with Hollerith's methods was only one eighth of that previously required, and so his techniques were adopted for use in the 1890 count. Although population had increased from 50 to 63 million people in the decade after 1880, the 1890 count was completed in less than three years (Holvien, 1977, Martin, 1970).

Following the 1890 census, Hollerith converted his equipment to commercial use and set up freight statistics systems for two railroads. In 1896 he founded the Tabulating Machines Company to make and sell his invention. Later this firm merged with others to form what is now known as International Business Machine Corporation (Holvien, 1977). (I. B. M.).

In 1833, Charles Babbage, Lucasian professor of mathematics at Cambridge university in England, proposed a machine which he named 'The analytical machine'. Babbage had designed a prototype computer which was a hundred years ahead of its time. Following Babbage's death in 1871, little progress was made until 1937 (Holvien, 1977).

Beginning in 1937, Harvard professor Howard Aiken set out to build an automatic calculating machine that would combine established technology with the punched card of Hollerith. With the help of graduate students and I.B.M. engineers, the project was completed in 1944. The completed device was known as the Mark I digital computer. (A digital computer is one that essentially does counting operations.) In many respects the Mark I was the realization of Babbage's dream (Martin, 1970).

In 1946, Dr. John Neumann, a mathematical genius, suggested in a paper that (1) a binary numbering system be used in building computers and (2) computer instructions as well as the data being manipulated be stored internally. These suggestions became a basic part of the philosophy of computer design. The binary numbering system is represented by only two digits (0 and 1). Since electronic components are typically in one of two conditions (on or off magnetized or demagnetized, conducting or not conducting), the binary concept facilitated hardware design (Nickolaieff, 1970).

Mauchly, Eckert and others at the University of Pennsylvania set out to build a machine with stored program capability called EDVAC (Holvien, 1977).

Meanwhile the EDVAC machine was finished in 1949 at Cambridge University, which was the first stored program electronic computer.

From 1954 to 1959, many organizations acquired computers for data processing purposes even though these first generation machines had been designed for scientific uses (Dertouzos, 1979). The computers of the second generation were introduced around 1959 - 1960 and were made smaller, faster, and with greater computing capacity. Some second generation computers were designed from the beginning with nonscientific processing requirements in mind.

During the 1970's, new discoveries in the fields of electronics and physics were being quickly applied to the development of new computer hardware. (Computer hardware consists of all the machines that make up a functioning computer system. Basically, these machines accept data input, store data, perform calculations and other processing steps, and prepare information output.) This incredibly rapid development in computer hardware technology may be seen by an examination of the factors of (1) size, (2) speed, (3) cost, (4) information storage capacity, and (5) reliability.

Computers come in various sizes from the very large to the ones that can be held in one hand. Systems may be classified in terms of relative computer power and cost as micro, mini, small, medium, or large.

Micro computers are tiny processors that began to appear in 1973. Although they are relatively slow in operation and have relatively limited data handling capabilities, these computers are being used in a rapidly expanding number of applications. Perhaps their most common use is to provide control and intelligence functions for some of the peripheral devices used with larger computer systems (Barron, 1979).

Mini computers are naturally, very small machines that perform the same arithmetic and logic functions, use several of the same programming languages, and have many of the same circuitry features of larger computers. Although they are general purpose devices, some are used for special or dedicated purposes, such as controlling a machine tool or process. Mini computers may be economically used for processing tasks that do not require considerable access to large masses of stored data.

Small computers may be punched card-oriented successors to electro-mechanical punched card installations, or they may substitute magnetic tapes or magnetic disc systems and are generally faster than card processors and have greater internal data storage media.

Medium and large sized computers are higher in price and have faster processing speeds, greater data storage capacity, wider selection of optimal equipment from which to choose and lower cost per calculation figures (Travenol, 1980).

Software:

Software is the general name given to all the programs and routines associated with the use of the computer hardware. Unfortunately, when compared with tremendous hardware advances, the developments in the software area seems less impressive. Furthermore, as anticipated hardware improvements are realized, an overwhelming proportion of the problems experienced in utilizing the computer to produce managerial information will be traceable to software difficulties (Business systems research group, 1980). There have been significant improvements in the software development. There are three basic software categories (1) translation programs; (2) application programs; (3) operating-systems programs.

Translation Programs: Primarily programmable computers were scientific oriented, then came the development of special machine codes for each computer. Such instructions typically consisted of strings of numbers to indicate particular functions to be performed. Machine language coding was difficult to program. The source program written by the programmer is converted to a machine readable form and is then read into the computer one unit at a time under the control of the translating program. The output of this operation is a machine language, which can then be read into the computer to control the processing of problem data.

Application programs: The programs which are written in machine language for a particular processing jobs are application programs. Many of these programs must be prepared by the user to process the tasks that are unique to their particular needs. A great amount of time was spent in duplicating the programs which were developed in other organizations (Business Systems Research Group, 1980). Equipment manufacturers and independent software companies have started to prepare generalized application packages for widely used applications.

Operating Systems programs: The operating system was initially a set of programs prepared by equipment manufacturers and users. These assist the computer operator. It is the function of the operator to load the data-input devices with cards and tapes, to set switches on the computer console, to start the processing run, and to prepare and unload output devices. Shifting control to specially operated operating programs thus reduced the operator's work, provided the relatively non-stop operation, and therefore speeded up the processing and increased the amount of work that could be accomplished. (Greenblatt, 1979).

Technological changes are occurring more quickly than ever before in history. Hardware advances include (1) substantial reduction in the size, weight, and cost of equipment compared with the same features of earlier machines and (2) significant increase in speed, storage capacity, and reliability. Advances in software include (1) more efficient and effective translating programs, which reduce tedious coding, (2) the development of better application packages, and (3) the creation of sophisticated multi-programming concepts and complex operating systems (Detrouzos, 1979).

As a result of difficulties experienced with traditional information-processing techniques, organizations have developed quicker responding and more integrated systems to meet the informational needs of decision makers.

Quick response systems enable managers to react more rapidly, reduce waste in the use of economic resources, and permit quick follow-up on creative ideas.

Many quick-response systems are taking a broader approach to the needs of organizations by attempting to provide better integration of information producing activities. Data-base systems, utilizing data management of software, are designed to help managers find answers to nonrecurring questions.

DATABASE

DATABASE

A database is a computerized record keeping system whose overall purpose is to maintain information and to make that information available to the user to assist in the process of making decisions.

The database system is a collection of data/ information and can consist of any information. In instance it can also be a patient registry. An electronic or computerized database allows a doctor to store large amounts of patient records in a relatively small amount of space.

The key to being able to use all the patients' information records is to be able to retrieve the information the way the doctor wants and when he needs it. A computer database "Management System" does just that. It allows the doctor to store, organize, manipulate and retrieve information. Add "quickly" and "easily" to this description.

A database can be regarded as a kind of electronic file cabinet that is a repository for a collection of computerized data files. Computerized files are referred to as "tables" rather than as files.

The rows of such a table may be regarded as representing the "records" of the file. The columns may be regarded as representing the fields of those records. In other words, each category is a field. Why database?:

Why use a database system? What are the advantages? The advantages of a database system over traditional, paper-based methods of record keeping will perhaps be more readily apparent in these examples.

- Compactness: No need for possibly voluminous paper files.

- Speed: The machine can retrieve and change data much faster than a human can. In particular, ad hoc, spur of the moment queries (Is this patient responding to the drug or how many of them are responding) can be answered quickly without any need for time consuming manual or visual searches.

- Currency: Accurate, updated information is available on demand at any time.

- Redundancy: This can be reduced. In database systems, each application has its own private files. That fact can often lead to considerable redundancy in stored data with resultant waste in storage space. Two files can be integrated, eliminating duplication.

- Inconsistency: It can be avoided.

- Integrity: This can be maintained. The problem of integrity is ensuring that the data in the database is accurate. Inconsistency between two entries that purport to represent the same "Fact" is an example of lack of integrity. Of course, some problems can arise if redundancy exists in the stored data. Problems can be avoided by having integrity checks whenever an update operation is attempted.

There are many kinds of databases. The database which is used for this study is a Relational database. The difference between a relational and non-relational database systems are:

1. The user of a relational system sees the data as Tables.

2. The user of a non relational system, by contrast sees the data as structures, either instead of or in addition to the table of a relational system.

Relational systems are based on an underlying set of theoretical ideas known as the "Relational Model". The principals of the relational model were originally laid down by Dr. E.F. Codd, at that time a member of the IBM San Jose research Laboratory. It was late in 1968, when Codd, a mathematician by training, first realized that the discipline of mathematics could be used to inject some solid principles and rigor into the field of database management. Prior to that time it was all too deficient in any such qualities. Codd's ideas were first widely published in a now classic paper " A Relational Model of Data for Large Shared Databanks." (Schmidt, 1983).

Related data that is stored in more than one Table can be retrieved in Relational databases. Using data from one table the user can locate the related data in other tables. Because tables are related only by the data they contain and not through pointers the user can establish the desired relationships. Before describing the relational data base selected for this study the author will briefly outline some of the benefits of the computer based medical record systems.

Benefits of computer stored medical records:

Fully operated computer stored medical record systems are uncommon, but a few have been in use for many years. These systems have demonstrated three kinds of benefits:

1. Computer stored medical records can solve many of the logistic problems of finding, organizing, and reporting patient information that occur with purely manual systems.

2. They can improve the efficiency and accuracy of physician's decisions by performing calculations and by identifying clinical events that need attention.

3. They can guide future policies and practices by analyzing past clinical experience within a hospital or physician's office.

Help With Finding And Organizing Patient Data:

The computer record has many advantages over its paper counterpart. Data retrieval is faster; the computer retrieves patient information in seconds, not the minute to hours required to obtain and pursue a paper record. Moreover the computer can provide records to physicians on call at home or at remote sites (Darnell, 1985). The access to computer records is greater than that of paper records. Many users can simultaneously read one computer record from different terminals, and computer records are never "lost" in the business office or attending physician's office, as paper records sometimes are.

