"Technology in health sciences".

In Section 1 of this course you will cover these topics:

- Introduction To Information Technologyhardware, Software, And Telecommunications
- Security And Privacy In An Electronic Age
- An Introduction To Medical Informatics And The Administrative Applications Of Computers

Topic : Introduction To Information Technologyhardware, Software, And Telecommunications

Topic Objective:

At the end of this topic student would be able to:

- Define information technology, computer, and computer literacy, and understand their significance and why you should be computer literate in todays society.
- Describe the classification of computers into supercomputers, mainframes, minicomputers, microcomputers, personal digital assistants, and embedded computers.
- Discuss the difference between digital and analog devices.
- Describe how all data and information are represented inside the computer.
- Differentiate between hardware and software and be able to discuss the different hardware components of a computer.
- Describe the difference between system and application software, know what an operating system is, and know what various application programs are used for what tasks.
- Discuss the significance of connectivity and networking.
- Identify communications media.
- List the components necessary for telecommunications to take place.
- State the uses of telecommunications and networking.

Definition/Overview:

Information technology: Information technology includes knowledge of computers, networks and computer Literacy. Computer literacy includes knowledge of basic computer concepts and the ability to use computers to make tasks easier. It includes the ability to use the Internet and World Wide Web. A computer is an electronic device that

- Accepts data as input
- Processes that data according to instructions stored in memory
- Produces information as output
- Stores the results

Key Points:

1. Computer

A computer is an electronic device that accepts data as input, processes it following the instructions of a program stored in memory, produces information as output, and stores the results.

2. Computer literacy

Computer literacy is knowledge of how to use computer technology.

3. Supercomputer and mainframe

Supercomputers are the largest and most powerful computers. They are used for scientific purposes, such as weather forecasting and drug design. Mainframes are less powerful, and are used in business for input/output intensive purposes, such as generating paychecks or processing medical insurance claims.

4. Embedded computer

The embedded computer is a single-purpose computer on a chip of silicon, which is embedded in anything from appliances to humans.

5. The difference between analog and digital devices

A digital device is one that computes by counting discrete, separate items.

On the other hand, devices that aid in calculation by measuring some continuous physical property or quantity are called analog devices.

6. Two kinds of input devices

Keyboards and direct entry devices.

7. Digitize

To digitize data is to translate it into binary digits (bits).

8. Sensor

Sensors are used to collect patient information for clinical monitoring systems, including physiological, arrhythmia, pulmonary, and obstetrical/neonatal systems.

9. Biometrics

Biometrics are being used in security systems to protect data from unauthorized users. Biometrics identifies people by their body parts, including fingerprints, hand prints; face recognition, and iris scans. Once thought to be almost 100 percent accurate, biometric identification systems are now recognized as far from perfect.

10. The central processing unit (CPU)

The CPU is located on a chip on the system board of the computer. It does the processing. It is comprised of the control unit which controls processing and the arithmetic-logic unit which performs mathematical and logical operations.

11. The differences between RAM and ROM

The part of memory where current work is temporarily stored during processing is called random access memory (RAM). RAM is on chips. It is temporary, volatile memory. The other part of memory (also on chips) is called read only memory (ROM) or firmware; it

contains basic start-up instructions, which are burned into a chip at the factory. You cannot change the contents of ROM.

12. Open architecture

Open architecture allows the user to add devices to a computer. The system board contains expansion slots, into which you can plug expansion boards for additional hardware. The board has a socket on the outside called a port. You can plug a cable from your new device into the port. The significance of open architecture is the fact that it enables you to add any hardware to your existing computer system.

13. The difference between soft copy and hard copy

Output devices are divided into two basic categories: those that produce hard copy (on paper) including printers and plotters and those that produce soft copy (output you cant pick up and walk away with), including monitors (the most commonly used output device). Soft copy is also produced by devices that produce speech, sound, or music.

14. Four secondary storage media

Magnetic tape, diskette, hard disk, optical media

15. The differences between system and application software

System software consists of programs that let the computer manage its own resources. The most important piece of system software is the operating system. The operating system is a group of programs that manages and organizes the resources of the computer. Application software allows you to apply computer technology to a task you need done. There are application packages for many needs. Word processors, spreadsheets, database management systems are a few types of applications.

16. Telecommunications network.

Networks that make use of telephone lines are telecommunications networks.

17. Bluetooth technology

Bluetooth technology can create small personal area networks. It is a wireless technology that can connect digital devices from computers to medical devices to cell phones. For example, if someone is wearing a pacemaker and has a heart attack, his or her cell phone will automatically dial 911.

18. Modem

A modem translates between the digital signals processed by computers and the analog waves carried by traditional phone lines, so that data processed on a computer can be transmitted over a phone line.

Topic : Security And Privacy In An Electronic Age

Topic Objective:

At the end of this topic student would be able to:

- Define security and privacy.
- Discuss threats to information technology, including crimes, viruses, and the unauthorized use of data.
- Discuss security measures including laws, voluntary codes of conduct, restriction of access to computer systems, and the protection of information on networks.
- Describe the impact of information technology on privacy, including the existence of large computerized databases of information kept by both government and private organizations, some of which are on networks linked to the Internet.
- Describe the relationship of privacy and security to health care, and appreciate the importance of the privacy of electronic medical records.
- Discuss the Health Insurance Portability and Accountability Act of 1996 (HIPAA) and the USA Patriot Act (2000), specifically their effects on privacy protections.
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Definition/Overview:

Security: Security measures attempt to protect computer systems, including information, from harm and abuse. Protection may take the form of anything from professional and business codes of conduct, to laws, to restricting access to the computer.

Key Points:

1. Privacy

Privacy has many aspects. Among them is the ability to control personal information and the right to keep it from misuse. Computer technology makes this much more difficult.

2. Threats to information technology

Threats to IT include threats to computer hardware, software, and data; they can be damaged by anything from simple carelessness to power surges, crime, and computer viruses. Computer systems, like any other property, can be hurt or destroyed by disasters such as floods and fires.

3. Four kinds of computer crime

Spreading viruses, theft of information, software piracy, and theft of services

4. Computer virus

A virus is a program that attaches itself to another program and replicates itself. A virus may do damage to your hardware or destroy your data, or it may simply flash an annoying message. Most states and the federal government make it a crime to intentionally spread a computer virus.

5. Identity theft

Identity theft involves someone using your private information to assume your identity. It is the fastest growing crime in the United States. Although identity theft predates computers, the existence of computer networks, the centralization of information in databases, and the posting of public information on the Internet make information much

easier to steal. An identity thief needs only a few pieces of information (such as Social Security number, mothers maiden name) to steal your identity. Under this false identityyour identitythe thief can take out credit cards, loans, buy houses, and even commit crimes.

6. Security measures

Security measures attempt to protect computer systems and the privacy of computerized data. They can include anything from laws and codes of conduct to restricting access to computers, to encryptionscrambling of data so that it does not make sense. There are federal laws that attempt to protect computer systems and aspects of privacy.

7. Measures that can help restrict access to computer systems

Many organizations restrict access to their computers. This can be done by requiring authorized users to have PINs (personal identification numbers) or use passwords. Locking computer rooms and requiring employees to carry ID cards and keys are also used to restrict access. Biometric methods including fingerprints, hand prints, retina or iris scans, lip prints, facial thermography, and body odor sensors also help make sure only authorized people have access to computer systems. Biometric technology can use facial structure to identify individuals. Biometric keyboards can identify a typist by fingerprints. None of these methods is foolproof.

8. Methods of protecting information on networks

Protecting information that is kept on a network is much more difficult because no one knows who can access a network. Even top-secret defense systems have been broken into. One way of protecting data is through encryption. Only authorized persons can see the decrypted data. Electronic blocks (called firewalls) can be used to limit access to networks.

9. Privacy with reference to networks and the Internet

Computer technology and the Internet allow for the inexpensive and easy gathering and distribution of personal informationfrom the most mundane to the most intimate details of our liveswhich may be collected without our consent or knowledge. The computer may

gather information about you without your knowledge as you browse the Net. Cookies are small files that a Web site may put on your hard drive when you visit. Cookies can be programmed to track your movements, collecting information that helps advertisers target you. This information may be sold and shared; the fact is that you do not control your information once it is in cyberspace.

10. Electronic database

An electronic database is an organized collection of data that is easy to access, manipulate, search, and sort.

11. Some effects of the USAPatriot Act on privacy.

The Patriot Act gives law enforcement agencies greater power to monitor electronic and other communications, with fewer checks. It allows increased sharing of information between the states, the FBI, and the CIA. The law expands the authority of the government to allow roving wiretaps, which intercept communications, wherever the person is. Both e-mail and voice mail may be seized under a search warrant. The government may track Web surfing. Without a warrant, the government may request information from Internet service providers about their subscribers, from libraries, health care providers, and other institutions. The Patriot Act also limits an individuals access to information under the Freedom of Information Act.

12. The Medical Information Bureau

The Medical Information Bureau is comprised of 650 insurance companies. Its database contains health histories of millions of people.

13. Trends combine to threaten the privacy of medical information

Recent law attempts to restore some measure of privacy? Health care information has traditionally been protected by state law. Now, however, this information routinely crosses state lines, which means it needs federal protection. It is very difficult to protect information on computer networks, especially the Internet. The privacy protections of the Health Information Portability and Accountability Act of 1996 began going into effect on

April 14, 2003. HIPAA provides the first federal protection for the privacy of medical records.

