Computers in Medical Education

Roles of computers in medical education

- Provide facts and information
- Teach strategies for applying knowledge appropriately in medical situations
- Encourage the development of lifelong learning skills

Goals

- Students must learn about physiological processes
- Must understand the relationship between observed illnesses and underlying processes
- Must learn to perform medical procedures
- Must understand the effects of interventions on health outcomes

Basic curriculum

- Premedical requirements
- Medical school
  - Basic
    - Physiology
    - Pathophysiology
  - Clinical
- Residency
- CME

Teaching strategies

- Lecture
- Interactive
  - Classroom
    - Socratic
    - Problem based learning
  - Bedside
    - See one, do one, teach one
    - Explicit teaching

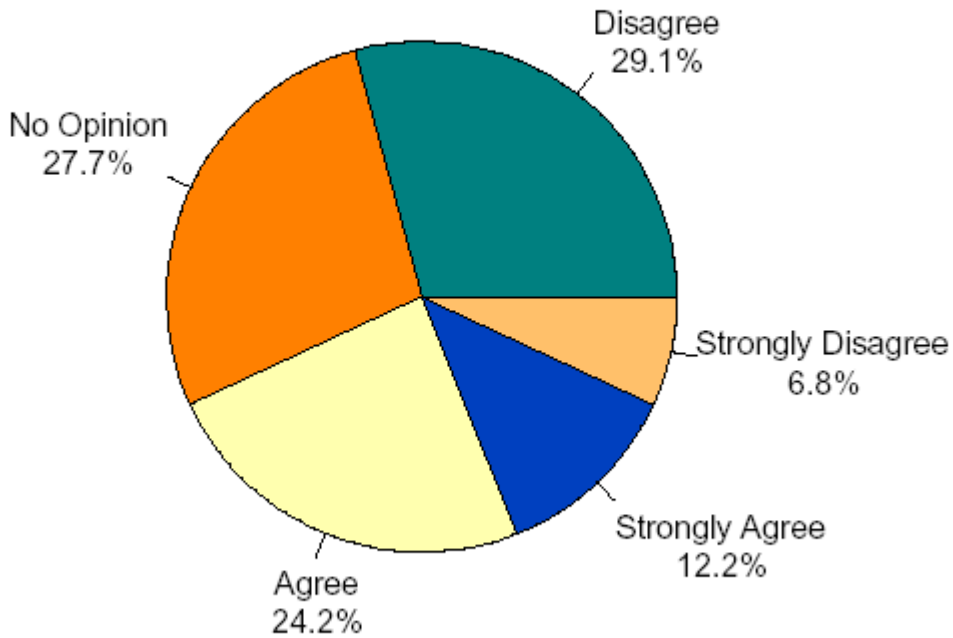
Process

- Presentation of a situation or body of facts containing core knowledge
- Explanation of important concepts and relationships
- How does one derive the concepts
- Why they are important
- Strategy for guiding interaction with the patient

Weaknesses of traditional approach

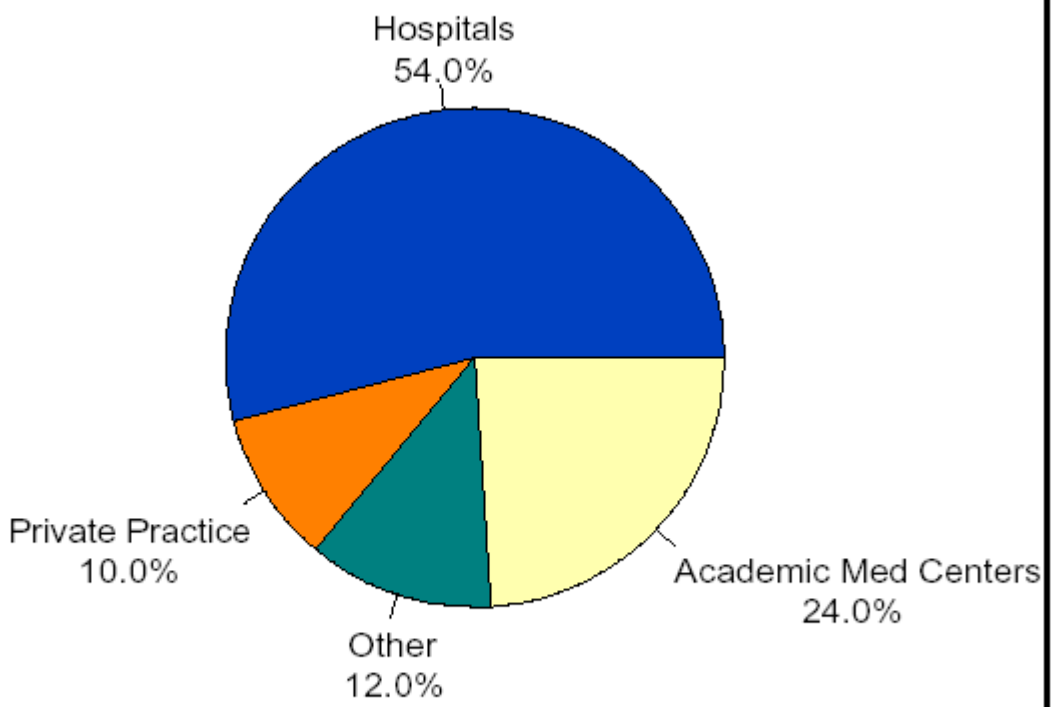
- Rapid knowledge growth
- Reliance on memorization rather than problem solving
- Reliance on lecture method
  - Passive recipients vs active