Information stored once in the computer can be displayed in many ways. The computer can copy the same patient's diagnosis into the discharge note, insurance forms, billing records, letters to referring physicians, and statistical summaries. It can insert laboratory data into the initial history, progress notes, the note to a referring physician, the patient's flow chart and the infection control report.

Because a computer stored medical record consists of discretely accessible pieces of information, the computer can also organize data into special reports, flow sheets, or graphs and specialized displays (Shabot, 1985, McDonald, 1986). Moreover it can tailor these reports to a clinical context, e.g., one format for a renal patient, another for a diabetic patient, another for comparing drug dosage with the temperature chart to identify the most likely dose to decrease fever (McDonald, 1988).

Ideally the computer constructs large portions of clinical reports from patient data already stored within its files. The physician would only have to add information that was not already available to the computer. For example, the computer might only require physicians to record the hospital course and summary conclusions but would construct the rest of the discharge summary from information previously recorded in the initial history, physical examination, laboratory and medical files. The physician might have to help with this construction by selecting the results to include from a menu of existing observations (data files). Even without physicians help, however the computer can extract salient observations from a time oriented record to create a useful summary (DeZegher- Geets, 1988).

The computer's power to find and display information adds more than convenience. Well organized patient data can save a physician's time. In one study information could be found four times faster in a structured flow sheet than in a traditional paper medical record (Fries, 1974). In fact test subjects could not find 10% of the items in the traditional paper record (Fries, 1974). Well organized data can also influence patient care decisions by offering a more complete picture of the patient to the decision maker. The routine use of the flow sheet significantly improved the physician's ability to predict clinical outcome (Whiting-O'Keefe, 1985). The decision theory suggests that better probability estimates result in better decisions (Pauker, 1980).

Computerized data display can also reduce health care costs. In an emergency department, physicians ordered 15% fewer tests when provided computer generated flow sheets (Wilson, 1982). In another study, displaying previous test results to physicians while they were ordering new tests also reduced test ordering (Tierney, 1987). However, all studies of the use of flow sheets on health care utilization have not shown a decrease in test costs (Whiting-O'Keefe, 1985).

Help With Decisions About Patient Data:

Humans as watch keepers predictably overlook rare and uncommon events (Alluisi, 1966). Physicians have overlooked radiologic and bacteriologic evidence of tuberculosis (Craven, 1975, Cole, 1974) and have failed to notice adverse drug effects even when the evidence was present in the paper chart

(Shapiro, 1971). Humans also falter when information loads are high (Drinkwater BL, 1967). The busy physicians office, with interruptions and telephone calls, and the emergency department, with simultaneous crises, are typical overload situations.

When a computer stores active patient data in an electronic form, it can automatically review this information and thereby bolster human data processing capabilities. For example, it can monitor a patient's course, detect problems that may have been overlooked, and suggest diagnostic and/or therapeutic interventions according to physician's defined rules. A database system does not require physician's initiative to invoke the review process, nor does it require physician's input to describe a patient to the computer as do stand alone consulting systems (Shortlife, 1987). However, information stored in a data base within the computer is a subset of the data available to the physician at a given time.

In most existing medical record systems, the computer can generate reminders to physicians according to specified rules. These rules are written by physicians like "standing orders" that apply to all patients in a particular category, such as those in a pediatric endocrinology department. In most instances, the rules consists of condition reminder pairs. When the computer detects a patient who satisfies a rule's conditions, it generates the associated reminders. A most recent system uses a graphic approach to allow oncologist to define chemotherapy protocols (Walton, 1987). Once the rules are loaded into the computer, they may be invoked by "stimuli", such as the arrival of a scheduled patient, the entry of an abnormal test results or a medication order or the passage of time.

Retrieving Past Medical Experience for Clinical Care, Administration, And Research:

The third benefit is the access of records which provides past clinical experience of a physician's practice or of an institution. The computers search and retrieval capabilities can identify selected subsets of patients and can statistically summarize various aspects of their care to answer administration/management or clinical research questions (McDonald, 1986, Tierney, 1986, Psaty, 1987).

To make optimal medical decisions a physician needs good estimates of the risks of the various outcomes (Pauker, 1980). Unfortunately, for many disorders published data that describe how risks vary with patient factors, such as age, sex, laboratory test results, and/or the severity of symptoms, are lacking. As a result, physicians tend to ignore large differences in risk of various outcomes among patients with the same disease. Consequently they tend to treat all such patients similarly. In the early 1970's physicians did not distinguish between patients at high and low risk for complications for myocardial infarction when making decisions about duration of hospitalization. Thus, patients were kept in the hospital for two to three weeks. When rules for distinguishing the low from the high risk patients were derived from the myocardial infarction Data Base at

Duke University, Durham, NC (McNeer, 1978), the situation improved. Now physicians usually identify low risk patients and discharge them in a week. The use of cardiac intensive care was similarly affected by a computer rule that distinguishes between low and high risk patients with myocardial infarction (Mulley, 1980).

The computer can provide the data needed to estimate risks accurately and thus, can help to make current medical practices more efficient.

Retrieval of data from medical record systems such as those described above is usually too slow to be useful for immediate patient care. Thus, cross patient analysis of medical Data Base for the entire hospital for administrative, planning or research is useful with appropriate indexing, and sufficient computer resources. With a larger computer and appropriate indexes the cross patient data can be obtained in seconds to minutes. This is illustrated by the Patient Chase System, at Beth Israel Hospital, Boston (Safran, 1986). Duke University's myocardial Data Base routinely provides physicians with estimates of patient's probability of survival after receiving medical or surgical therapy for coronary artery disease. Physicians take these estimates into account when choosing therapy (Pryor, 1983).

Software for medical use:

As a rule, medical associations avoid bestowing "seals of approval" to any off-the shelf medical software packages.

The American Medical association (AMA), the American Academy of Family Physicians and The American Association for Medical Systems and Informatics all agree that there is no single software package on the market capable of fulfilling the needs of all physicians and their various and sundry practices.

As the computerization of the doctor's offices continues, however, the fact that none of the 1,300 medical software packages now on the market carries the approval of the many esteemed professional associations only complicates the physicians burdensome job selecting the right software (Brown, 1988)

Accounting packages, accounts receivable, word processing, accounts payable and general ledger packages are more common in the medical field. Such packages cost from $2,000 to $6,500. Vertical-market packages dominate in computerized billing, the most main stream of systems used in physicians offices (Brown, 1985).

Dr. Andrew Ury, President of Physician Micro Systems Inc. in Seattle developed a Practice line of software which are mainly vertical packages. He also developed a word processing package called Medical Writer which is designed specifically for medical transcription, the process whereby a physician's notes are entered into the system following a patient's visit (Brown, 1988).

dBase applications are perfect for dealing with standard information and codes required on insurance forms.

Applied Software Technology of Las Gatos, Calif, offers Versaform XL, a horizontal, programmable database package specifically for accounting, and MD Versa Form, a vertical package for patient billing and insurance claims (John, 1988).

In 1984, Dr. Habib Tobbagi, of SanJose, Calif. decided to computerize his office with Versa Form XL when a change in personnel left him doing all the paper work. At that time he'd spend whole week-ends doing a week's worth of paper work. He sought a system that would enable him to put in half an hour each day should he again be without support staff. MD versa Form didn't do what he wanted. Consequently he learned Versa Form XL and devised his own accounting and insurance claim system tailored to his specific needs. He now markets his own vertical program, Physicians Accountant, to colleagues (Brown, 1988).

After billing, and word processing, the third most often used application in the doctor's office is appointment scheduling. An appointment scheduling package costs $500 to $1,000 (Brown, 1988).

HELP system is an expert system which is used to detect eligibility for home administration of intravenous antibiotics to bacterial endocarditis patients who responded well to treatment with antibiotics in the hospital (Proyr, 1985). This is only one example of the HELP systems. Another system is called Regentrie Medical Record System which is also a rules based expert system. Reminders produced by the COSTAR (Barnett, 1978) system reduced the percentage of overlooked positive streptococcal throat cultures from 7% to almost 0% and improved the response to positive VDRL tests (Winickoff, 1986). Physicians responded to 85% of the alerts from the HELP system at the Latter Day Saints Hospital in Salt Lake City by changing therapy and/or test orders (Hulse, 1976). The same system also improved prescriptions of antibiotics. (Evans, 1986). Reminders based on more than 1400 physician authored rules substantially increased adherence to a broad range of out-patient care protocols (McDonald, 1985). The system increased the use by 150% to 400% among eligible patients compared with controls (McDonald, 1981). Similar effects on preventive care were obtained by a reminder system at the University of North Carolina, Chapel Hill (O'Malley, 1987).

More doctors might use a computerized system if they were convinced that they would not have to hire additional staff or spend more time than they already devote to keeping records. A physician typically does not have a desire to use computers himself, instead he wants the staff to be primarily responsible for this application. However, more doctors are comfortable with using online-database and would be willing to use an automated patient record system if it was economical enough to set one up.

Personal computers (PC's) have made computerized record keeping simpler and more economical for private practice doctors. Once the database has been created, the PC becomes a health maintenance and medical research tool that provides an accurate profile of the doctor's practice.

There are a few horizontal packages such as Side Kick, Paradox, Practice Partner, Care Computer Systems. These have to be tailored according to the doctor's specific needs. Practice Partner, is an integrated package of medical office management software. Since this system is mainly a billing system, patient care is only a small part of the system. Care Computers markets Vista Care, an integrated hospital management system that includes modules for patient admission, patient records, staff scheduling, doctor's orders, nutrition management and accounting systems. This system provides the record-keeping capabilities necessary to satisfy government regulations. A system like this will be useful for a hospital with up to 100 beds.