14. New privacy safeguards provided by HIPAA

For the first time, all patients have the right to see their medical records and request changes. Patients will have some knowledge of the use of their medical records (although it is not clear how the USA Patriot Act will affect this) and must be notified in writing of their providers privacy policy. HIPAA gives patients more control over their medical information. Under the rule, medical records must be supplied within 30 days of the patients request, and the patients are allowed to review and copy their own records as they wish. Prior to HIPAA, many states did not give patients the legal right to see their records. Additionally, the patient can request amendments be made to their records.

15. The possible effects on privacy of HIPAA and the USA Patriot Act

Under both HIPAA and the Patriot Act, there are many circumstances that allow police access to your medical records without a warrant. HIPAA allows the release of private medical information in some situations including the assertion that you are a suspect or witness to a crime, or a missing person. Your information may also be released if national security or intelligence is involved or for the protection of VIPs including the president and foreign dignitaries. The government may also access your medical records under the USA Patriot Act for an investigation to protect against international terrorism or clandestine intelligence activities (Section 215). HIPAA requires that you be informed in a general way how your records may be used without consent. However, you do not have to be notified of any specific sharing of your information, and further the USA Patriot Act does not allow you to be told.

16. Computerizing medical records and storing them on networks

Computerizing medical records and making them easily available over networks is, of course, essential to good medical care and can save lives by providing continuity of care. However, access to networked medical records is not limited to medical personnel. The patients records are seen by primary care physicians, hospital and lab personnel, radiologists, pharmacists, consultants, and office and kitchen staffs. The movement to

computerize medical records and possibly put them on the Internet, the expanding use of telemedicine, the increasing use of e-mail by health care workers, the increased use of health maintenance organizations, and reliance on third parties to pay for medical care, all raise serious questions of patient confidentiality and privacy. Under HIPAA, however, health care providers and their business associates have put some privacy protections in place.

17. The Privacy Act of 1974

It prohibits disclosure of government records to anyone except the individual concerned, except for law enforcement purposes. It also prohibits the use of information except for the purpose for which it was gathered. It deals with the use and disclosure of Social Security numbers.

18. The Fair Credit Reporting Act of 1970

It regulates credit agencies. It allows you to see your credit reports to check the accuracy of information and challenge inaccuracies.

Topic : An Introduction To Medical Informatics And The Administrative Applications Of Computers

Topic Objective:

At the end of this topic student would be able to:

- Define medical informatics.
- Define clinical, special purpose, and administrative applications of computer technology in health care and its delivery.
- Define telemedicine.
- Discuss the computerization of tasks in the medical office with specific reference to MediSoft.
- Describe the electronic medical record.

- Define bucket billing.
- Discuss coding and grouping systems, insurance, and the various accounting reports used in the medical office.
- Discuss coding and grouping systems used in other health care environments.

Definition/Overview:

The use of computers to organize and apply medical information. The information includes patient information, administrative information, and the use of computers in education and pharmacy. It is traditional to divide computer applications in health care into three categories, clinical, administrative, and special purpose. Telemedicine includes all three categories.

Key Points:

1. Define medical informatics

Medical informatics has many definitions. The common emphasis in all definitions of medical informatics is on the use of technology to organize information in health care. That information includes patient records, diagnostics, expert systems, and therapy.

2. Three traditional categories for the application of IT in health care

Traditionally the application of computer technology in health care is divided into three categories. The clinical uses of computers include anything that has to do with direct patient care, such as diagnosis, monitoring, and treatment. Special purpose applications include the use of computers in education and some aspects of pharmacy. Administrative applications include office management, scheduling, and accounting tasks. Many programs are specifically designed for medical office management.

3. Bucket billing

Bucket billing is used by medical offices to accommodate two or three insurers, who must be billed in a timely fashion before the patient is billed.

4. Relational database

A relational database is an organized collection of related data, in which information input in one part of the program can be linked to information in another part of the program.

5. Database file, table, record, and field

A database file holds all related information on an entity, for example, a medical practice. Within each file, there can be several tables. Each table holds related information; for example, one table might hold information on a practices doctors; another holds information on its patients; another on its insurance carriers. A table is made up of related records; each record holds all the information on one item in a table, for example, one patient. Each patient has a record in the practices patient table. All the information on one patient makes up that patients record. Each record is made up of related fields. One field holds one piece of information.

6. Key field

The key field uniquely identifies a record. The information in that field cannot be duplicated. Social Security number, chart number, and patient number are all common key fields.

7. What information is likely to be requested on the patient information form?

It includes personal data like name, address, home and work phones, date of birth, Social Security Number, and student status. The patient is also asked to fill in information about his or her spouse or partner. Medical information is required: allergies, medical history, and current medications. The patient is asked to provide insurance information for him or herself and a spouse or partner. This information includes the name of the primary, secondary, and tertiary insurance carriers, name and birth date of the policyholder, the copayment, and policy and group numbers.

8. One advantage of the electronic medical record

The EMR helps guarantee continuity of care; each of your health care providers knows your full medical history and can therefore provide better care.

9. Open-source EMR

Define DRG. A standard grouping system is DRG (diagnosis related group). Today, hospital reimbursement by private and government insurers is determined by diagnosis. Each patient is given a DRG classification, and a formula based on this classification determines reimbursement. If hospital care and cost exceed the prospective cost determination, the hospital absorbs the financial loss.

10. CPT and ICD

Services including tests, lab work, exams, and treatments are coded using CPTs (Current Procedural Terminology, Fourth Edition). ICD-9-CM provides three-, four-, or five-digit codes for thousands of diseases. The ICD is the International Classification of Diseases Clinical Modification, 9th edition.

11. Super bill

A super bill or encounter form is a list of diagnoses and procedures common to the practice.

12. charges, payments, and adjustments

Charges, payments, and adjustments are called transactions. A charge is simply the amount a patient is billed for the providers service. A payment is made by a patient or an insurance carrier to the practice. An adjustment is a positive or negative change to a patient account.

13. Guarantor

A guarantor is the person responsible for payment; it may be the patient or a third party. Define preferred provider organizations (PPOs). A patient with PPO insurance can seek care within an approved network of health care providers who have agreed with the

insurance company to lower their charges and accept assignment (the amount the insurance company pays). The patient may pay a copayment, the part of the charge for which the patient is responsible. The patient may choose, however, to go out-of-network and pay the providers customary charges. The insurance company may then reimburse the patient a small amount.

14. Medicaid

Medicaid is a jointly funded, federal-state health insurance for certain low-income and needy people. It covers approximately 36 million individuals including children, the aged, blind, and/or disabled, and people who are eligible to receive federally assisted income maintenance payments. Medicaid resembles managed care, in that the patient is restricted to a network of providers, must get a preauthorization for procedures, and needs referrals to any specialist.

15. Define Medicare

Medicare (a federal program administered by CMS) serves people 65 and over and disabled people with chronic renal disorders. Medicare allows patients to choose their physicians; referrals are not needed. Some Medicare patients choose to belong to HMOs. Many people supplement Medicare with private fee-for-service plans in which they are not restricted to a network of providers; they do not need referrals to specialists. The patient is required to pay a cost-sharing amount; the provider bills the insurance for the remainder.

16. Claim

A claim is a request to an insurance company for payment for services.

17. Patient day sheet

A patient day sheet lists the days patients, chart numbers, and transactions. It is used for daily reconciliation.

18. Payment day sheet

A payment day sheet is a grouped report organized by providers. Each patient is listed under his or her provider. It shows the amounts received from each patient to each provider.

19. procedure day sheet

A procedure day sheet is a grouped report organized by procedure. Patients who underwent a particular procedure such as a blood sugar lab test are listed under that procedure. This report is used to see what procedures a health care worker is performing. It also can be used to find the most profitable procedures.

20. Practice analysis report

A practice analysis report is generated on a monthly basis, and is a summary total of all procedures, charges, and transactions

21. Patient aging report

A patient aging report is used to show a patients outstanding payments. Current and past due balances are listed on this report based on the number of days late. For example, an account can be past due 3060 days, 6090 days, and over 90.

22. Resource utilization group (RUG)

A RUG is coding system developed in response to the Balanced Budget Act of 1997. This act mandated prospective payment systems for home health agencies, hospital outpatient care, and rehabilitation hospitals. For skilled nursing facilities, resource utilization groups (RUGs) were established. The system bases payment on average prices, with adjustments.

23. Healthcare Common Procedure Coding Systems (HCPCS)

HCPCS were developed to standardize claims processing for government and private insurance; the system is divided into three subsystems. The first is a coding system identifying services and procedures. The second identifies products, supplies, and some

services and equipment used outside the doctors office. The third is comprised of codes developed by states.

24. Home Health Resource Group (HHRG)

Home Health Resource Group helps determine prospective payment for home health care for Medicare patients. HHRG is based on estimates determined by data collection using OASIS (Outcome and Assessment Information Set). Based on HHRG each patient is assigned to one of 80 categories based on the severity of the patients condition, functional status of the patient, and the use of services.

25. Ambulatory patient classification (APC).

Reimbursement for hospital outpatient services is based on ambulatory patient classification (APC).

26. Clearinghouse

A clearinghouse is a business that collects insurance claims from providers and sends them to the correct insurance carrier. Used by practices that submit electronic claims.

27. EOB and ERA

An insurance companys response to a paper claim includes an explanation of benefits (EOB) which explains why certain services were covered and others not; an electronic remittance advice (ERA) accompanies the response to an electronically submitted claim.

In Section 2 of this course you will cover these topics:

- Telemedicine
- Information Technology In Radiology

Topic : Telemedicine

Topic Objective:

At the end of this topic student would be able to:

- Define telemedicine.
- Describe store-and-forward technology and interactive videoconferencing.
- List the various subspecialties of teleradiology, telepathology, teledermatology, telecardiology, telestroke, telepsychiatry, and telehome care.
- Describe the use of telemedicine in prisons.
- Discuss the changing role of the telenurse.
- Describe the legal, licensing, insurance, and privacy issues involved in telemedicine.