Figure 1: Are Graduating Medical Students' confident about Using a Variety of Forms of Telemedicine



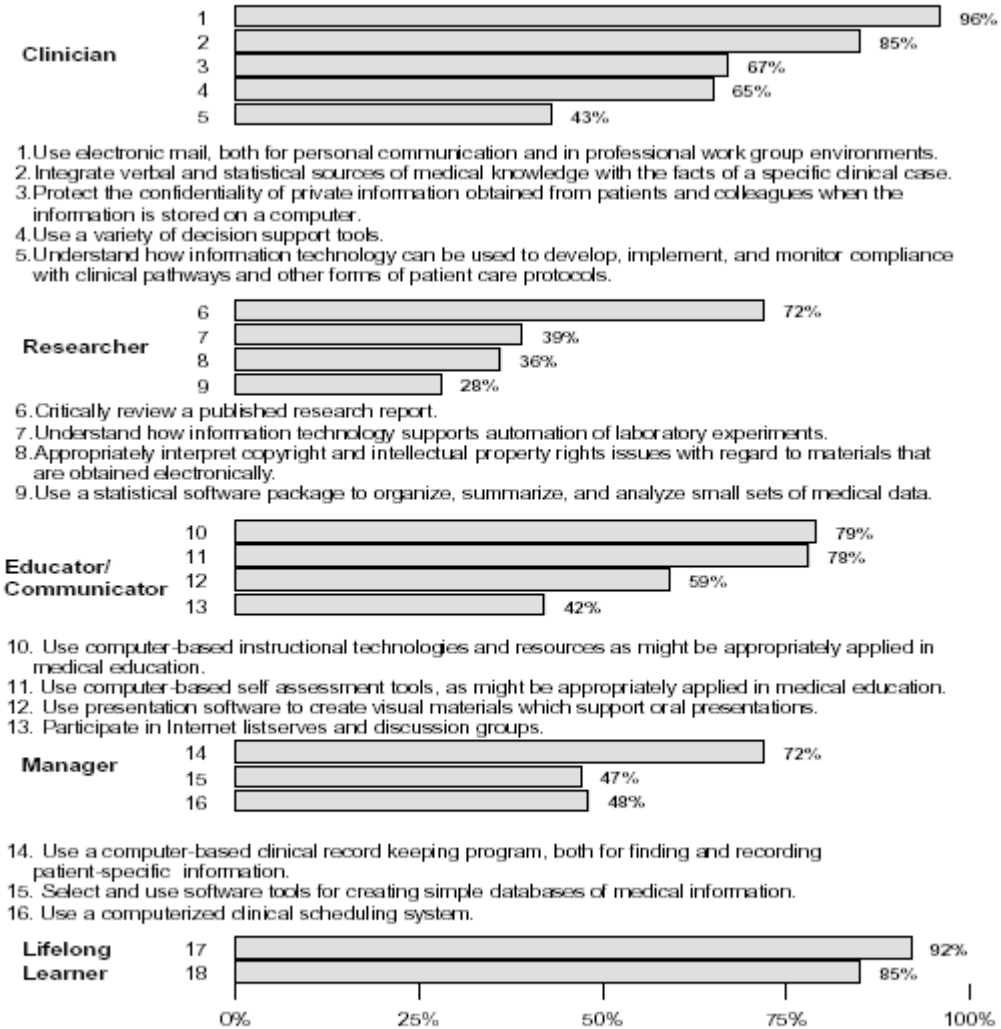
AAMC Medical School Graduation Questionnaire (2000)

Figure 2: Where Telemedicine Users Work



Trends in Telmedicine: Competing in a Converging Market

Figure 1. Percentages of 1999 Medical Schools Graduates who Agreed or Strongly Agreed that They Have the Following Knowledge and Skills



1. Use electronic mail, both for personal communication and in professional work group environments.
2. Integrate verbal and statistical sources of medical knowledge with the facts of a specific clinical case.
3. Protect the confidentiality of private information obtained from patients and colleagues when the information is stored on a computer.
4. Use a variety of decision support tools.
5. Understand how information technology can be used to develop, implement, and monitor compliance with clinical pathways and other forms of patient care protocols.
6. Critically review a published research report.
7. Understand how information technology supports automation of laboratory experiments.
8. Appropriately interpret copyright and intellectual property rights issues with regard to materials that are obtained electronically.
9. Use a statistical software package to organize, summarize, and analyze small sets of medical data.
10. Use computer-based instructional technologies and resources as might be appropriately applied in medical education.
11. Use computer-based self assessment tools, as might be appropriately applied in medical education.
12. Use presentation software to create visual materials which support oral presentations.
13. Participate in Internet listserves and discussion groups.
14. Use a computer-based clinical record keeping program, both for finding and recording patient-specific information.
15. Select and use software tools for creating simple databases of medical information.
16. Use a computerized clinical scheduling system.
17. Carry out reasonably sophisticated searches of medical information databases.
18. Use the World Wide Web to locate and acquire information on consumer health, patient education, medical research, and health care policy issues.