Out of all the above packages, the author recommends Paradox for the physician's office because it is a user friendly software. It is easy to learn and the doctor can create the database the way he wants to. Furthermore it is cheaper, easy to operate and learn. Since it is a stand alone package the response time is faster and it also has the capabilities to interact with multiuser packages.

The description of this package (Paradox) with instructions for installation are shown in Appendix C.

RESULTS

RESULTS

Paradox has been installed and ran to create a database with the data from growth hormone deficient patients of St. Joseph's Hospital.

The main menu screen has a menu area located at the top and work space below the menu area. There is also a message window in the lower right of the screen which can be made to appear as needed (Fig 1).

Planning is an essential first step to create a table in database. Deciding what information should be included in the table and how it should be laid out is a part of this process. All of the fields pertaining to the patient record which are important to the physician are taken into consideration.

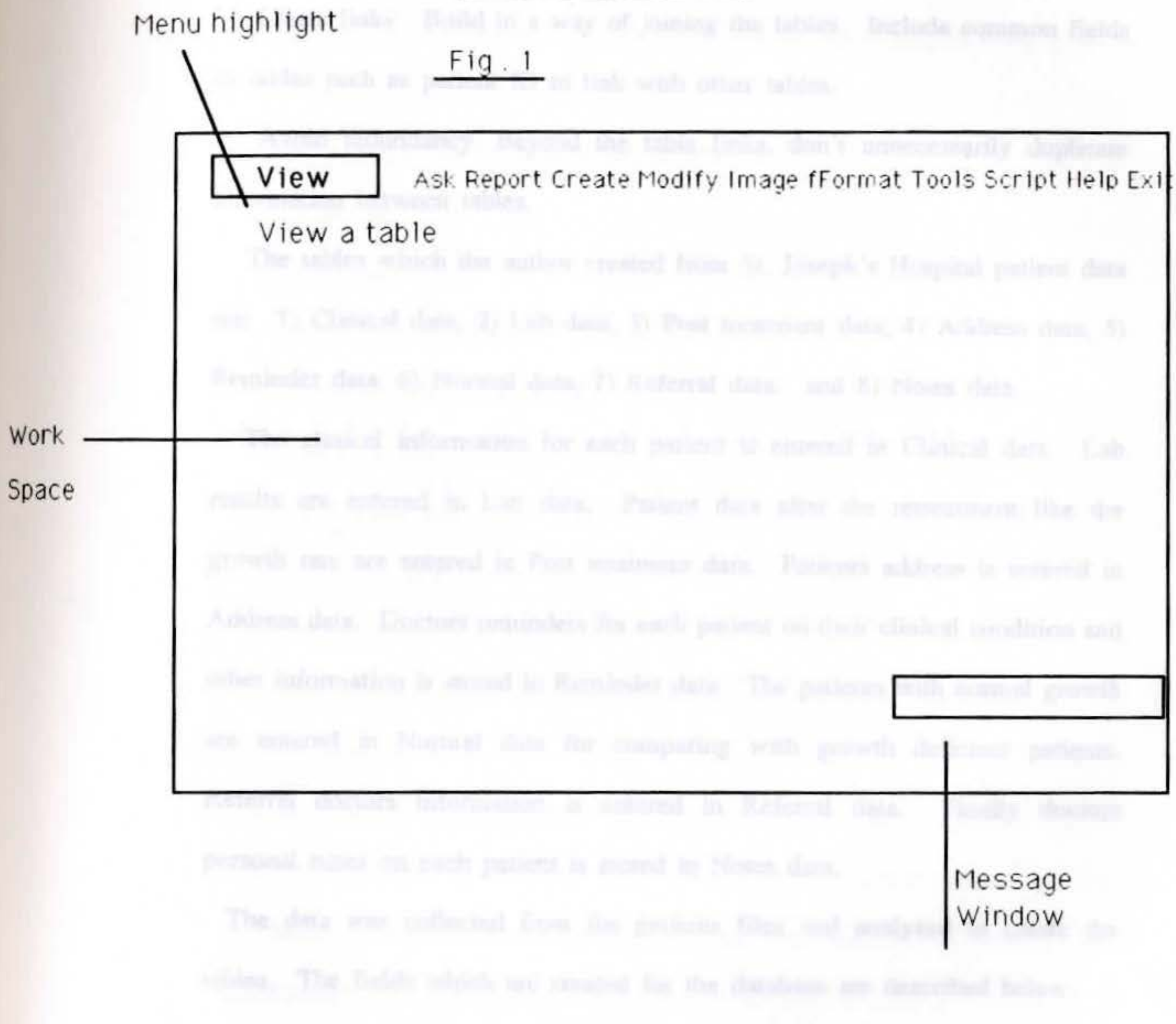
The important tips to remember when creating tables are :

. Be complete: try to include fields for all the information that the doctor needs.

. Don't put all the information in one table. It is better to create several tables, each with a few fields, rather than a single large table.

Paradox Main Screen

Fig . 1



. Keep the tables familiar. It is best to create the tables that correspond to the information which are in the patients files like lab data, post treatment data etc.

. Create links. Build in a way of joining the tables. Include common fields in tables such as patient ID to link with other tables.

. Avoid redundancy. Beyond the table links, don't unnecessarily duplicate information between tables.

The tables which the author created from St. Joseph's Hospital patient data are: 1) Clinical data, 2) Lab data, 3) Post treatment data, 4) Address data, 5) Reminder data, 6) Normal data, 7) Referral data, and 8) Notes data.

The clinical information for each patient is entered in Clinical data. Lab results are entered in Lab data. Patient data after the retreatment like the growth rate are entered in Post treatment data. Patients address is entered in Address data. Doctors reminders for each patient on their clinical condition and other information is stored in Reminder data. The patients with normal growth are entered in Normal data for comparing with growth deficient patients. Referral doctors information is entered in Referral data. Finally doctors personal notes on each patient is stored in Notes data.

The data was collected from the patients files and analyzed to create the tables. The fields which are created for the database are described below.

For this demonstration, an experimental database will be created using patients' data under the Growth Hormone ProtropinR treatment. Patient data for this database are taken from St. Joseph's Hospital in St. Charles, Missouri. All the patients' identities are held in strict confidence and the data will be created as belonging to a particular group. The patients' ages ranged from 2 to 16 years.

The patients data is categorized as follows:

1. Clinical Data
2. Lab data
3. Post treatment data
4. Normal data
5. Address data
6. Reminder data
7. Referral data
8. Notes data

The fields which are entered in the database are described below.

Clinical data:

1. Patient ID: Birth date of the patient is used as patient number

2. Growth rate: Growth rate is calculated from the growth charts by taking the measurements from the previous years and adding the numbers and subsequently dividing by the number of years.

3. Z Score: Scores are calculated by comparing the patient's height with normal (standards) values and obtaining the standard deviation.

4. Chronological age: This is the actual age of the patient.

5. Bone age: During the growth and development of the child, morphologic changes occur in the skeleton. These include the calcification and growth of epiphysial centers of the bones, changes in the size and shape of these centers and eventual fusion of the epiphysis with diaphysis. The recognition that these changes occurred in a more or less regular sequence in different bones at different times and could be related to the maturation of the individual led to the concept of a "Bone Age" (Hing 1986).

6. Tanner Stage: The sexual developmental stages of puberty are described by Tanner (Tanner,1962). Each Tanner stage specifies which aspect of pubertal development is graded by the doctor. The Tanner system grades genital, pubical hair, and breast development separately.

7. Sex: Sex of the patient.

<u>Lab data:</u>

This data was collected from the patients who are in the study conducted by Genentech. The clinical forms which are used for this study are in Appendix B.

All these patients who are under this study are admitted to St.Joseph's health center, measuring their height and weight, and the samples are taken for the study.

1. Patient ID: Birth date of the patient

2. Mean: Mean of the peaks in the graph.

3. Peak mean: Mean of all the peaks in the graph.

Post treatment data: This data is collected from the patient after the treatment.

1. Bone Age: This is the bone age after the treatment.

2. Growth Rate: This is the growth rate after the treatment. This is taken under consideration after 6 months of the treatment. It is used to evaluate the patient's growth.

3. Start date: Treatment start date.

Normal data:

This is collected from the children with normal growth, and data is used to compare with the growth deficient children.

1. Growth Rate: Growth charts are used for this comparisons. Appendix A explains about the growth Hormone and growth charts.

2. Chronological Age: Age of the child.

3. Sex: Sex of the child.

Address data:

The address of the patient is entered here.

1. Patient ID: Patient's ID is entered

2. Address : Street Address

3. City: City

4. State: State

5. Zip: Zip Code

Reminder Data:

This data, depending on the date, will print a reminder for the doctor, if the patient is due for a checkup or for a shot or for any important information.

1. Patient ID: Birthdate of the patient

2. Reminder Data: Any information that needs to be remembered about the patient

Referral Data:

Here the doctor can list the address and form letter for the referral doctor. The doctor can send the patient's progress and charts to the referral doctor.

1. Patient ID: The referral doctor's Patient ID.

2. Doctors Name: Referral Doctor's name.

3. Address: Referral doctor's address.

4. State: State

5. Zip: Zip code

Notes data:

This is the notes that a doctor can keep as a scratch pad for each patient. This table contains mainly two fields one- Patient ID, and the other is just text data where the doctor keeps notes on the patient.

After planning the tables, from Main menu, select to create any desired table. A 'prompt' appears asking for the new table name. The cursor is in the field named 'field'.

To define table fields fill out the table structure image. An example is shown in Fig 2. For each field enter its name, field type (alpha numeric, number, currency, or date, and whether it is a key field).

Field name: In the area labeled field name, type each field name up to 25 characters long.

Field type: Choose a field type form the choices below.

Fig. 2

```
            Field Name    Field Type
Struct
   1        PatientId     A25*----(Alpha numaric
   2        Name          A25      Key field)
   3        Street        A25
   4        City          A25
   5        State         A25
   6        Zip           N-------Number Field
```

A alpha numeric (1-255 characters)

N numeric

$ currency

S short number

D date

Key field: These are used to identify records. The keys give the following benefits

. prevent duplication in the key fields

. keeps the table sorted according to the values in the keys

. creates the primary index on that field which can speed queries and other operations.