Definition/Overview:

Telemedicine: Telemedicine is a rapidly developing application of clinical medicine where medical information is transferred via telephone, the Internet or other networks for the purpose of consulting, and sometimes remote medical procedures or examinations. Telemedicine may be as simple as two health professionals discussing a case over the telephone, or as complex as using satellite technology and video-conferencing equipment to conduct a real-time consultation between medical specialists in two different countries. Telemedicine generally refers to the use of communications and information technologies for the delivery of clinical care.

Key Points:

1. Telemedicine and discuss some of its positive effects

Telemedicine uses computers and telecommunications equipment to deliver medical care at a distance. Various technologies are used: from plain old telephone service to ISDN lines, to DSL, to dedicated T1 lines, to satellite, to broadband cable, to the Internet. The medical information transmitted can be in any form, including voice, data, still images, and motion video. Telemedicine can deliver the whole range of medical care from

diagnosis to patient monitoring to treatment. It gives patients remote access to experts who in turn have access to patient information.

2. 10 Subspecialties of telemedicine.

Telemedicine encompasses many subspecialties of medicine, including radiology, pathology, oncology, ophthalmology, cardiology, stroke, dermatology, psychiatry, telehome care, and teletriage.

3. Store-and-forward technology

Where is it appropriate to use? Store-and-forward technology involves sharing information in a time- and place-independent way over the Internet. The information is stored, digitized, and then sent. If a medical specialty is image-based, store-and-forward technology may be appropriate. The information may include digital images and clinical information.

4. Teleconferencing.

Give one example of its use. Interactive videoconferencing or teleconferencing allows doctors to consult with each other and with patients in real time, at a distance. A patient may be in his or her primary physicians office with a camera and a telecommunications link to a specialists office. All can see and hear each other in real-time. It might require only a videophone and a connection to the Internet. However, the most sophisticated systems involve microphones, scanners, cameras, medical instruments, and dedicated phone lines. One form of video teleconferencing is the remote house call, involving only one medical practitioner and a patient in another location.

5. Telepathology

Telepathology is the transmission of microscopic images over telecommunications lines. The pathologist sees images on a monitor instead of under a microscope. Telepathology requires a microscope, camera, and monitor, as well as a connection to a telemedicine system. Telepathology can use real-time videoconferencing during an operation for consultation. But in daily practice, store-and-forward is common. Pathology is based on the study of images; diagnosis is based on the study of images on slides from a

microscope looking for diagnostic features. If a second opinion is needed from a distant expert, telepathology may be used. The images are taken from the slides by camera. Still images usually are at a higher resolution than those sent in real-time. The images and other clinical data are used for a complete case description, and then sent, in many cases over the Internet.

6. Teledermatology

How would you judge its effectiveness? In your answer, refer to studies mentioned in the text. Teledermatology uses both videoconferencing and store-and-forward technology. Both methods appear effective. The advantage of the videoconference is that it closely resembles the traditional visit to the doctor, but is more expensive than store-and-forward technology. Studies have shown that diagnosis made via videoconferencing agree with face-to-face dermatology visits 5988 percent of the time. A small study comparing store-and-forward teledermatology with face-to-face dermatology found 6191 percent agreement. Certain skin conditions were found to be more difficult to diagnose via teledermatology. Diagnostic confidence was lower and the rate of biopsies higher. The advantage of store-and-forward is the high quality of the images and the low cost. To date there have been no definitive outcomes studies. Some small studies have found that although there are limitations with store-and-forward (image quality and lack of patient interaction), teledermatology reduced unnecessary visits to dermatologists by more than 50 percent. A small pilot study (2003) found that teledermatology was useful at assessing skin conditions.

7. The history of listening to the heart at a distance

The earliest attempt at listening to the heart at a (small) distancethrough a rolled paper occurred in 1816. Since the invention of the telephone, doctors have attempted to send heart and lung sounds over long distances. But the quality of the sound was not good enough. During the 1960s, it became possible to transmit heart sounds more accurately and faxes can be used to send EKGs. By the 1990s echocardiograms could be telecommunicated. Second opinions via telecardiology are one of the most common requests in telemedicine.

8. The time-saving aspects of telemedicine

If the stroke is caused by a clot (determined by a CT scan) the victim may be helped by the administration of a clot-busting drug called t-PA if it is given within a few hours. However, if the stroke is caused by excessive bleeding, t-PA can kill the patient. Immediate and accurate diagnosis is crucial. However, many small hospitals do not have experts. One study showed that 70 percent of stroke patients did not receive t-PA either because they arrived at the hospital too late or because the hospitals could not provide the correct therapy. Telestroke programs connect small hospitals with urban medical centers; stroke experts at the large hospitals can diagnose via telemedicine.

9. Advantages and disadvantages of telepsychiatry.

Telepsychiatry involves the delivery of therapy using teleconferencing. It usually makes use of some sort of hardware that can transmit and receive both voice and picture. Experts warn that therapy at a distance is not a substitute for the human contact involved in face-to-face counseling. However, sometimes it is the only choice, for example, in rural areas where there are very few therapists and patients would have to travel long distances to see them. Studies of psychiatric consults between primary care providers and psychiatrists in New Hampshirecame to the same conclusionthat videoconferencing and face-to-face consults were similar. A study of telemedicine for diagnosing patients with obsessive-compulsive disorder found it as successful as face-to-face therapy. A small study compared videoconferencing and face-to-face cognitive behavioral therapy in treating childhood depression and found them equally effective. Some studies have found patients more comfortable talking to a distant psychiatrist. Others found that using a telenurse and a traditional psychiatrist improved depression more than simply a psychiatrist, although there was no improvement in the numbers of clients taking their medication properly. Telepsychiatry was also found to be successful in delivering therapy to the family of a girl suffering from anorexia. However, there are some negative aspects to telepsychiatry: the technology limits the therapists perception of nonverbal clues, and the equipment can be distracting; the therapist has to be sensitive to distortions in eye contact and the fact that a patient can appear to have stopped speaking when in fact he or she has not.

10. Smart stretcher.

A smart stretcher includes a respirator, heart machine, intravenous drugs, and monitors that transmit all the data they gather immediately to the hospital. Using the smart stretcher means that no time needs to be wasted transporting the patient. Monitoring and treatment can begin immediately.

11. telehome care.

Telehome care involves the monitoring of vital signs from a distance via telecommunications equipment, and the replacement of home nursing visits with videoconferences. It is usually used to manage chronic conditions such as congestive heart failure and diabetes, but it should be noted that it is beginning to be used for remote monitoring by ICU doctors at home. Telehome care involves a link between the patients home and a hospital or central office that collects the data.

12. Effectiveness of telehome care.

Refer to the studies in the text in your answer. A small United StatesUnited Kingdom study concluded that 45 percent of U.S. home visits could be remote. Many small studies have found both nurses and patients like the video visits and one study found that telehospice care was quite cost effective. A study in Italyfound home telemonitoring for patients with severe respiratory illness decreased hospital admissions; patients were satisfied. The study concluded that telemonitoring can provide high quality home care. Another small study found telemedicine effective in reducing hospital admissions for patients with congestive heart failure; patients had their vital signs and general appearance telemonitored, while maintaining regular video contact with health care professionals who offered advice on drug use and diet. In California, a study compared the use of face-to-face with videoconferencing in control and intervention groups. No difference in medication compliance, knowledge of disease, and ability for self-care were found.

13. The use of telemedicine in prison settings.

Telemedicine is now widely used in state prisons in Arizona, Iowa,Maryland, Texas,Massachusetts, Virginia,Pennsylvania, and New York, and in the federal prison

system. The stated reasons for introducing telemedicine are cost-containment, security, and enhanced medical care for inmates. Telemedicine is used to provide specialist care, not primary care, which is delivered on-site. A review of the literature on Texasindicates that both patients and providers are satisfied with the care and that the vast majority of systems experienced reductions in travel and security costs. One preliminary study found that 95 percent of the telemedical consults have saved a trip to a clinic. A teleconsult clinic for HIV positive inmates was established in Texasin 1999: it was found to cut costs, but have no effect on outcomes. There seems to be a consensus that telemedicine in prisons saves money and increases security by decreasing off-site visits. Survey data also indicate that both prisoners and prison administrators are satisfied with telemedicine. It may be that more prisoners seek treatment because they do not have to travel; in states like Texas, a visit to a clinic can mean four days of travel shackled in a truck.

14. The Baby CareLink program.

Baby CareLink is a highly successful program. It originated in Bostonwhere its purpose was to compare high-risk, premature infants receiving traditional care with an experimental group, which in addition to traditional care received a telemedicine link to the hospital while the babies were hospitalized and for six months after. The families could see and hear their babies in the nursery, although they were at home. They could log on to a secure Web page with up-to-date information about their babies. Once home, the families had access to the nursery and experts and could ask any question they pleased. The doctor or nurse could see the baby and reassure the parent. One purpose of Baby CareLink was to see if parents felt more comfortable and knowledgeable about their babies care, so that the hospital stay would be shorter. The experimental group did have shorter hospital stays. In a later case study of Baby CareLink in Chicago it was found that the average length of stay for the experimental group was 2.73 days shorter, that only 18 percent were readmitted (less than the expected 40 percent), medical staff were happy with the program, and parents were more comfortable with their infants.

