Technology in Medicine

Computers in health care

• Medical information systems-patient records, diagnostics, expert or decision support systems and therapies.
  • Improving all aspects of health care
• Administrative applications
  • Office management systems/scheduling and accounting; *physician offices use for scheduling and accounting
• **Clinical and special purpose systems like computerized charting
Technology in Medicine

- Technology in the Clinical Setting:
  - Electronic Medical Record
  - Mobile Medical Records

Special Purpose Systems: **Example of this is coding systems created to standardized medical diagnosis and terminology. They are used for medical insurance claims.**
Standard coding systems are used for reimbursement of expenses; examples include DRG or diagnostic related groups. This classification determines how much money will be reimbursed. These coding systems standardize medical insurance claims.
Other Applications

- Computer-assisted surgery
- Prosthetics
- Pharmacy: e-prescribing—use of computers and software to enter prescriptions and send them to pharmacies electronically
Computer in Healthcare

- If someone wanted to work as an insurance clerk, what class would BEST prepare her for the technology of the job? **Computerized billing**

- Someone who is interested in a career in medical informatics should enjoy working with **computers.**
Computer-assisted surgery

- Computer-assisting surgical planning
- Robotics

Minimally invasive surgery
  - endoscopic surgery
  - laparoscopic surgery
Computer-Assisted Surgery

Computer-Assisted Surgery: involves the use of virtual environment technology to provide surgeon with realistic accurate models on which to teach surgery and to plan practice operations. With virtual reality tech, the computer can create an environment that seems real, but is not.
Robotics

- For example; plastic surgeons can practice on a model of a face and see the results of their work.

- Robotics: robots are used under the control of software and the surgeon. Through a combo of hardware and software, a robot may be able to “see” via video devices, and to “hear” through microphones using speech recognition software.
Robots, unlike humans, can hold endoscopes and other instruments without becoming tired or shaky. Robots are also used to scale down the surgeon’s motions. Some surgeons report that this makes their hands “rock steady,” making surgery on small delicate areas such as the eye safer.
Feedback mechanisms allow the robot to determine the proper pressure and tension needed to manipulate a particular object. Robots are able to compare tissue density and thus "decide" whether tissue is normal or a tumor by remembering its "pressure signature."
Robotics/Minimally Invasive Surgery

Currently, robotics and minimally invasive surgery are being used in complex surgeries. New computer-controlled systems are making it possible to perform trauma surgery (such as femoral fracture fixation) through quarter inch incisions; one such system has received FDA clearance.
Minimally Invasive Surgery

- Utilizes an endoscope or a laparoscope, performs procedures through small incisions that involve a minimum of damage to healthy tissue. Some laparoscopic surgeries involve electronic cutting tools, posing some risk for the patient. Still, there is less bleeding, pain and shorter recovery time.
Youtube Video

http://www.youtube.com/watch?v=HFrZFFBCaItU
Prosthetic Devices

- **Myoelectric limbs** - The myoelectric hand prosthesis is an alternative to conventional hook prostheses for patients with traumatic or congenital absence of forearm(s) and hand(s). These prostheses have a stronger pinch force, better grip, and are more flexible and easier to use than conventional hooks.
Microprocessors- This is an internal computer or microprocessor that controls an internal fluid, either hydraulic, pneumatic, or magnetorheologic fluid. This internal computer monitors each step in a gait cycle.

Computer technology for vision and hearing
Cameron Clapp competes at the 2005 Endeavor Games with the help of C-Leg prosthetic devices. Microprocessors in the knee guide a hydraulic system that influences each step.
Prosthetics

http://www.youtube.com/watch?v=T6R5bm6qx2E
The Computerized Pharmacy

- Computers and drug errors
- The automated community pharmacy
- Hospital pharmacy robot and bar-codes
- Point-of-use drug dispensing—a small computer attached to a large cabinet sits at the nursing unit.
Pharmacy

- 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 computer keeps track of all transactions.
Radiology and Digital Imaging

- X-rays
  - Traditional vs. digital x-ray
  - Mammography

- Ultrasound

- Digital imaging
  - Computerized tomography
  - Magnetic resonance imaging
  - Positron emission tomography
Traditional Xray

Definition: Beams of xrays, produced by an xray generator, transmitted through an object; ex: the part of the body to be scanned. The xrays are absorbed by the material they pass through in differentiating amounts, depending on the density and composition of the material. *Most likely used if a broken bone is suspected.
For example; bones absorb x-rays relatively well, while soft tissue such as muscle fiber, which has a lower density than bone, absorbs fewer x-rays. This results in a picture where the bones are white and tissue appears darker. This makes traditional x-rays suitable for scans of bones and tissues dense in calcium, such as bone/teeth.
Traditional x-ray
Mammogram
Mammogram

- Mammograms are done via traditional xray. If an abnormality is spotted on the xray, then additional testing may be done via Ultrasound techniques or guided biopsies.
Digital Xray

Definition: Computer technology, whereby radiographs are seen immediately after exposure on the computer screen; no developing or waiting is necessary. They can be magnified, colorized and have their density manipulated for greater information. Certain areas of the xray can be emphasized or enlarged.
Digital Xray
Ultrasound

Definition: Sound or other vibrations having an ultrasonic frequency; particularly as used in medical imaging.
Ultrasound
Ultrasound
CT Scan

- Definition: computerized axial tomography, uses xray technology to take multiple cross-sectional views of the inside of the body. Compared to regular xrays, a CT scan can take clearer images of organs, bone, soft tissue, blood vessels and other areas of the body.
CT Scan
CT scan
MRI

Definition: Magnetic resonance imaging; a technique that uses a magnetic field and radio waves to create detailed images of the organs and tissues within your body. Also can be used to produce 3D images that may be viewed from many different angles. Produces high resolution image that help diagnose a variety of problems.
MRI
So? What’s the difference between a CT scan and MRI?