To establish a key field enter an (*) after its field type. In the patient's data the key field is Patients ID field. A key can consist of more than one field in a table. The keys must be the keys in that table (Fig. 2). After creating, the tables data is entered in the tables.

What is Data entry? Data entry is the act of entering information into the computer through a keyboard. This is often a very tedious but very important part of the computer's use. One cannot expect to have reports unless the database is formed and is accurate. The Patient database is a pool of information containing pieces of information. If any part of the information is incorrect, the database is corrupt. An error of omission is as bad as, if not worse than error of commission. The doctor who is relying upon the information should check each record thoroughly to insure an accuracy of the database. By selecting the Modify/Edit or Modify/Coedit screen the data can be entered in the tables. But if there are more than a few records it is preferable to use Modify/Data entry option. With this method, the existing records are not displayed on the screen, so they cannot be removed or changed accidentally.

Select Data entry screen and enter the table name. An entry table with fields names will be displayed (example is shown in Fig. 3). It is easy to enter the records immediately, moving around and typing and editing the entry table.

Fig. 3

Entry	Patient ID	Bone Age	Growth Rate
1	DOB080978	9.0	2.7
2	DOB022274	12.0	3.5

After selecting data entry screen, the data is entered in each field. By pressing the function key F2, the data will be saved.

If any of the new records has a key value that duplicates the key of an existing record, the new record will be placed in a temporary table called keyvoil. This record can be edited or removed by using Tools/More/Add screen and add them to the original table.

The Modify/Multi-entry selection enables the user to use a single table as a data entry form, but have the records added to two or more tables at once.

This is done to create new records or modifying the existing records. This feature is very useful to add multiple records to multiple tables (example is shown in Fig. 4a, Fig. 4b).

In this example through a single source entry form data is entered in three tables, post treatment data, clinical data, address data.

The three components for this screen are:

. A single source table on which a user can enter all the information

. Two or more target tables onto which the data is entered from the source table

FIG .4 a

Multiple Table Entry Screen

entry	PatientId	Boneage	GrowthRate	Name	Street	city	state	Zip	Zscore	Chronological
	DOB080978	9.0	2.7	John Smith	12redoak	Davis	Ca	95616	-2SD	12

Fig. 4b

Data entered on single source table will be stored in all the three tables below.

Post Treatment Data			
Entry	Patient ID	Bone Age	Growth Rate
1	DOB080978	9.0	2.7

Address Data					
Patient ID	Name	street	city	state	zip
DOB080978	John Smith	12red oak	Davis	Ca	95616

Clinical Data			
Patient ID	Chronological	Growth Rate	Zscore
DOB080978	12	2.7	-2SD

. A predefined map tells Paradox which fields in the target tables corresponds to the field in the table.

After creating a table, if there is a need to restructure a table it is easy to do in Paradox. By using Modify/Restore option indicate the table name and a restructure table image will be displayed. Now just edit the restructured table.

After entering the data if the doctor wishes to view the data in the tables the view option is available. View is used to show tables on the screen. It lets the doctor get a feel for the patient's information by examining the data closely. Once the table is in view the doctor can move rapidly to any part of the screen. The screen can be rearranged or resized, or the fields reformatted to fit the needs at that movement.

When a view is chosen from the main menu, Paradox will ask for the name of the table.

```
Table:
Enter name of table to view or press <- to a list
```

Now a table can be selected. For example if the doctor wants to see a patient's post treatment data table, that table will be displayed by selecting it. Many images can be displayed simultaneously. If the doctor wants to see post treatment data and clinical data he can select both and both tables will be displayed (example is shown in Fig. 5a, Fig 5b).

Fig. 5.a POST TREATMENT DATA

Patient ID	Bone Age	Growth Rate
DOB080978	10	2.7cm
DOB022286	3	1.0cm
DOB013080	10	5.0cm
DOB101081	8	2.2cm
DOB051282	5	1.8cm
DOB061872	14	4.5cm

CLINICAL DATA Fig 5.b

Patient ID	Growth Rate	Zscore	Chronological
DOB010272	1.0	-2SD	13
DOB022281	.5	-2SD	6
DOB080973	2.2	-3SD	13
DOB021379	1.0	-2SD	9
DOB090787	2.0	-3SD	2
DOB010171	3.3	-2SD	16

It is also possible to view two or more images of the same table at once. This is useful for comparing records located in different parts of a large table.

When viewing an image on a network, Paradox automatically places prevent full lock on it. This is the least restrictive type of lock and allows other users simultaneous access to the table for all operations except those that require a full lock. Appendix 'C' describes the general concepts on locks.

If an owner of a table has protected the table from unauthorized access, the user who wants to use it should present a valid password before using it.

ASK:

The Ask option on the main menu is the heart of Paradox. This powerful facility is used to ask questions about, and manipulate, the information on any table.

The questions that are asked by the users are called 'Queries'. The doctor can ask questions about one table or join two or more tables together in a single query. In a query the doctor can choose

. which tables contain the information

. which fields to display

. which records to select

. which calculations to perform

Queries can also be used to perform operations that find, change, add or remove information;

. insert new records into a table

. deletes records from a table

. change values in fields

. find records in a table

The method used to ask questions and perform operations is called "Query By Example". Instead of finding time to figure out how to do the query, the doctor simply can give the example of results that he or she is looking for to Paradox. Paradox automatically seeks the fastest way of getting the answer or performing the operations.

Queries are flexible, interactive, and iterative. If a query does not obtain the results the doctor is looking for, the doctor can easily fine tune it and perform the query again. By constructing queries that build on each other the doctor can try 'what if?' with the data.

Constructing Query Statements: A query can be composed by filling out query forms for the table containing information. After selecting for ASK operation type the table name or select all tables and then select the desired table. A query form will be displayed with all of its fields but no data.

Repeat the process to select all the tables that the doctor wants in the query. Query can refer to many tables at one time up to the number allowed by the computer configuration. Filling out query form involves typing into its fields by pressing function key F6 for check mark. A small check mark will appear on the form.

Patient ID	Bone Age	Growth
/		/

Suppose the doctor wants a list of all the patients who are under growth treatment. This figure shows a query form for Post treatment data table, patient's ID, and growth rate, are checked for display. In the answer table the doctor can see all the patients with their growth rate after the treatment. Fig. 6 will show the result of this query.

Fig 6

POST TREATMENT DATA

	Patient ID	Growth Rate
1	DOB080978	2.7cm
2	DOB022286	1.0cm
3	DOB013080	5.0cm
4	DOB101081	2.2cm
5	DOB051282	1.8cm
6	DOB061872	4.5cm
7	DOB010272	1.0cm
8	DOB022281	.5cm
9	DOB080973	2.2cm
10	DOB021379	1.0cm
11	DOB090787	2.0cm
12	DOB010171	3.3cm

If the doctor wants to select a particular patient and look at the results it is easy to give an exact match. For example, the doctor can give patient's first name or last name, or give patient's ID. The example is shown in Figure 7. Since Paradox is a relational database it is possible to link and view three tables for this query.

Fig. 7

Post Treatment Data		
Patient ID	Bone Age	Growth Rate
/	/	

Clinical Data	
Patient ID	chronological
/	/

Address Data					
Patient ID	Name	street	city	state	zip
Smith/	/				

Answer Table		
Patient ID	Chronological	Growth Rate
DOB020273	16	4.5

Fig. 8

Post Treatment Data			
Patient ID	Bone Age	Growth Rate	Start Date
/		/	/<=010188,>=010189

Fig. 8

POST TREATMENT DATA		
	Patient ID	Growth Rate
1	DOB080978	2.7cm
2	DOB022286	1.0cm
3	DOB013080	5.0cm
4	DOB101081	2.2cm
5	DOB051282	1.8cm
6	DOB061872	4.5cm
7	DOB010272	1.0cm

If the doctor wishes to know growth rate for all the patients who are on the treatment since 01/05/88 or he can specify the range between 01/01/88 to 01/01/89 or the doctor can specify more than one selection criterion in a field. The doctor simply has to enter the range <=01/01/88, >=01/01/89 in the date field of the patient record query form. This example is shown in Fig. 8.

If the doctor cannot remember the correct spelling of the patient's last name, then the best way is to use wild card operator. The ...wild card operator stands for a series of characters, including no characters or blank spaces. The patient's last name is either Weidner or wiedner. Enter W..d..r. Paradox matches all the names between these letters. The example is given in Figure 9.

Fig. 9

Address Data					
Patient ID	Name	Street	City	State	Zip
	-/W..d..r				

Answer Table					
Patient ID	Name	Street	City	State	Zip
DOB060786	Weidner	12 Alice	Davis	Ca	95616

Sometimes a doctor would like to know the lab results to check for somatidin count or other lab results. Usually it takes time to get the results manually. If he would like to know whose charts are incomplete in lab results, then blank operator is used. By typing Blank in the field on the query form Paradox will automatically select all the patient records with blanks in those fields and display them. Entering Blank on query form is different than leaving the field empty. Blank tells Paradox to select records with no value in it. This example is given in Fig. 10.

Fig 10

Lab Data		
Patient ID	Mean	Peak Mean
/	-/Blank	

	Patient ID	Growth Rate
1	DOB080978	2.7cm
2	DOB022286	1.0cm
3	DOB013080	5.0cm
4	DOB101081	2.2cm
5	DOB021379	1.0cm
6	DOB090787	2.0cm
7	DOB010171	3.3cm

Querying from several tables is similar to querying from one table except that

. User needs to fill out form for each table

. Use example elements to tell paradox how the information in the tables should be linked.