15. Telenursing contributing to a change in the role of the nurse

Telenursing puts nurses in a more autonomous position. Telenursing involves both teletriage and the telecommunication of health related data, the remote house call, and the monitoring of chronic disease. Teletriage starts with a call from a worried patient or

parent with a question to the nurse. Software helps the nurse ask a series of questions to aid in diagnosis and make a recommendation to the patient. Telenursing increases access to medical advice by making it available in the home. Nurses may be in more autonomous positions in telemedicine programs. In England there is a 24-hour phone line staffed by nurses. The nurses use diagnostic software and are linked to databases, hospitals, primary care providers, and ambulances. The nurses staffing these lines need to know how to use the software and how to get correct information; she or he also needs knowledge of local health care services. In the United Statesthe Veterans Affairs telephone care program is staffed by RNs only.

16. **Technical, legal and insurance issues need to be addressed**

Certain aspects of telemedicine require high-speed, broadband media, since the files transmitted may be so huge (greater than 1 gigabyte). These lines are not in place in many areas. Legal issues include state licensing of medical personnel. Acquiring a license is a costly and time-consuming process. Practicing without a license is a crime. Licensing laws are different in each state. Some states allow consultations across state lines. Only 12 states have agreements that make it easier for nurses to practice across state lines. Currently, there is minimal insurance coverage for telemedicine, although this is changing slowly.

17. Telemedicine and privacy.

Telemedicine raises many privacy issues; medical information routinely crosses state lines, some of it via e-mail, which is not private. There are typically nonmedical personnel involved including technicians and camera operators. According to the Final HIPAA Privacy Rules, several privacy issues are relevant: Under HIPAA, Federal laws preempt state laws that are in conflict with regulatory requirements or those that provide less stringent privacy protections. But those states that have more stringent privacy laws would preempt Federal law. This leads to a patchwork of different standards. In a telemedical consultation, many people (both medical and nonmedical) may be presentbut not apparent to the patient. Telemedicine requires greater concern with patient privacy and more complicated consent from patients.

Topic : Information Technology In Radiology

Topic Objective:

At the end of this topic student would be able to:

- Describe the contributions of digital technology to imaging techniques.
- List the uses of traditional X-rays and the advantages of digital X-rays.
- Discuss the definition and uses of ultrasound.
- Discuss the newer digital imaging techniques of CT scans, MRIs, Functional MRIs, and PET scans, their uses, and advantages and disadvantages.
- Describe new interventional radiology techniques of bloodless surgery.

Definition/Overview:

Radiology: Radiology is the medical specialty directing medical imaging technologies to diagnose and treat diseases. Originally it was the aspect of medical science dealing with the medical use of electromagnetic energy emitted by X-ray machines or other such radiation devices for the purpose of obtaining visual information as part of medical imaging. Radiology that involves use of x-ray is called roentgenology. Modern day radiological imaging is no longer limited to the use of x-rays, and now includes technology-intensive imaging with high frequency sound waves, magnetic fields, and radioactivity.

Wilhelm Conrad Rntgen (English spelling Roentgen) first discovered x-radiation on 8 November 1895 at the Physical Institute of Wuerzburg University. He named the radiation he had discovered "X-radiation". This term is still in use today in the Anglo-American region. His work was first published in a meeting protocol of the Wuerzburg Physical-Medical Society in the 1895 volume; the article was submitted by W.C. Rntgen on 28 December 1895. Roentgen received the first Nobel Prize for Physics for the discovery of X-rays in 1901.

Today, following extensive training, radiologists direct an array of imaging technologies (such as ultrasound, computed tomography (CT) nuclear medicine, and magnetic resonance imaging (MRI)) to diagnose or treat disease. Interventional radiology is the performance of (usually minimally invasive) medical procedures with the guidance of imaging technologies.

The acquisition of medical imaging is usually carried out by the radiographer or radiologic technologist. Outside of the medical field, radiology also encompasses the examination of the inner structure of objects using X-rays or other penetrating radiation.

Key Points:

1. A traditional x-ray.

A traditional X-ray uses high-energy electromagnetic waves to produce a two-dimensional picture on film. If the X-ray encounters bone, which it cannot penetrate, this appears white on the film. Whatever organ the X-ray passes through appears black on the film. Some soft tissue appears gray. Contrast agents can improve the clarity of the images, but X-rays do not produce good images of all organs and cannot see behind bones at all.

2. Some advantages of digital over traditional X-rays

Digital images have several advantages over images on film. Digital X-rays do not have to be developed, but are immediately available and can be viewed directly on a computer screen, making them accessible to more than one person at a time, that is, to anyone on a computer network. They are more flexible: Areas can be enhanced, emphasized and highlighted, made larger or smaller. The quality of a copy of a digital X-ray is as good as the quality of the original. They can be immediately transmitted over phone lines for a second opinion.

3. Describe ultrasound.

Ultrasound (although predating computers) now makes use of computers to create dynamic images. Unlike x-rays, ultrasound uses no radiation. It uses very high frequency sound waves and the echoes they produce when they hit an object. This information is used by a computer to generate an image, producing a two-dimensional moving picture on a screen.

4. ACT scan.

Computerized tomography (CT scan) uses X-rays and digital technology to produce a cross-sectional image of the body. CT scans use radiation passing a series of X-rays through the patients body at different angles. The computer then creates a cross-sectional image from these X-rays. Soft tissue can be distinguished because it absorbs the X-ray differently.A CTscan produces a more useful image than a traditional X-ray.

5. Some differences between a CT scan and an MRI

Magnetic resonance imaging (MRI) machines use computer technology to produce images of soft tissue within the body that could not be pictured by traditional X-rays. Unlike CT scans, MRIs can produce images of the insides of bones. CT scans use radiation. MRIs use magnetic fields and radiowaves.

6. MRIs are more useful in certain areas than CT scans

Discuss these areas. Magnetic resonance imaging can produce accurate and detailed pictures of the structures of the body and the brain, and can distinguish between normal and abnormal tissue. MRI is more accurate than other imaging methods for detecting cancer that has spread to the bone, although PET/CT finds cancer of the lungs more accurately. MRIs may be used for diagnosis and for the treatment of certain conditions that used to require surgery: For example, using MRI, radiologists can now clean or close off arteries without surgery. MRIs do not use radiation and are noninvasive. MRIs are used to image brain tumors and in helping to diagnose disorders of the nervous system such as multiple sclerosis (MS). MRIs also detect stroke at an earlier stage than other tests. MRIs can help find brain abnormalities in patients suffering from dementia. It is particularly useful with brain disorders because it can distinguish among different types of nerve tissue.

7. the uses of functional MRIs

Functional MRIs measure small metabolic changes in an active part of the brain. FMRI identifies brain activity by changes in blood oxygen. FMRIs can be used to identify brain area by function in the operating room and help the surgeon avoid damaging areas such as those that are associated with speech. Strokes, brain tumors, or injuries can change the

areas of the brain where functions such as speech, sensation, and memory occur. FMRIs can help locate these areas and can then be used to help develop treatment plans. They can also help in the treatment of brain tumors, and assess the effects of stroke, injury, or other disease on brain function.

8. PET scan

Positron emission tomography (PET) scans use radioisotope technology to create a picture of the body in action. PET scans use computers to construct images from the emission of positive electrons (positrons) by radioactive substances administered to the patient. PET scansunlike traditional X-rays and CT scansproduce images of how the body works, not just how it looks.

9. Some of the uses of PET scans

PET scans create representations of the functioning of the body and the mind. They are used to study Alzheimers, Parkinsons, epilepsy, learning disabilities, moral reasoning, bipolar disorder, and cancer. PET scans are also used to diagnose arterial obstructions.

10. How is PET useful in studying brain functioning?

PET scans can show the functioning of the brain by measuring cerebral blood flow. PET scans produce a picture of activity, of function. A person is administered a small amount of radioactive glucose. The area of the brain, which is active uses the glucose more quickly and this is reflected in the image that the computer constructs. Neuroimaging techniques using PET can present a picture of brain activity associated with cognitive processes like memory and the use of language. PET scans are used to study the chemical and physiological processes that take place in the brain when a person speaks correctly or stutters. PET can show the specific brain activity associated with schizophrenia, manic-depression, posttraumatic stress disorder, and obsessive-compulsive disorder. They have shown the precise area of the brain that malfunctions in certain mental illnesses and the effects of both drugs such as Prozac and traditional talking therapy on nerve cells.

11. A bone density (dexa) scan

A bone density scan or dual X-ray absorptiometry scan is a special kind of low radiation X-ray that shows changes in the rays intensity after passing through bone. Doctors can see small changes in bone density from the amount of change in the X-ray.

12. Stereotactic breast biopsy?

Stereotactic breast biopsies make use of digital
X-rays to locate the abnormality and use a needle to extract tissue. They are less invasive than surgical biopsies, but not as accurate and cannot be used with all patients.

13. Stereotactic radiosurgery

Stereotactic radiosurgery (gamma knife surgery) is a noninvasive technique that is currently used to treat brain tumors in a one-day session. The use of the gamma knife for brain surgery has grown exponentially over the last few years. It is appropriate to brain tumors because the head can be completely immobilized. Radiosurgery can be performed by a modified linear accelerator, which rotates around the patients head and delivers blasts of radiation to the tumor or by a gamma knife.

14. Some advantages and disadvantages of gamma knife surgery

Some of the advantages of gamma knife surgery involve its relatively low cost, the lack of pain to the patient, the elimination of the risks of hemorrhage and infection, and short hospital stay. Patients are able to resume daily activities immediately. However, as the procedure grows in popularity, some doctors are questioning its safety and efficacy. What will the effects of high doses of radiation be in the long run? Although it is recognized as effective in treating some brain tumors, they question its widespread use.