- A CT scan and an MRI operate differently and are better suited for different types of diagnoses. An MRI, suited for examining soft tissue (ligament and tendon injury, spinal cord injury, brain tumors, etc.) while a CT scan is better suited for bone injuries, lung and chest imaging and detecting cancers.
Difference between CT scan and MRI

- CT scans are routinely used in ED due to length of time procedure takes=5 minutes versus MRI=30 minutes. MRI does not use radiation, CT scans do. MRI’s are more expensive than CT scans.
Definition: A nuclear medicine imaging technique which produces a three-dimensional image or picture of functional process in the body. Examines the chemical activity in certain parts of your body, which may help detect abnormalities in those areas.
When do you get a PET scan?

- Most often used in people who have heart disease, cancer or brain disorders. For example, cancer cells show up as brighter spots on PET scans because they have a higher metabolism rate than normal cells. Can determine if cancer is spreading, is treatment working, if cancer has recurred.
Positron Emission Tomography (PET)
Bloodless surgery

- Interventional radiology
- Stereotactic radiosurgery
- Focused ultrasound surgery
Interventional Radiology

Definition: Medical subspecialty of radiology which utilizes minimally-invasive image-guided procedures to diagnose and treat diseases. Minimizes the risk to patients and improves outcomes. Some examples include angiography, breast biopsy and feeding tube placement.
Interventional radiology
Stereotactic Radiosurgery

Definition: Form of radiation therapy that focuses high-powered xrays on a small area of the body. Better targets the abnormal area. It is a treatment and not a surgical procedure. Often used to slow down the growth of small, deep brain tumors that are hard to remove during surgery.
Stereotactic radiosurgery is the very precise delivery of radiation to a brain tumor with sparing of the surrounding normal brain.
Focused Ultrasound Surgery

- Focused Ultrasound Surgery is a non-invasive outpatient, surgical procedure that uses high intensity focused ultrasound waves to destroy tissue in combination with Magnetic Resonance Imaging which guides and monitors the treatment.
Telemedicine

- **Definition:** “The use of computers, the Internet, and other communication technologies to provide medical care to patients at a distance.”

- **Forms:**
  - Voice
  - Data
  - Still images
  - Motion picture
Telemedicine

- Includes:
  - Diagnoses
  - Patient monitoring
  - Treatments
Telemedicine

- Telehealth:
  - Larger field that includes health-related education
  - Public health research
  - Health services administration
Telemedicine

Advantages:
- Brings high quality medical care to anyone regardless of distance
- Decreases patient wait time
- Decreases patient travel time
Telemedicine

- Teleradiology: Oldest form of telemedicine using computers and telecommunications.
- Interactive video conferencing: Conferencing that allows medical professionals and patients to consult in real-time, using telephones and video screens.
Telemedicine

- **Telepathology**: Transmission of microscopic images over telecommunications lines allowing the pathologist to view images on a monitor instead of under a microscope.
- **Telepsychiatry**: Uses teleconferencing to deliver psychotherapy. May not be suitable for some types of mental illness.
Telemedicine

- Remote monitoring devices
  - Telespironometry-
    - used for asthma patients
    - information transmitted over telephone lines to remote location
  - Arrhythmia monitoring
    - ECG telemetry that monitors a patient’s cardiac status and sends it to a remote location
Effectiveness of Telemedicine

- Examining a patient at a distance is not the same as examining that patient face to face.
- In prisons, telemedicine has led to decreased costs and improved health care for inmates.
Effectiveness of Telemedicine

- Medical assistants at the remote sites may be useful
- Small hospitals and clinics may find hardware costs prohibitive
- Research studies generally favorable for medical and cost effectiveness
Use of Telemedicine

- Health care to the elderly (homebound)
- Connect rural primary care physicians to urban specialists
- Allow families of high-risk newborns to watch babies’ hospital care from home
- Data can be transmitted from ambulance to ER
- Patients with chronic illnesses can receive medication reminders at home
Issues in Telemedicine

- Technical issues
  - appropriate telecommunications infrastructure must be in place
  - not available in some rural and urban areas
  - requires high bandwidth (cable modem)
Issues in Telemedicine

- Insurance issues
  - insurance may not cover all telemedicine

- Legal issues
  - licensing laws differ in each state
  - liability is not clear

- Privacy issues
  - electronic medical record subject to misuse
  - HIPPA (Health Insurance Portability and Accountability Act of 1996)
Bell Ringer for Monday

- If you have been out of the nursing field for more than 10 years, you may have to receive training in what technology?
Bell Ringer for Tuesday

- What type of patient would benefit from a computerized prosthetic device?
Bell Ringer for Wednesday

- What can be done with a digital x-ray that cannot be done with a traditional x-ray?
Bell Ringer for Thursday

- Telepsychiatry......
  - Replaces traditional psychoanalysis
  - Is most useful for mental patients with aggressive behavior who may pose a physical threat
  - Is best used with patient who are schizophrenic or having hallucinations
  - Can be used in special circumstances but does not replace face-to-face counseling