Tables in multiple query are linked by common fields which must contain the same kind of information. For example, the patient table, lab table have patient ID as a common field to link them. Tables can also be linked with each other, if a record selected from a table has the same value in a corresponding field in another table. For example, the clinical data, post treatment data, address notes can be linked together in a query as shown in example Fig. 7.

Reports:

Doctors can use the queries which were created before and produce reports or create new reports. Reports are used to arrange the information in the Paradox table into a printed form.

The simplest way to run a report is to turn the printer on and press instant report by pressing the keys ALT F7, while a table is on the screen. Paradox will automatically design and print a standard tabular report containing all the data in the table (example of a standard report is shown in Fig. 9). If the doctor wishes for a hardcopy of the report, it can be very quickly printed. Time permitting, doctors can design and produce elaborate reports.

In circumstances where the standard report does not meet the requirements then a report generator can be used to:

. select fields from the table

. group information together

. changes the names and formats of columns

. add titles

. wrap long fields onto several lines

. calculate new fields

. computes totals and subtotals

. rearrange information on the page

. format mailing labels

To design a report:

. Select a table to report on

. select the name and the description for the report

. fill out the report specifications

. Fine tune the report

. save the report specs

Whenever the doctor wants to print a report, he can use the existing pre-designed report format. Every report is based on a single table. If the user wants two or more tables included in the report 'Ask' is used to compose a query to joins the tables.

Reports can be either tabular reports or free form reports. In tabular reports the data is arranged in columns and rows like in Paradox tables. In free form the data is arranged freely the way the user wants to.

In a free form the doctor can position information in any way the doctor prefers, such as:

.indented

.repeated

.grouped

.summarized in any arrangement on the form.

Because of this free form reports can be used to print

. insurance forms

. schedule forms

. referral letters

. mailing labels for patients or for referrals

All the above features describe the use of Paradox in a clinical setting to

. create tables

. enter the data

. view the table

. query the data

. report the data

DISCUSSION

Discussion:

Automation started in the early 1960's. It has revolutionized medicine because important information relative to diagnosis is obtained much faster.

The computer, once hailed as a sure cure for virtually every defect or weakness of our health care institutions is being regarded with increasing skepticism as a costly precision-made tool that's as likely to add to the costs of health care as to help contain them. In actual fact, the potential of the computer to reduce costs, improve efficiency, and increase the effectiveness of health care continues to be great. However, to tap that potential, computer based information systems must be carefully designed and adapted to meet the specific needs, objectives, and characteristics of the particular institution that uses them.

Managing hospital or other health care institution today is a vastly more complex and a difficult problem than it was a few years ago. Hospitals will have begun to improve management of information because of increasing demands for productivity. In order to accomplish improved productivity, doctors in turn, have adopted new technologies that save time and efficiency which resulted in improved diagnostic and therapeutic procedures. At present computer databases are also in use for billing and insurance claims. However, no patient registry database has been in use in doctor's offices or in hospitals where the author inquired in the St.Louis metropolitan area.

As stated in the hypothesis by creating a patient registry database the doctor will be able to better manage the patient's information and save time.

Querying the results as in Fig. 7 (page 50) will take seconds, but to locate the same information from paper files may take several minutes. Since patient information can be recalled in several tables, it may take only seconds to view information such as, patient lab data and post treatment data.

Similarly, location of specific patient information is time consuming. Not only is it difficult to locate this information from paper records quickly, but also it takes considerable storage space to store such specifics in paper records. This information can be obtained in seconds from the database.

Three tables are joined into one display as shown in Fig. 5 (page45). It is virtually impossible to even locate these tables in seconds in a clinical environment. In automated patient records such as the patient registry database any such type of complicated query is very simple to execute in seconds.

If the doctor would like to know if the lab results of a patient have arrived, he does not have to go through each file to see how many of them are empty. Such a query (Fig. 10 page 53) can be obtained in seconds through database.

Of course, the initial input of all the patient's records will take time even for creating the database. But once the records are entered into the database and the queries are created then it is just a matter of seconds to obtain results of any query. The doctor can initially create all the frequent queries that are done routinely. These can be run by support personnel and problems if any, in the registry can be periodically solved.

The patient registry will save doctors' and nurses' time which they can utilize for other important activities like in analysis and studies of the characteristics of the disease.

The estimated time outlays for many events by both the manual record keeping and the computer based record system are shown in Tables 1 and 2. This information supports the fact that the patient registry database is a practical time-saving tool.

Table 1

The Time Estimates To Create A Patient Registry (initial creation and input)	
Events	Time Estimate
1. Get familiar with Paradox	2 days
2. Creation of Tables	4 Hours
3. Creation of Queries	4 hours
4. Designing the Reports	6 hours
5. Input the data	8 hours
6. Test queries	1 hour
7. Print desired output	2 hours

Consecutive time estimates to run the queries and input the data	
Events	Time Estimates
1. Input New patient	10 min
2. Run existing queries	10sec
3. Print reports	10sec
4. Run query in fig 4	2sec
5. Run query in fig 8	3sec
6. Run query in fig 9	3sec

Table 2

Creation and Maintenance of Paper records	
Events	Time Estimates
1. Create a new patient record	2 hours
2. Maintenance of existing records	1 hour
3. Compare like query in fig 4	1 hour
4. Compare like query in fig 8	4 hours
5. Compare like query in fig 9	8-12 hours
6. Analyzing the data	6 hours
7. Finding and organizing the data hours	

The author will now discuss the criteria used for selecting 'Paradox' as the recommended database for patient registry and also compare some of its advantages and disadvantages.

There are many software packages available for medical use. Not all of them are easily accessible. The local software companies carry only a few financial packages which have a tag-along patient information provision. None of these are just patient registry databases.

In addition, these are not complete packages. A complete medical package is a package which should be able to maintain a patient registry, scheduling system, insurance and financial systems. Each one of them by itself has to be purchased separately. This is also very expensive.

Paradox, Lotus-1-2-3, and dBase which are available locally are not in the market for medical purposes. Hence these are cheaper. But they can be customized for medical use. Price comparisons for these packages are shown in Table 3. Paradox is the cheapest of all the three. Paradox is a relational database. Even though it is not customized for medical purposes, it is not difficult to create a database and customize it to the doctors needs. It is thousands of dollars cheaper and affords greater accessibility.

Table 3

Software Company	Name of the Package	cost
MEDICAL		
1. Simon McGraw Hill	Medical Practice	$6,500
2. Health Care Practice	Inhouse Package	$7,000
3. Midwest Management	Marc's	$6,500
4. Santiago	Medical Manager	$3,500
5. ASH medical	SMART	$1,995
6. IMS	Medical Office Manager	$1,550
NON-MEDICAL:		
1. Lotus	Lotus-1-2-3	$2,000
2. dBASE	dBASE-II	$2,200
3. Paradox (single user)	Paradox2	$499
4. Paradox (network) (6 users)	Paradox2	$650

Paradox can be purchased as a single user 's and alone' for a doctor's office or can be for six doctors in a network or can be in a hospital with networking multiples of six. Network can be advantageous for a group practice. The doctors can update the same patient's record and maintain one single record instead of multiple files. It is also advantageous for the doctors not to wait for the test results to manually arrive, since the data can be updated in the database at the lab.

The database must be organized to effectively care for all patients, and be able to reflect the activities of different care givers according to their skills and the appropriate level of medical concern. Each care giver must have access to enough salient data about the patient to understand the task at hand in terms of patient's status, to be aware of what other doctors are doing, and to recognize what significant changes occur. With Paradox networking this is possible.

The Reminder table and other tables for each patient and important queries will be created only once by the doctor. The office personnel would be able to run the queries periodically and identify any problem areas for physician's to address.

Each patient's information in the database is sensitive, and confidential information must not be compromised when working on a network. Paradox provides two ways to ensure that only those who are authorized can access the data. The Tools/More/Protect selection from main menu contains an extensive array of capabilities that enable the doctor to selectively restrict other user access to the particular table, forms, reports, and other objects. The Paradox protection generator allows network administrator to set up a group of users with different levels of access to selected objects. If patient information should be shared with other departments, Paradox allows information to be shared.

Since paradox has the capabilities of printing labels, all the patients' and referral doctors' names and addresses can be printed on labels for easy mailing. By better managing patient records, the doctor's office improves efficiency.

Office personnel can send a letter to the patients reminding them about their next appointment. This can be done easily using form letters. In the letter the doctor can refer to the patient's progress and encourage the patient to take the medication regularly. This could improve patient-doctor relationships. Before a patient's appointment the nurse routinely can run a query about the patient's previous history and progress and a reminder datasheet. This can help the doctor tremendously to be current on the patient's information before the visit. The doctor can discuss the results with the patient and this reduces the gap between patient and the doctor. The patient will feel closer to the doctor, and the doctor is able to spend more time with the patient.

Most database management and spreadsheet programs, including Paradox store data in special formats that are not directly compatible with each other. The biggest advantage that Paradox has over other systems is that it lets the user transfer data easily and freely between Paradox and other computer programs. There is no need to re-enter the data or reconstruct the database.

For example, in a hospital setting, if a pediatric endocrinologist has his data in Paradox, and the radiologist has data in a Lotus-1-2-3 program, the endocrinologist can export patient information into Lotus-1-2-3. Through the Paradox export-import function, the data can be converted between Paradox and these formats:

. Lotus-1-2-3

. dBaseII, III, and III PLUS

. VisiCalc (DIF)

. Ascii.

One of the disadvantage of the Paradox system is that it is only suitable for small group practices. For larger hospitals it is advisable to consider a larger computer based database. In a networking system the response time of paradox is slower. Since it is not an expert system which is rules based, Paradox does not have the concept of rules.

After interviewing five doctors, it was evident that doctors do not like to take time to learn and experiment with computer software. They prefer the software to be customized, so that they can just enter the data into the system. Since Paradox is not primarily designed for medical use, doctors have to spend some time to create and maintain databases. In addition, doctors need to have some computer knowledge to know how to backup the data. However, a medical package is designed for medical use and the package comes with a training program, installation and maintenance.