15. Focused ultrasound surgery

Focused ultrasound surgery does not involve cutting, but the use of sound waves. Studies involve the use of ultrasound to stop massive bleeding and to treat cancer. By focusing an ultrasonic beam roughly 10,000 times the power used for prenatal pictures they can raise

the temperature of cancerous tissue at the focal point to nearly boiling. Within seconds, the tissue dies.

In Section 3 of this course you will cover these topics:

- Information Technology In Dentistry
- Information Technology In Surgery

Topic : Information Technology In Dentistry

Topic Objective:

At the end of this topic student would be able to:

- Describe the use of computers in education.
- Discuss the significance of the electronic patient record in integrating practice management and clinical applications.
- List the impact of changing demographics on dental practice.
- Describe the use of computers in endodontics, periodontics, and cosmetic dentistry.
- Define diagnostic tools, including the X-ray, digital X-ray, electronic concordance, and thenew tools that use light.
- Define minimally invasive dentistry.
- List the uses of computers in dental surgery.
- Describe the trend toward growing specialization.
- Describe the emerging field of teledentistry.

Definition/Overview:

Dental informatics combines computer technology with dentistry to create a basis for research, education, and the solution of real-world problems in oral health care using computer applications. From the time the patient calls the office for an appointment recorded

in an electronic appointment book, to the services offered and the instruments in use, even to the pain the patient senses, digital technology plays a role.

Discuss ways that IT helps in the education of dentists. Dentists can surf the Web for online information specific to their professional interests and use e-mail to communicate with each other and their patients. Computer-generated treatment plans are used to help educate patients. Virtual reality simulations are beginning to be used in the education of dentists and dental surgeons. DentSim is a program that uses virtual reality. Its purpose is to teach technical dexterity to dental students.

Key Points:

1. The electronic dental chart

The electronic dental chart will be standardized, easy to search, and easy to read. It will integrate practice management tasks (administrative applications) with clinical information. It will include all of the patients conditions and treatments, including images.

2. The surgeon generals report on oral health in 2000

Describe them. In the year 2000, the surgeon general issued a first report on dental health. The report pointed to changes over the last 100 years. In the year 1900, most people lost their teeth by middle age. By the middle of the twentieth century, the baby-boom generation was taught to take care of their teeth. By the late twentieth century, many children were drinking fluoridated water, having their teeth regularly cared for, and thus suffering less decay. Dental health in general has improved over the last century. These trendssuccessful preventive treatments in middle-class children and an increasing aging population who have kept their teethhave changed the conditions dentists are treating and the expectations of patients. Dentists are filling fewer teeth, but increasingly and aggressively treating the more affluent portion of the aging population.

3. The current epidemic of dental disease mean

Although dental health in general has improved, decay is epidemic among some populations. Victims of this epidemic are low-income, minority, and some immigrant

populations. One study traced the high number of cavities in poor children to increased lead levels in the childrens blood, plus shortages in calcium and vitamin C.

4. A fiber optic camera

The fiber optic camera is analogous to the endoscope used in surgery. It is used to view an area that is normally difficult to see. The dentist aims a fiber optic wand at the area of the mouth to be examined. The image can be viewed on a monitor by patient and dentist. The image can help the dentist see and diagnose problems at a very early stage.

5. Endodontics

Endodontics is the dental specialty that diagnoses and treats diseases of the pulp.

6. Periodontics

Periodontics is concerned with diagnosing and treating diseases of the gums and other structures supporting the teeth.

7. Cosmetic dentistry

Cosmetic dentistry attempts to create a more attractive smile.

8. Procedures used by cosmetic dentists

Bonding involves the application of a material to the tooth that can be shaped and polished. Dental implants can be used to replace missing teeth; computers help plan the exact placement of the implant.

9. Traditional diagnostic tools

A basic diagnostic tool is a clinical examination using a probe. Traditional X-rays have been used for more than 100 years to diagnose cavities. X-rays are more effective than clinical examination. X-rays can be used because as the mineral content of the tooth decreases, the X-ray shows the cavity as darker. The dentist must then interpret the X-ray correctly. This is not a foolproof method of diagnosis, and may not detect cavities at an early stage when minimal intervention is necessary.

10. Electrical conductance

Electrical conductance is also currently used to diagnose cavities. An electric current is passed through a tooth, and the tooths resistance is measured. A decayed tooth has a different resistance reading than a healthy tooth. Studies differ on the accuracy of this method, but tend to rate it high in detecting substantial cavities, not early lesions.

11. Describe DIFOTI

Digital Imaging Fiber-Optic Transillumination (DIFOTI) diagnoses by using a digital CCD camera to obtain images of teeth illuminated with laser light. The images are analyzed using computer algorithms.

12. The uses of lasers in dentistry

There are several uses of lasers in dentistry. Low-level lasers can find pits in tooth enamel that may become cavities. The FDA has approved laser machines for drilling and filling cavities; lasers also reduce the bacteria in the cavity. Minimally invasive dentistry uses lasers. Surgical lasers, used in place of drills, burst cells by heating them. One laser works on hard tissue, another on soft tissue. Lasers can quickly harden the material used to fill the tooth, reducing the time a filling takes to complete. Lasers cannot be used where previous fillings or crowns exist.

13. Minimally invasive dentistry

Minimally invasive dentistry emphasizes prevention and the least possible intervention. Teeth are constantly affected by acids, which demineralize the surfaces (dissolve the enamel). Early lesions beneath the enamel can be treated with calcium, phosphate, and fluoride, which help remineralize teeth. Preventive measures include antibacterial rinses and toothpastes, fluoride, diet, sealants, and the use of sugarless gum to increase saliva.

14. Air abrasion

Air abrasion can remove small amounts of a tooth; it involves aiming high-speed particles at the tooth. It can be used for the removal of cavities, of defects in the enamel, and to

detect cavities in fissures by opening them for inspection. It is relatively painless. It removes less of the tooth than a traditional drill.

15. Part do computers play in dental surgery

Computers play a part in the delivery of anesthesia and the planning and creation of dental implants. Computerized monitoring devices can keep track of a patients vital signs. For patients requiring implants, software can create a three-dimensional view of the patient: this allows the dentist to see the exact relationship of the planned implant to the patients bone. The surgery can be done as a simulation; dental CT scans allow the surgeon to rotate the implant on the screen so that by the time the patient is operated on, the surgery is planned down to the last detail.

16. Increasing specialization in dentistry

In the last quarter of the twentieth century, only 10 percent of dentists were specialists. This is expected to rise to about 30 percent. This is due in part to the decrease in the number of dentists trained, while the number of specialists trained remains constant, so that specialists form a greater proportion. It is also due to changing demographics. As life expectancy increases and dental health improves, more affluent patients who feel they need to be attractive will seek cosmetic dentistry. With the aging population, some dentists will specialize in geriatrics. New technologies that allow dental problems to be diagnosed and treated earlier will result in dentists who specialize in diagnostics.

17. Teledentistry

Teledentistry programs have been developed to help dentists access specialists, improving patient care. One system uses the Internet and requires a computer and digital camera. The general dentist can e-mail a patients chart, including images to the specialist who can suggest both diagnosis and treatment. This saves the patient time and travel, and gives her or him access to expert advice.

Topic : Information Technology In Surgery

Topic Objective:

At the end of this topic student would be able to:

- Describe the use of computers in education.
- Discuss the significance of the electronic patient record in integrating practice management and clinical applications.
- List the impact of changing demographics on dental practice.
- Describe the use of computers in endodontics, periodontics, and cosmetic dentistry.
- Define diagnostic tools, including the X-ray, digital X-ray, electronic concordance, and thenew tools that use light.
- Define minimally invasive dentistry.
- List the uses of computers in dental surgery.
- Describe the trend toward growing specialization.
- Describe the emerging field of teledentistry.

Definition/Overview:

Computer-assisted surgical planning involves the use of virtual environment technology to provide surgeons with realistic accurate models on which to teach surgery and plan and practice operations. With virtual reality (VR) technology, the computer can create an environment that seems real, but is not. Currently, these lifelike simulations are used in the health care field. The models created by VR technology can look, sound, and feel real. The models can respond to pressure by changing shape and to being cut by leaking. A model such as this, which is interactive, allows surgeons not only to plan surgeries more precisely, but also to practice operations without touching a patient. Some models include a predictive element, which shows the results of the doctors actions. For example, plastic surgeons can practice on a model of a face and see the results of their work.

Key Points:

1. Minimally invasive surgery

Minimally invasive surgery, utilizing an endoscope, performs procedures through small incisions that involve a minimum of damage to healthy tissue. There is less bleeding and pain, and a shorter recovery time. This means shorter hospital stays and lower costs.

2. Some advantages of using robots in the operating room

Robots, unlike humans, can hold endoscopes and other instruments without becoming tired or shaky. Robots are also used to scale down the surgeons motions. Some surgeons report that this makes their hands rock steady, making surgery on small delicate areas such as the eye safer.

3. ROBODOC

The earliest use of a robot in surgery was in hip replacement operations. Integrated Surgical Systemss ROBODOC (which is undergoing FDA-approved clinical trials) is a computer-controlled, image-directed robot which performed its first hip replacement in 1992. It can be used only with cementless implantswhich constitute about one-third of those done each year. It has been used in thousands of hip replacement operations worldwide. Because ROBODOC actually cuts into a patients femur, there have to be strict built-in safeguards. The safeguards come from the program, which controls the robot and physical limitations on how much ROBODOC can move.

4. AESOP

AESOP (Automated Endoscopic System for Optimal Positioning), which was introduced in 1994, by Computer Motion, Inc., is the first FDA-cleared surgical robot. Originally developed for the space program, AESOP is now used as an assistant in endoscopic procedures. It holds and moves the endoscope under the direction of the surgeon. AESOP was first developed to be controlled by foot pedals. However, currently it responds to voice commands.

5. ZEUS

ZEUS has three interactive robotic arms, one of which holds the endoscope, while the other two manipulate the surgical instruments. The surgeon, sitting at a console, controls them. The endoscope is controlled by voice commands. The surgeon manipulates instruments, which resemble surgical tools, while looking at a monitor; the surgeons manipulations control the robotic arms, which are actually doing the surgery. ZEUS includes a feedback system so that the surgeon feels the tissue. The computer-controlled robotic arms also scale down the surgeons movements, filtering out any hand tremor. This means that a one-inch movement by the surgeon becomes a one-tenth of an inch movement of the robots surgical instrument. By eliminating the hands vibrations, ZEUS makes delicate procedures safer.

6. HERMES

Systems software is required to connect the operating room hardware into a network that a surgeon can control with voice commands. HERMES is an FDA-cleared operating system that performs these tasks, allowing the surgeon to use his or her voice to control all the electronic equipment in the operating room, coordinating the endoscope and robotic devices. It also allows the surgeon to adjust lighting with a voice command. The surgeon can use Hermes to take and print pictures and access the patients electronic medical record including images and other information.

7. Augmented reality surgery

Augmented reality surgery uses computer-generated imagery to provide the surgeon with information that would otherwise be unavailable. The computer-generated images may either be fused with the image on the monitor or projected directly onto the patients body during the operation allowing the doctor to virtually see inside the patient. However, an image on a monitor is two-dimensional. A head mounted display that combines the computer-generated images and the image of the patient allows the surgeon to see a three-dimensional field and see different views by simply turning her or his head instead of adjusting the endoscope, making it more like traditional open surgery.

8. Successful distance surgeries

In September 2001, a woman in France had her gall bladder removed by doctors in New York. She spent two days in the hospital. Technically, the surgery made use of high-speed fiber optics, so that time delay was minimal. In this computer-assisted laparoscopic procedure patient and doctor never touch; the surgeon controls the robot through hand signals. Successful prostate cancer surgery was performed in April 2002, between Germanyand Virginia. Using the SOCRATES system, the American doctor was able to see and hear as if he were in the operating room in Berlin; he also controlled AESOP, while the German surgeon did the surgery. In March 2003, ZEUS was used to perform distance surgery in Canada to correct a patients acid reflux disease. At one hospital, endoscopic instruments were inserted into the patients stomach. At another hospital 400 kilometers away a surgeon used ZEUS to perform the successful surgery. ZEUSs sensors took the information from the surgeons hand movements and sent it to the distant instruments.

In Section 4 of this course you will cover these topics:

- Information Technology In Pharmacy
- Computerized Medical Devices, Assistive Technology, And Prosthetic Devices

Topic : Information Technology In Pharmacy

Topic Objective:

At the end of this topic student would be able to:

- List some of the uses of computers in surgery.
- Describe the role of computers in surgical planning.
- Define robot, endoscopic surgery, minimally invasive surgery, augmented reality, and tele-presence surgery; be aware of the SOCRATES system that allows long distance mentoring of surgeons in real time.

- List some of the robots used in surgery including ROBODOC and AESOP, ZEUS and da Vinci.
- Describe some of the advantages and disadvantages of computer-assisted surgery.
- Describe the use of lasers in surgery.

Definition/Overview:

Biotechnology: Biotechnology sees the human body as a collection of molecules, and seeks to understand and treat disease in terms of these molecules. It attempts to identify the molecule causing a problem and then create another to correct it. Specific drugs are aimed at inhibiting the work of a specific disease-causing agent. In order to be effective, the drug needs to bind to its target molecule. It needs to fit, something like a key in a lock. To achieve an exact fit, the precise structure of the target must be mapped. Powerful computers allow scientists to create graphical models.

Key Points:

1. Rational drug design

One way of developing drugs with the help of computers is called rational drug design. Developing drugs by design requires mapping the structure and creating a three-dimensional graphical model of the target molecule. Since this involves a huge number of mathematical calculations, without computers the process took many years; after the calculations were completed, a wire model of the molecule had to be constructed. Now, supercomputers accurately do the calculations in a small fraction of the time, and graphical software produces the image on a computer screen.

2. Bbioinformatics

The application of information technology to biology is called bioinformatics. This field seeks to organize biological data into databases. The information is then available to researchers who can search through existing data and add new entries of their own.

3. The Human Genome Project

Discuss the relationship of computers to the project. The Human Genome Project, sponsored in the United States by the National Institutes of Health and the Department of Energy, began in 1990 and involved hundreds of scientists all over the world. The goal is to find the location of the 100,000 or so human genes and to read the entire genetic script, all 3 billion bits of information, by the year 2005. The project has succeeded in mapping the human genome. One of its goals is an attempt to understand the molecular bases of genetic diseases. This project would be inconceivable without computers and the Internet. Computers are used to keep track of the genes as they are identified; this prevents duplication of effort and ensures that no genes are overlooked. The Internet allows findings to be immediately communicated to scientists working on the project anywhere in the world.

4. The relationship between understanding the genetic basis of a disease and treating the disease

Three to four thousand diseases are caused by errors in genes. Altered genes also contribute to the development of other disorders such as cancer, heart disease, and diabetes. The Human Genome Project expects to be able to identify such genes, which might make prevention, early detection, and treatment possible. Once the gene is identified, drugs can be designed. Treatment may include gene therapy to replace the defective gene or the development of drugs.

5. Comment on recent developments in biotechnology

Refer to Herceptin, Lucentis and Avastin in your answer. In September 1998, the U.S. Food and Drug Administration (FDA) approved Herceptin as effective against certain types of metastatic breast cancer. Herceptin can work for patients who have too much of a specific gene in their tumor cells. Clinical trials for Lucentis for the treatment of macular degeneration continue in 2003. Lucentis is an antibody that binds to a protein that is involved in the formation of blood vessels. In 2003, the FDA approved fast track status for the development, testing, and review of Avastin, an antibody that inhibits the protein that plays a role in the maintenance and metastases of tumors.

6. RNA interference

Another new technology aimed at drug development is called RNA interference or RNAi. RNA stands for ribonucleic acid. It is made in the nucleus of a cell, but is not restricted to the nucleus. It is a long coiled up molecule whose purpose is to take the blueprint from DNA and build our actual proteins. RNAi is a process that cells use to turn off genes. The attempt at developing drugs based on RNAi is in its infancy, and would, if successful, turn off genes associated with disease. Prior attempts at turning off genes with drugs have not succeeded.

7. Antisense technology

Antisense technology is one experimental technology used to develop drugs to shut off disease-causing genes. It has not been very successful. In a large clinical trial of a drug called Genasense the results were mixed.

8. Comment on the use of computers in drug trials

Software has been developed that allows companies to simulate clinical trials on a computer before the actual trials begin. A simulated drug trial uses information about the drugs effects from earlier trials, animal studies, or trials of similar drugs. By trying out many what ifs on computer models, the actual trials can be more precisely designed, making it more likely that they will be definitive.

9. The Physiome Project

The Physiome Project has created a virtual heart using mathematical equations to simulate the processes of the heart. It has been used in studies of irregular heartbeats. The project is developing a virtual body on which to test drugs, and will then attempt to create a virtual immune system to find treatments for conditions such as arthritis and autoimmune disorders. These mathematical models will help reduce the time necessary to test drugs. However, computer assisted drug trials are not a replacement for actual clinical trials.

10. The purpose of computer-assisted trial design

The purpose of computer-assisted trial design (CATD) is to decrease the time and money spent on the trial phase of drug development.

11. The effect of computerized warning systems on adverse drug events

Computer warning systems can be used to prevent adverse drug events (ADEs). Serious ADEs occur in about 7 percent of patients admitted to hospitals. Many of these are caused by a physician prescribing either the wrong drug or the wrong dosage, because of lack of knowledge of either the patient or the drug. In 1994, a computerized warning system was designed and put into place in one hospital. The hospital already had in place a database with patient information; the existing system warned of a patients specific drug allergy and of adverse drug interactions. The new alert system added warnings of other likely ADEs.

12. A computerized pharmacy that uses robots and bar codes

A fully automated dispensing system involves the employment of a robot. In one such system, a prescription is entered into the pharmacy computer; the pharmacy computer, in turn, activates the pharmacy robot, which first determines what size vial is needed for the prescriptionfrom the three available sizes. A robotic arm grips the correct size. One system has 200 cells, each containing a different drug. The arm is moved to the correct cell; the tablets or capsules are counted by a sensor and dropped into the vial. The computer prints a label and puts it on the vial, which is delivered via a conveyer belt to the pharmacist. The pharmacist uses a bar code reader to scan the bar code on the label; an image of the medication and prescription information appears on the screen. The pharmacist puts the lid on and gives the customer the prescription.

13. Point-of-use dispensing

Some computerized hospital pharmacies are using point-of-use dispensing of drugsa decentralized automated system. A small computer attached to a large cabinet sits at the nursing unit. It is networked to the hospital pharmacy computer. A nurse types a password and the unit displays a list of patients; the nurse selects the patient and enters the drug order and the computer delivers it by opening the drawer containing the

medication; the nurse enters the name of the drug and closes the drawer. The computer keeps track of all drug transactions, for billing and inventory purposes.

14. The advantages of point-of-use dispensing over traditional medication dispensing

Point-of-use dispensing has several advantages over traditional manual dispensing. It shortens the time between the order for a medication and its delivery to the patient Automating drug distribution improves patient care in other ways too. Drugs are more likely to be administered on schedule and significantly fewer doses are missed. Although apparently not reducing dispensing errors to zero like centralized robotic systems claim to do, one study found that a decentralized system decreased dispensing errors by almost one-third. Decentralized computerized drug delivery has a positive financial impact for the hospital, making it more likely that patients are charged for the medications used. It also decreases the time nurses spend on medication-related activities, such as counting controlled substances, charting, documentation, and billing.