Nevertheless, the author recommends 'Paradox' for its utility and fidelity till the doctors outgrow its capacity. In this study Paradox has been shown to be easy to use and requiring significantly less time than manual filing. In addition, manuals are well documented and Paradox periodically provides updates and enhancements which can be added without losing the database.

Patients should be the ultimate beneficiaries of these computer stored medical records, but they are not immediate users. It is very important how the physician uses records and how he or she writes, responds and remembers patient information. Often forgotten in the automation process is the fact that the fundamental information unit in health care is the patient.

CONCLUSION

CONCLUSION

During her visit to the Pediatric Endocrinology Department of St. Joseph's Hospital the author realized that doctors are in need of a computerized patient registry database.

The author has proposed a database for these patient's records because the present system of keeping and maintaining these files is not very efficient, and needs improvement. In the new database, retrieval of patient data can be documented and retrieved faster and maintained with accuracy.

It is not uncommon for a doctor to compile an inch thick sheaf of paper for one patient with an active medical history. Maintaining detailed records is not necessarily going to help the doctor or the patient unless the doctor has a way of finding the data that might be buried in the middle of that paper stack. The practice style and specialties within the medical profession vary so much there are wide differences in the type of information doctors collect and the way they want to organize it.

The proposed database is called Paradox which is user friendly and easy to learn. The Paradox database makes it easy for physicians to convert their record keeping systems by allowing them to preserve the system they are comfortable with. The database does this by allowing them to customize the on-screen record form to their own style.

The database makes it easier for doctors to create flowcharts and graphs to monitor patient progress, to observe changes in laboratory tests and measure the effects of medication. A computerized database of patient records allows doctors to search all their patient records to find who are using a particular drug. In this study the author was tracking the use of the growth hormone.

The database can be programmed to alert the doctor when a patient is due for his next visit for a particular shot, or the doctor also can easily determine how long the growth hormone patient has been out of medication. From such a database, a pediatric endocrinologist can also learn whether his patient has made progress in his or her height or the patient is not responding to the drug.

Paradox can also work in the network system, where there are multiusers (doctors) using the database system. Each doctor can update their own patient's data or add new patient information. The hospital administration can look at all the records and produce reports for their use. Two or more doctors on a network can share information, tables, forms and reports of their patients. Paradox's special coedit function will enable many network users to edit the same table simultaneously.

Patients who are treated for different conditions by different doctors, can have the advantage that the primary physician is able to know about the patient's progress through the database rather than waiting for the files to come back to him. This should save a lot of time.

Another advantage with Paradox is that data can be imported from other programs, (such as Lotus 123, and dBase) into Paradox and data can be exported from Paradox tables to other programs. This feature also should help the hospital administration since data can be interfaced even if the doctors have different computers.

Because of these advantages it is suggested that the doctors should maintain patient's records in Paradox database. As shown, this database will satisfy doctors' needs to eliminate human error in data entry, save time and be flexible and be expandable to multi- users. Therefore, manual activities of record keeping and time spent to maintain records will be reduced dramatically.

Use of the current manual record is undependable, capricious, and wearing. With increasing volumes of patient data and increasing paperwork requirements, working with manual records will only become more difficult. Attending physicians and/or house staff can spend 30% to 50% of their time writing, chasing, copying, wondering and guessing about medical and patient facts (Mamlin, 1987). If the computer systems do the tracking, and searching, physicians can spend more of their time synthesizing, learning, judging, discovering, and deciding.

In health care, information defines how a practice will be organized and how care will be delivered. The computer stored medical records gives health care a golden opportunity to reorient medical information processing away from geopolitical units and toward the patient as the overriding information focus (McDonald, 1988).

An integrated approach to automated clinical record keeping over the next decade could significantly contribute to the quality of care while enhancing the effectiveness and efficiency of service (Principii,1986, Mowry, 1986).

The time has come to take this forward leap, not only for the good of providers, but more importantly, for the good of patients. With the increasing availability of computer stored medical records, care will be faster and more efficient. The author believes that it will be a happier system for both patients and physicians.

APPENDIX A

Growth Hormone

Growth begins when a baby is conceived and continues throughout life. It is a complex process, influenced by a variety of factors that are only beginning to be understood.

Parents keep track of their children's growth in many ways. They are assured when the doctor says their baby is growing well. Parents notice how quickly new clothes are outgrown. They observe their child's size in relation to that of classmates and playmates. If a child is not growing as expected or is lagging behind classmates in size most parents become concerned and seek advice of their pediatrician or a family physician.

The first thing a concerned parent is likely to learn is that there is a wide range of "normal" for both height and weight, and the smallest child in the class may or may not have a medical problem relating to size. Not all short children have abnormal growth(Blizzard, 1986).

Accurate serial measurement of height and weight and a record of growth are essential components of the clinical evolution of all children. Maintenance of a growth chart allows comparison of an individual child with a large population in terms of percentile ranking for height and weight, facilitates observation of the pattern of growth, and provides the basis for calculation of growth velocity(Genentech, 1985).

There are about 2 million children in the United States who are shorter than 98% of children their age (Blizzard, 1986). Most of these boys and girls are normal in every way, but some have problems that can have long lasting effects on their health and growth if they are not diagnosed and treated.

THE NORMAL PATTERN OF GROWTH

A 2 1/2 month old fetus (a baby before it is born) weighs about 1/10 of an ounce (2.8 grms) and is 1/4 inches (3.2 cm) long; all its body organs are present and all are almost completely formed. At this point, the process of growth begins to speed up. By 5 months the fetus may be growing as fast as 1 inch (2.5 cmm) per week. Growth slows towards the end of pregnancy as the baby fills the uterus. At birth full term babies are usually 19 to 21 inches (48 to 53 cm) long and weigh from 6 to 8 1/2 pounds (2.8 to 3.8 kg)(Genentech, 1985).

Table 4 shows growth is also rapid during the first year of life. More infants grow as much as 10 inches and more than double their birth weight by their first birthday. Growth slows at 1 and 2 years of age. An average child grows about 5 inches between the first and second birthdays. After 2 years of age, growth continues at a slower but steady rate of 2 1/2 inches per year until about the age of 11 in girls and 13 in boys, when the growth spurt that goes along with adolescence usually begins. Normal growth stops when the child is between 16 and 18 years of age. When the growing ends, the bones fuse (Owens, 1986).

TABLE 4

Normal Growth Rates During Childhood	
Age	Growth Rate (in inches and cm per year)
Birth to 1 year	7 to 10 inches (17.8 to 25.4cm)
1 to 2 years	4 to 5 inches (10 to 12.7 cm)
2 years to puberty	2 to 2 1/2 inches (5 to 6cm)
Pubertal growth spurt	
girls	2 1/2 to 4 1/2 inches (6 to 11 cm)
boys	3 to 5 inches (7 to 12cm)

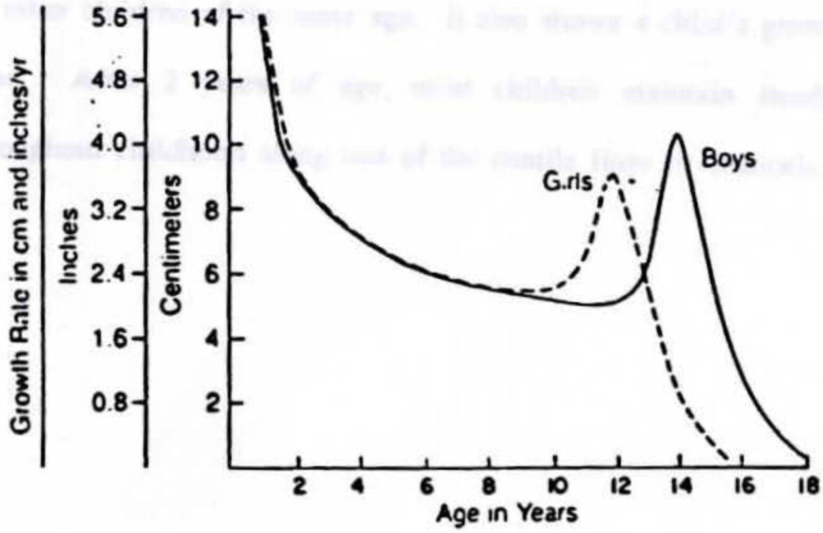
Figure 11 shows this typical pattern of growth for boys and girls from birth to adolescence. The growth rate is shown on the left side of the chart, the child's age in years is shown along the bottom.

GROWTH CHARTS

The most valuable tool for assessing a child's growth is a well kept growth chart made up of accurate measurements. A child's height and weight should be measured and marked on the child's growth chart as part of every visit to the doctor. Children under the age of 3 years should be measured at least every 6 months; children over 3, every year. If there is any concern about growth, measurements should be made as often as every 3 months until the growth pattern becomes clear. The most widely used growth charts are constructed by measuring many boys and girls of all ages and breaking the range of their heights and weights into centiles, or percents. These centiles are represented on growth charts (Figures 12 and 13) by the curved lines marked 5, 10, 25, 50, 75, 90, 95.

The spaces between the centile lines are called channels. Age in years is marked along the bottom of the chart. Height in inches and centimeters is marked along the sides. The 50th centile line is the average height for any given age.

Figure 11:Typical Pattern of Growth Rate From Birth Through Adolescence



To use the chart, find the child's age along the bottom and draw a line going up, parallel to the two sides of the chart. Then find the child's height along the side and draw a line across, making the point where the child's age line and height line cross.

The growth chart shows how a child's height and weight compare to those of other children of the same age. It also shows a chlid's growth pattern over time. After 2 years of age, most children maintain steady growth rate throughout childhood along one of the centile lines or channels.