15. Telepharmacy

Telepharmacy involves using a computer, a network connection, and a drug-dispensing unit to allow patients to obtain drugs outside of a traditional pharmacy, at, for example, a doctors office or clinic.

16. theadvantages of telepharmacy

Telepharmacy promises to be especially helpful in rural areas and underserved urban neighborhoods where there is no accessible local pharmacy. Using a telepharmacy connection can mean that the patient walks out of the doctors office with the medication in hand, having already teleconsulted with the pharmacist; neither patient nor pharmacist has to travel. It could prove to be particularly beneficial to populations who cannot travel easily. The elderly, for example, have a poor drug compliance recorddue in part to their difficulty traveling. There are several other advantages to telepharmacy. A telepharmacy does not need to fill as many prescriptions as a conventional pharmacy to be cost effective. Entering prescriptions directly into a computer may cut down on dispensing errors caused by illegible handwriting.

17. The problems associated with the expansion of telepharmacy

There are problems with telepharmacy that could slow its expansion. Pharmacy has traditionally been subject to state regulation. Each state has different pharmacy regulations. The National Association of Boards of Pharmacy has model telepharmacy regulations, but only some states have adopted them.

18. The implantable chip that delivers medication

Newly developed chips with embedded medications can be surgically implanted in the patient. The drug may be released by diffusion. It may be embedded in a biodegradable material that releases as it degrades.

19. Advantages of using an implanted chip to deliver medication

Some of the potential uses of the chip include delivering an entire course of medication over a period of months, delivering a series of vaccines at the correct time, delivering medication that needs to be taken continuously, including painkillers and medications for chronic conditions. This pharmacy on a chip is completely biodegradable. One advantage of using chips to deliver medication is that because they bypass the stomach, they avoid stomach upsets.

Topic : Computerized Medical Devices, Assistive Technology, And Prosthetic Devices

Topic Objective:

At the end of this topic student would be able to:

- Describe the contribution of information technology to the development and testing of drugs.
- Define biotechnology and rational drug design.
- Discuss the significance of the Human Genome Project and its contribution to the understanding of genetic diseases.
- List the use of computers in clinical drug trials.

- Discuss the relationship of the understanding of the molecular basis of a disease to real breakthroughs in treatment.
- List the uses of computer technology in pharmacies, including
- The use of computers in theneighborhood drug store, from the printing of drug information for customers to the full automation of the process of filling prescriptions using robots and bar codes
- The use of computers in hospital pharmacies
- In centralized dispensing systems using robots and bar codes
- In decentralized point-of-use dispensing units
- Discuss tele-pharmacy, that is, the linking of pharmacists via telecommunications lines to dispensing units in remote locations such as doctors offices.
- Discuss the impact of information technology on pharmacy as it affects pharmacists, patients, and hospital administrators.

Definition/Overview:

Computerized Medical Devices: Computerized medical devices are electronic devices equipped with microprocessors. They provide direct patient services such as monitoring and administering medication or treatment

Computerized drug delivery systems are used to give medications. Insulin pumps include a battery operated pump and a computer chip. The pump is not automatic. However, the chip allows the user to control the amount of insulin administered. Insulin is administered via a plastic tube inserted under the skin; the tube is changed every two or three days. The pump is worn externally and continually delivers insulin according to the users program.

Three computerized monitoring systems. Computerized physiological monitoring systems analyze blood; arrhythmia monitors monitor heart rates; pulmonary monitors measure blood flow through the heart and respiratory rate.

Key Points:

1. Computerized medical instruments

Computerized medical instruments are electronic devices equipped with microprocessors. They provide direct patient services such as monitoring and administering medication or treatment.

2. The insulin pump

Computerized drug delivery systems are used to give medications. Insulin pumps include a battery operated pump and a computer chip. The pump is not automatic. However, the chip allows the user to control the amount of insulin administered. Insulin is administered via a plastic tube inserted under the skin; the tube is changed every two or three days. The pump is worn externally and continually delivers insulin according to the users program.

3. Three computerized monitoring systems

Computerized physiological monitoring systems analyze blood; arrhythmia monitors monitor heart rates; pulmonary monitors measure blood flow through the heart and respiratory rate.

4. Ophthalmologist and optometrist

An ophthalmologist is a doctor who treats eye diseases. An optometrist examines the eye and prescribes glasses.

5. The Optomap Panoramic200

The Optomap Panoramic200 can examine the retina without dilation using low-powered red and green lasers. The image can be reviewed right away and is larger than that produced by conventional examination. It can help in the early detection of retinal tears, macular degeneration, and diabetic retinopathy.

6. Americans with Disabilities Act of 1990

The Americans with Disabilities Act of 1990 prohibits discrimination against people with disabilities and requires that businesses with more than fifteen employees provide reasonable accommodation to allow the disabled to perform their jobs.

7. Describe two adaptive mice.

The head mouse moves the cursor according to the users head motions. Puff straws allow people to control the mouse with their mouths.

8. Augmentative communication device

An augmentative communication device is any device that helps a person communicates. Medicare began covering these devices in 2002. Those who lack the ability to speak or whose speech is impaired can have a computer speak for them. The device should allow the user to communicate basic needs, carry on conversations, work with a computer, and complete assignments for work or school.

9. An environmental control system

Environmental control systems help physically challenged people control their environments. Speech recognition technology can be used in the home to control appliances. One system understands and obeys voice commands. Using this system one can control home appliances with voice commands. It also acts as a speaker phone which will dial or answer calls on command. Other environmental control systems allow the installation of a single switch to control the operation of several appliances (including other controllers). Environmental control systems can be used to control any electrical appliance in the home. This would include lights, telephones, computers, appliances, infrared devices, security systems, sprinklers, doors, curtains, and electric beds. Voice, joysticks, or switches may control the system. This may enable physically challenged people to live independently at home.

10. Myoelectric limb

Myoelectric limbs are artificial limbs containing motors and responding to the electrical signals transmitted by the residual limb to electrodes mounted in the socket.

11. The C-leg

The C-leg (computerized leg) is a lower leg prosthesis. It includes a prosthetic knee and shin system controlled by a microprocessor. It is made of lightweight carbon fiber and gets its power from a rechargeable battery. With a traditional prosthesis, the user has to think about each step. But the C-leg analyzes gait 50 times per second; it anticipates movement, and thus thinks for the patient. It is supposed to adjust to uneven ground by itself, but results from studies are mixed. It requires less energy for walking at speeds slower or faster than usual, but not at the walkers usual speed; the user does not have to think about changing walking speed.

12. The uses of CFES technology

Computerized functional electrical stimulation (CFES or FES) directly applies low-level electrical stimulation to muscles that cannot receive these signals from the brain. CFES technology was originally developed by NASA. FES has been used for many years in pacemakers and other implanted devices. It is now used to strengthen paralyzed muscles with exercise. It can be used to simulate a full cardiovascular workout to people who are paralyzed, reducing the secondary effects of paralysis. FES even makes it possible to restore movement to some limbs paralyzed by stroke and spinal injury.

13. The risks of implants

Implants pose some risks including rejection of the implant and infection at the site. Some implants can cause blood clots and require the user to take anti-clotting medications.

In Section 5 of this course you will cover these topics:

- Informational Resources: Computer- Assisted Instruction, Expert Systems, And Health Information Online

Conclusion And Future Directions

Topic : Informational Resources: Computer- Assisted Instruction, Expert Systems, And Health Information Online

Topic Objective:

At the end of this topic student would be able to:

- List the many informational resources that computer technology and the Internet have made available and their use in the health care fields.
- Describe the use of computer-assisted instruction in health care education.
- Discuss the Visible Human Project; many simulation programs use data from this project.
- Describe simulation programs such as ADAM, which make use of text and graphics.
- Describe simulation programs that make use of virtual reality to teach surgical procedures, dentistry, and other skills.
- Define patient simulators.
- Be aware of the existence of distance learning programs in health care education.
- Discuss the role of expert systems, such as INTERNIST, MYCIN, and POEMS in health care.
- Describe the resources on the Internet, including medical literature databases, physicians use of e-mail, general information and misinformation, and support groups, and be able to discuss both the positive andnegative consequences of using the Internet as a resource for health information.
- Discuss the availability of self-help software.

Definition/Overview:

Eight in ten internet users have looked for health information online, with increased interest in diet, fitness, drugs, health insurance, experimental treatments, and particular doctors and hospitals. When it comes to online health searches, specific diseases and treatments continue to be the most popular topics. But the greatest growth is in seeking information about doctors and hospitals, experimental treatments, health insurance, medicines, fitness, and nutrition.

The Internet can be a mixed blessing when it comes to health care. We now have more health information at our fingertips than anyone dreamed possible just a few short years ago.

Key Points:

1. The Visible Human Project

The Visible Human Project is a computerized library of human anatomy at the National Library of Medicine. It began in 1986; it is an ongoing project. It has created complete, anatomically detailed, three-dimensional representations of the male and female human body. The images are accessible over the Internet. Hundreds of people have used these images on computer screens where they can be rotated and flipped, taken apart and put back together. Structures can be enlarged and highlighted. The images, also available on CD-ROM, have been used by students of anatomy, researchers, surgeons, and dentists who discovered a new face muscle. The Visible Human is available for both teaching and research. Some of the projects using data from the Visible Human include several three-dimensional views of the human body and images of MRIs and CT scans. ADAM, a program that is used to teach anatomy, uses data from the Visible Human.