Figure 12: Boys' Growth Chart

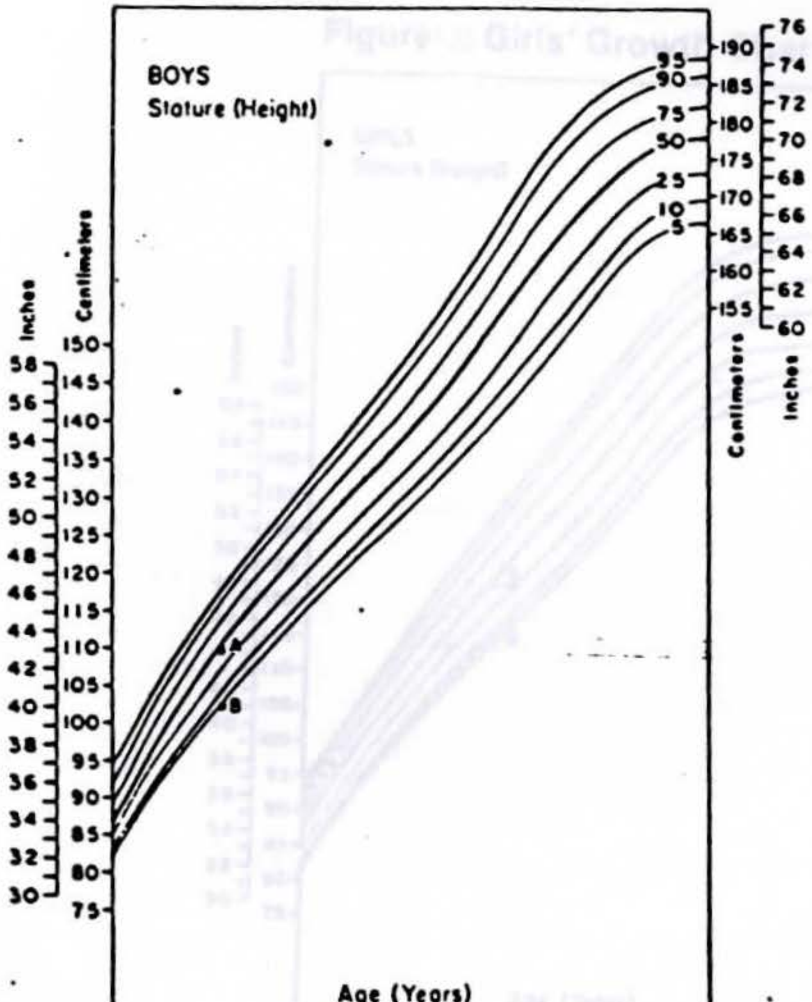
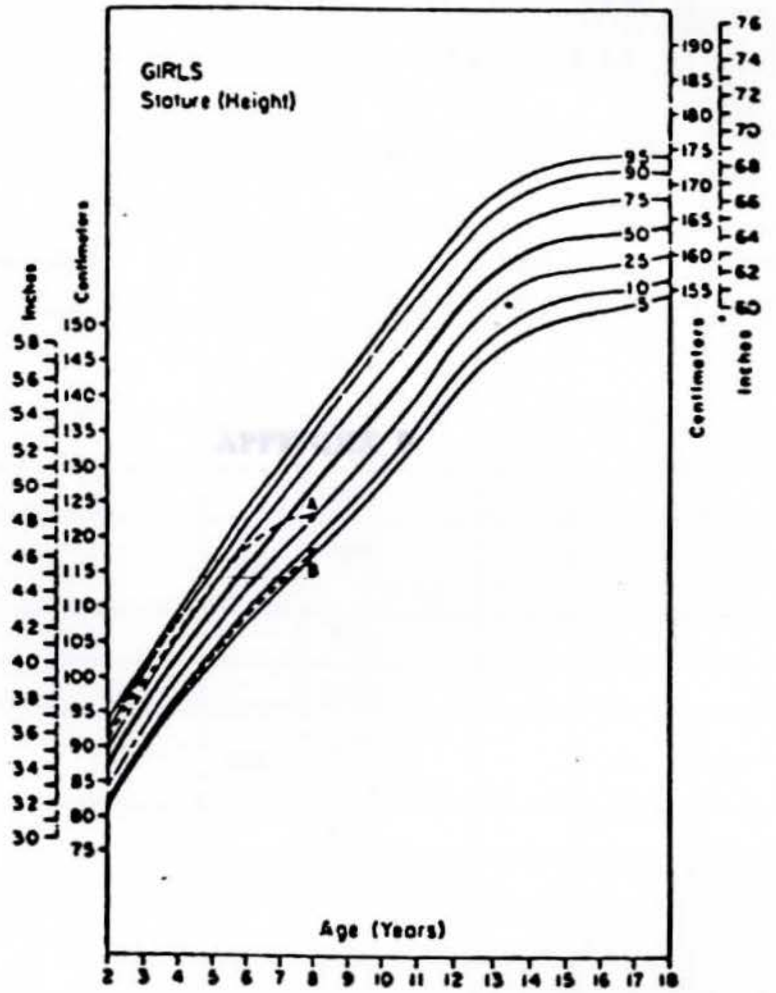


Figure13: Girls' Growth Chart



APPENDIX B

GENENTECH NATIONAL COOPERATIVE GROWTH HORMONE STUDY

INTERMITTENT BLOOD SAMPLING FOR GROWTH HORMONE

DOCTOR: ______________________ NAME (optional): ______________________

INSTITUTION: ______________________ PATIENT INITIALS __ __ __ DOB ___-___-___ (m) (d) (y)

Check the appropriate box:

☐ 24 hour sampling (begin at 8am)

☐ 12 hour sampling (begin at 8pm)
Start recording samples at #37 of the flow chart.

Indwelling catheter or butterfly needle inserted: Date ___/___/___ Time ___:___

Obtain a 1.2mL blood sample at each drawing (a MINIMUM of 0.4mL serum is required to do growth hormone assay).

For the Somatomedin-C samples obtain an additional 2mL and place in a tube containing EDTA (purple top).

CLOCK TIME	SAMPLE	TIME DRAWN	COMMENTS (record activity hourly)	CLOCK TIME	SAMPLE	TIME DRAWN	COMMENTS (record activity hourly)
8am	SM-C sample #1 (0 min)			2pm	#19 6 hrs		
	#2 (20min)				#20		
	#3 (40 mn)				#21		
9am	#4 (60min) 1 hr			3pm	#22 7 hr		
	#5				#23		
	#6				#24		
10am	#7 2 hrs			4pm	#25 8 hrs		
	#8				#26		
	#9				#27		
11am	#10 3 hrs			5pm	#28 9 hrs		
	#11				#29		
	#12				#30		
12pm	#13 4 hrs			6pm	#31 10 hrs		
	#14				#32		
	#15				#33		
1pm	#16 5 hrs			7pm	#34 11 hrs		
	#17				#35		
	#18				#36		

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(over)

GENENTECH NATIONAL COOPERATIVE GROWTH HORMONE STUDY

INTERMITTENT BLOOD SAMPLING FOR GROWTH HORMONE

START 12 hour sampling at #37
* Do SM-C sampling only if STARTING 12 hour sampling

CLOCK TIME	SAMPLE	TIME DRAWN	COMMENTS (record activity hourly)	CLOCK TIME	SAMPLE	TIME DRAWN	COMMENTS (record activity hourly)
8pm	*(SM-C sample) #37 0/12 hrs			3am	#58 7/19 hrs		
	#38 (20 min)				#59		
	#39 (40 min)				#60		
9pm	#40 (60 min) 1/13 hrs			4am	#61 8/20 hrs		
	#41				#62		
	#42				#63		
10pm	#43 2/14 hrs			5am	#64 9/21 hrs		
	#44				#65		
	#45				#66		
11pm	#46 3/15 hrs			6am	#67 10/22 hrs		
	#47				#68		
	#48				#69		
12am	#49 4/16 hrs			7am	#70 11/23 hrs		
	#50				#71		
	#51				#72		
1am	#52 5/17 hrs			8am	#73 12/24 hrs 8 hr Clonidine		
	#53						
	#54				SM-C sample		
2am	#55 6/18 hrs			Time Clonidine given: _______			
	#56			#74 60 min: _______			
	#57			#75 90 min: _______			

APPENDIX C

Requirements for Paradox

PARADOX AND COMPUTER SYSTEM

SINGLE USER SYSTEM REQUIREMENTS

The requirements for Paradox database are:

* an IBM PC, PX XT, XT Model 286, or PC AT; a Compaq Portable, Plus, Deskpro, Compaq Portable II, Compaq Portable III, or Compaq 386; or other 100% compatible computer

* one hard disk and at least one floppy disk drive, or no hard disk and two floppy disk drives

* at least 512k bytes of internal (RAM) memory

* DOS 2.0 or higher

* a compatible monochrome, color, or EGA monitor, with adapter

* optionally, a compatible printer, with adapter

* formatted floppy disks for storing original or backup copies of the tables and other objects user creates with Paradox

* optionally (to obtain even faster performance), an AST Rampage Board, an Intel Above Board, or other expanded memory adapter.

Multiuser System Requirements

In order to use Paradox or Paradox Network Pack on a computer network the requirements are one of the following configurations:

*a Novell network with Novell Advanced Netware version 2.0A or higher

*a 3COM 3Plus network with 3Com 3Plus operating system version 1.0 or version 1.1 or higher

*an IBM Token Ring or PC Network with IBM PC Local Area Network Program version 1.12 or higher

*a Torus Tapestry Network version 1.4 or higher

*an AT&T Starlan Network with AT&T P6300 Network Program version 1.1 or higher

*any other network configuration that is 100% compatible with one of the networks listed above and DOS 3.1 or 3.2

one or more personal computers (see the list above) to serve as workstations. Each workstation must have

*any combination of hard or floppy disk drives (or not disk drives at all) *at least 640k bytes of internal (RAM) memory

*DOS 3.1 or higher

*a compatible monochrome, color, or EGA monitor, with adapter

*optionally, a compatible printer, with adapter

*optionally (to obtain even faster performance), an AST Rampage Board, an Intel Above Board, or other extended memory adapter.