2. The virtual human embryo

A new project called the virtual human embryo is digitizing some of the 7,000 human embryos lost in miscarriages, which have been kept by the National Museum of Health and Medicine of the Armed Forces Institute of Pathology since the 1880s. An embryo develops in 23 stages over the first eight weeks of pregnancy. The project will include at least one embryo from each stage. It will be sectioned and sliced. Each slice will be placed under a microscope and digital images will be created. Users will be able to access the images on DVDs and CDs, and manipulate and study them.

3. Drill-and-practice and simulation software

Computer-assisted instruction (CAI) is used at all stages of the educational process. Drill-and-practice software is used to teach skills that require memorization. Simulation software simulates a complex process. The student is presented with a situation and given choices. The student is then shown what affect that choice would have on the situation. Early simulation programs used text and graphics to describe a situation. Later, animation

and sound were added. Today, some programs use virtual reality so that the student actually feels as if he or she were performing a procedure such as administering an epidural.

4. ADAM. ADAM teaches anatomy and physiology

It uses two- and three-dimensional images (some of them created from the Visible Human data) and has versions available for both patients and professionals. It is interactive, allowing the user to click away over 100 layers of the body and see more than 4,000 structures! Using multiple windows, the user can compare different views of one anatomical structure.

5. Virtual reality simulations help teach many skills

Discuss several. Virtual reality simulations being used to train surgeons to perform minimally invasive operations. A device using a mannequin and computer imaging allows medical students to practice inserting a bronchoscope into a childs trachea. The epidural simulator allows the student to perform the procedure while feeling the resistance of the tissue, but without endangering a live patient. Students can learn to administer an IV from a simulation program instead of practicing on a rubber arm. In dentistry, virtual reality simulations make use of mannequins to allow students to practice filling cavities while watching both the mannequin and a monitor. The student feels the tooth via the instruments, learning to distinguish between a healthy and a diseased tooth.

6. A human patient simulator

Human patient simulators are programmable mannequins on which students can practice medical procedures. The simulator has liquids flowing through its blood vessels, inhales oxygen and exhales carbon dioxide, produces heart and lung sounds, has eyes that open and close, pupils that dilate, a tongue that can swell to simulate an allergic reaction. The student can perform an electrocardiogram,take the pulse, measure blood pressure and temperature. Medications can be administered intravenously; the mannequin reads the bar code and reacts as it has been programmed to react. Students can practice intubations and needle decompression of pneumothorax (accumulation of air or gas in the lung); chest tubes may be inserted. Different types of patients can be simulated including a healthy

adult, a woman experiencing problems with pregnancy, a middle-aged man suffering from hypertension.

7. Expert systems

An expert system is an attempt to make a computer an expert in one narrow field. Both facts and rules about how the facts are used to make decisions in the field are entered in the computer. Expert systems are a branch of artificial intelligence, which examines how computers behave like human beings, that is, in intelligent ways. Expert systems have been used in medicine since the 1950s. They are meant to be decision support systems, which help, but do not replace, medical personnel. They are especially useful when there is a limited, well-defined area of knowledge needed for a decision, which will be based on objective data. The health care provider enters symptoms, test results, and medical history. The computer either asks for more information or suggests a diagnosis, and perhaps treatment. Some systems give the diagnosis in the form of a probability.

8. One suggested code of conduct for health-related Web sites

One code of conduct suggests that Web sites disclose any information that consumers would find useful, including who has a monetary interest; that they distinguish scientific information from advertising; attempt to assure the high quality of information; disclose privacy risks and take steps to ensure privacy.

9. The digital divide

Access to health-related information on the Internet is not equally distributed through society, but is restricted to those with access to computers with an Internet connection and the knowledge to make use of them. The digital divide refers to the gap between information haves and have-nots. White and Asian Americans, those with higher incomes, and higher education are more likely to have computer and Internet access than low income, less educated people, and African Americans and Hispanics. People in rural areas have less access to the Internet than people in urban areas.

10. Ttarbright World

Starbright World is a network linking 30,000 seriously ill children in 100 hospitals and many homes in North America. Children in the network can play games, chat, and send and receive e-mail. They can also get medical information.

11. thedesirability of providing e-mail for patients

Comment.Doctors who oppose the use of e-mail cite concerns with liability (a paper trail), privacy, time, the possibilities of misunderstanding, and the slowness of e-mail compared with conversation. The small percent of doctors who provide e-mail state that patients are calmer when they know there is an open line to their physicians, and therefore dont need to communicate as much. Some doctors who provide e-mail for their patients maintain that email has not played a role in one malpractice suit.

12. Briefly describe MEDLINEPlus.

In 1998, the National Library of Medicine introduced MEDLINEPlus, which is meant for the general public. In 2001 there were 2.3 hits per month. The information is selected using strict guidelines to guarantee accuracy and objectivity.

Topic : Conclusion And Future Directions

Topic Objective:

This topic summarizes developments in information technology as they relate to health care. Upon completion of this topic, you should be able to:

- Summarize new developments in clinical and special purpose applications of IT to health care.
- Discuss new administrative applications, specifically the use of the electronic medical record.
- List the advantages and disadvantages associated with the use of the electronic medical record.

- Describe demographic changes and their impact on occupational outlooks for health care professionals.
- Describe the social implications of the applications of information technology to health care.

Definition/Overview:

Information technology (IT) has the potential to improve the quality, safety, and efficiency of health care. Diffusion of IT in health care is generally low (varying, however, with the application and setting) but surveys indicate that providers plan to increase their investments. Drivers of investment in IT include the promise of quality and efficiency gains. Barriers include the cost and complexity of IT implementation, which often necessitates significant work process and cultural changes. Certain characteristics of the health care marketincluding payment policies that reward volume rather than quality, and a fragmented delivery system can also pose barriers to IT adoption. Given ITspotential, both the private and public sectors have engaged in numerous efforts to promote its use within and across health care settings. Additional steps could include financial incentives (e.g., payment policy or loans) and expanded efforts to standardize records formats, nomenclature, and communication protocols to enhance interoperability. However, any policy to stimulate further investment must be carefully considered because of the possibility of unintended consequences.

Key Points:

1. The VeriChip

Comment on its privacy implications. New devices emerge every day from pacemakers that can communicate over the Internet to the experimental VeriChip, which may in the future be implanted and linked to a database of medical information. This would pose privacy problems because all of your information would be available from one placeyou. Without proper security measures in place, this would endanger personal privacy.

2. Computerized devices in development

Other devices that depend on microprocessors and sophisticated software are also in development: a toothbrush that checks for bacteria and blood sugar and sends the information to your medical record; glasses that help with memory; skin surface mapping that detects melanoma early; smart bandages that can detect bacteria and viruses and

inform the wearer if an antibiotic is needed; a wheelchair controlled by voice or a touch pad that finds its own way through a crowded room or subway platform. A brain prosthetica chip that mimics the hippocampus (responsible for memory)is in the very early stages of development. Other implants in development can help grow bones.

3. Smart glasses

Electronic glasses are in the development stage. These smart glasses will be able to automatically focus and refocus. Traditional glasses bend light with their lens shape. Electronic glasses will contain software, chips, and material sensitive to the application of electrical voltage. The latter will change the refraction of the material in the lens. Each pixel in the lens can have different amounts of electricity applied. Problems have to be solved before these glasses are ready to be sold to the public. Glasses have to transmit light. However, currently these glasses absorb light.

4. Tthe problems of the EMR

The problems raised by the electronic medical record include the cost of instituting and maintaining a computerized system, which can be prohibitively high for a small practice, problems of reliability, and problems of security and privacy, which have not been solved.

5. Current employment outlook for health care professionals

Demographic changes and changes in the organization of the delivery of health care are combining to improve the occupational outlook for health care professionals. According to the U.S. Bureau of Labor Statistics, there will be more than 3 million new jobs in health carethe largest numerical increase of any industry from 19962006. The Employment of registered nurses is expected to grow faster than the average for all occupations through the year 2006. In a later report, the BLS predicted, About 13 percent of all wage and salary jobs created between 2000 and 2010 will be in health services. Most of the increase will not be in hospitals, but in other settings. Because of the increasing percentage of older people in our population, many health care professionals will work in home health care, assisted living facilities, and in nursing homes. The expansion of opportunities is also related to the fact that more conditions are treatable.

Moreover, there is financial pressure on hospitals to release patients as soon as possible and to perform medical services on an outpatient basis. This increases the need for nurses specializing in home health care. Many of the procedures that once were done in hospitals are now done in HMOs and surgicenters, increasing the opportunities for nurses and other health care professionals in such settings. The rapid development of telemedicine is putting some nurses in autonomous positionssupervising projects.

6. Comment, social organization of health care

The social organization of health care and its delivery is not a technical issue. Technological developments (accurate CT scans, PET scans, microprocessors embedded in prosthetic limbs, etc.) make more effective health care a possibility; however, they do not make it a reality. The prices of the new technology (e.g., $25,000 for a wheelchair that climbs stairs) put it out of reach of the vast majority of people. Today fewer people have jobs that offer health insurance. In HMOs, medical decisions may be made on business, not medical, grounds. Furthermore, treatments and devices judged experimental are not covered. The continued development of expensive state of the art equipment may complement the current spate of hospital mergers and the centralization of health care organizations. On the other hand, some developments like telemedicine make the use of this equipment (if insurance companies will cover it) available to more people in more places than ever before. Moreover, medical information is available via the Internetbut only to those with a computer and an Internet connectionaccentuating social and economic differences. The same can be said of the incredible prosthetic devices becoming available to those with the money or insurance to pay for them.