PROGRAM CAPACITIES

In Paradox, a single table can contain up to

*2 billion records with up to 4,000 characters each

*255 fields with up to 255 characters per field.

Each table may have up to 15 associated forms and 15 reports.

The number of tables that can be joined in a single query is unlimited.

INSTALLING PARADOX

Before running Paradox, it must be installed either on a single computer or on a computer network.

Paradox keeps track of the number of users simultaneously accessing the program for a network. The number of simultaneous users is limited to the number authorized by the Paradox license agreement for the network.

A number of different configurations are permitted under the Paradox and Paradox Network. Pack license agreements (note that the Network Pack can **only** be installed on a network server). These are:

***Standalone**: If user is not working on a network, they could install Paradox as a standalone program on their own computer.

***Personal workstation**: If the user sometimes uses Paradox as a standalone program and will sometimes be sharing Paradox data stored on a network, the user can install Paradox on his own computer and use his copy to work with files shared through the network. This configuration does not affect the number of simultaneous users on the network.

***Network workstation**: A copy of Paradox installed on the user's computer can also be used to add to the number of users who may concurrently start the program from a network. How-ever, in this configuration, whenever the user starts Paradox he will count as a network user.

***Network configuration**: All users will access Paradox from a network and there are no copies installed on either personal or network workstations.

STARTING PARADOX

This section presumes that Paradox is already installed on the computer or on a network.

STARTING THE COMPUTER

HARD DISK SYSTEM

After installing Paradox, restart (reboot) the system so that the configuration parameters established by the installation program will take effect. To do this, either turn the computer off and then on again, or press **Ctrl-Alt-Del** simultaneously to reset it.

1.Turn on the computer, or finish whatever program is already running, so that the DOS system prompt for the hard disk (usually C) on the screen. The user may have to type **c:** to change to the hard disk drive.

2.Type **cd\paradox2** and press **Enter** to change the current directory to \paradox2.

3.Type **paradox2** and press **Enter**.

In a few seconds the user will see Paradox's title screen with the copyright notice and "signature" information entered during the installation, and then the Main menu.

USING PARADOX ON A NETWORK

The following section provides an overview of the major multiuser features of Paradox. As noted below, most of these features are discussed in more detail later in this manual, in the *PAL User's Guide*.

General Concepts

Using Paradox on a network is almost exactly like using it as a standalone program on the computer. The main difference is that, on a network, the user will often be sharing tables, forms and reports with other users. Many times, two or more users will be working with the same tables simultaneously.

When using Paradox on a network

*Paradox automatically **locks** tables, forms, reports, and other objects when necessary to ensure data integrity and consistency. If the user needs to use a table or other object that has been locked, Paradox will tell them the name of the user who has locked it.

*Paradox's special **Coedit mode** lets two or more users edit a table simultaneously. Each record is automatically locked as it is being edited and unlocked when changes have been made.

*Paradox lets the user **instantly see** changes made by other users to tables being worked with.

*Each user can use **explicit locks** and other protection features that supplement Paradox's automatic locking capabilities. These features let the user maintain complete control over other user's access to tables you are sharing through the network. This is particularly useful for custom applications.

*A user can choose among multiple printers on the network simply by making a menu selection.

*For programmers and application developers, **PAL** (the Paradox Application Language) and the Paradox Personal Programmer contain a full range of tools to build multiuser applications. These tools are designed to guarantee that applications avoid network deadlock.

PARADOX

After installing the Paradox execute program by typing paradox, then the menu screen will be seen.

There are two major parts to this screen: the menu area located at the top, and the work space located below the menu area. There is also a message window in the lower right of the screen which appears as needed.

Moving from option to option, the message line under the main menu changes, explaining each option. The options in the menu area represent Paradox's major operations. They are:

- View to display a table on the screen
- Ask to locate, select, and calculate information contained in tables
- Report to design and print a report based on a table or query
- Create to create a new table in which to store information
- Modify to add, change, or sort information in a table; or to revise the structure of a table
- Image to re-arrange information on the screen
- Forms to design or change a form to display or enter information
- Tools to manage the objects in your database, to convert data in Paradox tables to or from other specified programs or formats and to access network options
- Scripts to record or play back a repeated sequence of actions
- Help to display information about the program

- Exit to finish your session with Paradox and return to DOS When the main menu is not displayed on the screen, press the F10 Menu key to display it.

To select an option, either highlight it and press return, or press the first letter of that option.

All Paradox data is stored in tables. A table is a collection of information stored in rows and columns. In other databases, this collection of data may be referred to as a file. View is the main menu option used to show an image of the table on the screen. The table image displays up to 22 records at one time and shows as many fields or columns as the screen width allows. To see the additional information, move horizontally or vertically around the screen. This allows quick movement to view any part of the table.

Edit mode is useful if changing information, or adding an individual record to a table. If adding more than one or two records in a table, it is recommended to use the Data Entry option on the Modify submenu instead of edit mode. In the edit mode, records can be added anywhere in your table by using one of these steps:

- To add a record at the beginning of a table, move the cursor to the first record and press INS.

- To add a record at the end of a table, move the cursor to the last record and press the down arrow.

- To add a record within a table, move the cursor to the record right below where you want the new one, and press INS.

It is often necessary to change the way information looks or is arranged on the screen. Image options offer great flexibility to arrange information so it is easier to work with. Changes made last only while the image is on the screen unless you save them in a .SET file on disk by using the Image/KeepSettings option. Once saved, they will be displayed whenever the table is on the screen.

Changes only affect how information looks, it does not affect the data. If there are multiple images on the screen, and the KeepSettings option is used, the changes are made to whichever image is current. Image options can be used with both tables and forms.

The Image/GoTo/Value command is a powerful way to search for and go to a particular value in a table. Paradox will move the cursor to the first occurrence of that value. If that was not the record searched for, use Zoom Next ALT + Z to search for subsequent occurrences of the value. As a shortcut for Image/GoTo/Value, you can use the Zoom key CTRL + Z.

The search value can be either an exact match or a pattern with wild card operators. As in query statements, the ".." wild card stands for series of characters and the "@" operator stands for any single character. For example, when looking for someone whose name begins with "Sm", you would enter the patter "Sm.." as the search value.

To define a table in Paradox, select the Create option from the main menu. After naming the new table, a table structure image is displayed, much like the one shown below. It provides an area to enter the field names and assign the field type and length. All the information needed is right on the screen.

The Modify Edit option to add records to a table has been used. When there are more than a few records to add, it is recommended that the Modify/ DataEntry option is used. With the DataEntry method, records previously entered in the table are not displayed on the screen. This prevents accidently changing or removing existing records.

When Data Entry is selected, enter a table name, and an empty Entry table is displayed. The status message indicates Data Entry mode and data can be entered. Moving around and editing are the same as in any Paradox table. Press F7 Form Toggle to enter records in the form setting.

GLOSSARY

GLOSSARY

Achondroplasia - A hereditary disease in which bones are inadequately formed, so that arms and legs are very short in proportion to the rest of the body.

Adolescence - The teenage years, when the child is becoming an adult physically and mentally.

Alphanumeric Field - A field containing letter and/or numbers and special characters.

Bone age - Refers to the stage of development, or maturity of the bones. In most children, bone age will be about the same as chronological (actual) age, but in some children it may be advanced (ahead) or delayed (behind). It is measured by taking an X-ray, usually of the hand and wrist, to look at the bones and compare them to standards for boys and girls of various ages.

Centile or percentile - A number based on dividing something into 100 parts, in this case, a group of children of the same age. The centile number tells what percent of children of that age are taller or shorter than the child being measured.

Character - Any number, letter, or other symbol that appears on the workspace.

Cm (centimeter) - A unit to measure length in the metric system. 1 cm = 0.4 inches; 2.54 cm - 1 inch.

Cursor - A blinking underline or bright box that marks your location on the workspace or points to where your next action will take effect.

Database - A data base designed in accordance with a set of principles called the "relational model". Information in a relational data base must be organized into tables. An organized collection of information.

Deficiency - Not enough of something, in this case a hormone.

Fetus - An unborn child.

Field - A single element in a record.

Field Type - The kind of information that a column contains, such as alphanumeric, date, dollar, or numeric.

File - A DOS file. May refer to DOS files created by products other than Paradox, such as pfs or dBaseIII, or to Paradox objects such as Image Setting or Query Speedup files for a table.

Genes - Chemical units inherited from parents. Genes determine the specific characteristics of offspring.

Growth hormone - A hormone secreted by the pituitary gland which causes physical growth.

Hormones - Chemicals secreted into the bloodstream in small amounts by glands throughout the body;
hormones "set in motion" many life processes - growth, puberty, reproduction, metabolism, self-preservation.

Idiopathic - Occurring without a known cause.

Kg (kilogram) - A unit to measure weight in the metric system. 1 kg = 2.2 pounds; 0.45 kg = 1 pound.

Number Field - A field that can contain only numbers, a sign, and a decimal point.

Pituitary gland - A small gland attached by a stalk to the base of the brain; it secretes hormones that control other glands and regulate growth. It is sometimes called the "master gland".

Puberty - Often used to mean the same thing as adolescence, but it can be used to describe the time when the physical changes of adolescence occur.

Query - A question you ask about the data stored in Paradox tables.

Record - Each row of a Paradox table is one record. Each record is a group of related fields. Relational

Row - The horizontal component of a table.

Skeletal dysplasias - Conditions involving abnormal development of the bones.

Somatomedin - A chemical produced by the liver and other tissues in response to growth hormone (GH). It is the "middle-man" between GH and the changes in cells that lead to growth.

Structure - The overall shape of a table that specifies the number of fields it has, the order of the fields, and the field types, including key fields, if any.

Submenu - A lower-level menu that appears when you select from a high-level menu, containing more detailed items that further refine your choice.

Table - A structure made up of rows (records) and columns (fields) that contains information.

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