Source: 1999 AAMC Medical School Graduation Questionnaire.

Terms

- Computer assisted learning
- Computer based education
- Computer assisted instruction

Advantages of computers in medical education

- Computer can augment, enhance or replace traditional teaching methods
  - Rapid access to body of information
    - Data
    - Images
    - Immersive interfaces
  - Any time, any place, any pace
  - Simulated clinical situation

Advantages

- Interactive learning
  - Active vs. passive solving
- Immediate student specific feedback
  - Correct vs. incorrect, tailored response
- Tailored instruction
  - Focus on areas of weakness
  - Request help in interpretation

Advantages

- Objective testing
  - Permits standardized testing
  - Self-evaluation
- Fun!

Experimentation

- Safe exploration of what-if in a well done scenario
  - You can do things with simulated patients you can't do with real ones

Case variety

- The ability to experience disease scenarios one otherwise wouldn't see
  - Simple: diabetes
  - Complex: multiple disease, multiple medications

Time

- Manage diseases as they evolve over time
  - Rapidly evolving problems
  - Chronic diseases

Problem-solving competency

- Book smart vs. real-world
- Memorization vs. thinking
- Testing
- Right answer vs. cost-effective vs. safest vs.quickest (fewest steps)

Board examinations

- USMLE test
- CME testing

History of CAI

- Pioneering research in the 1960's
  - Ohio State
    - Tutorial evaluation system
      - Constructed choice, T/F, multiple choice, matching or ranking questions
      - Immediate response evaluation
      - Positive feedback
      - Corrective rerouting
    - Authoring language

History

- Barnett MGH 1970
  - Simulated patient encounters
    - 30 simulated cases
  - Mathematical modeling of physiology
    - Warfarin, insulin, Marshall
  - Dxplain

History

- University of Illinois
  - Computer aided simulation of the patient encounter
    - Computer as patient
    - Natural language encounter

COMPUTER: Il's a Tuesday morning, the middle of a cold !anuary. You have seen three palicnls in the clinic and now a rounh person is waiting for you in your office. Tht woman---middle-aged, while, brown hair---is sitting at the side of your desk as you open the door. Her features seem wom. and she is slightly underweight. She looks up and smiles at you with a minimum of enthusiasm and effort.

STUDENT: What brings you to see me?

COMPUTER: Well. I'm just tired all the Lime. I don't ever feel like I'm rested and all my energy is gone.

STUDENT: How long has this been going on?

COMPUTER: About six months ago I started reeling tired all the lime. I finnally felt like I had to do something about it.

STUDENT: What did you do?

COMPUTER: Are you still talking about my being tired?

STUDENT: Yes.

COMPUTER: Well, I've been taking vitamins. but they don't seem to help. Maybe you can give me something stronger.

History

- Illinois 1970's
  - Programmed logic for automated teaching (PLATO)
    - Plasma display (required specialized equipment)
    - Combination of text, graphics and photos
  - TUTOR authoring language

History

- University of Wisconsin
  - Used simulated case scenarios and estimated the efficiency of the student in arriving at a diagnosis (cost-effectiveness)

History

- Initial installations site limited
- Subsequent modem dial-up
- Proliferation of medical CAI, CME development entities
- Development of the internet
  - Initial material bandwidth limited
  - Increasing use of streaming video

Modes of CAI

- Drill and practice
  - Material presented with immediate testing
  - Grading and progress or loop back
  - Poor students benefit
- Didactic
  - Lecture with the advantage of time and place independence
  - No questions
  - Howard Hughes Institute
  - Penn site

Modes

- Discrimination learning
  - Many clinical situations require practitioner to differentiate between different clinical manifestations
    - 3 days cough and fever
    - Red rash
  - Computer can help the student learn to recognize subtle differences

Modes

- Exploration vs. structures interaction
  - Hyperlink analogy
  - Requires feedback/guidance

Modes

- Constrained vs. unconstrained response
  - Student may have a pre-selected set of possible response (learn to answer questions)
  - Student may be able to probe system using natural language

Modes

- Constructive
  - Put the body together from pieces of anatomy

Simulation

- Static vs. dynamic

Static simulation

THE PATIENT IS A 56 YEAR-OLD MALE.

HE CAME TO THE EMERGENC(DEPARTMENT BECAUSE OF MODERATE EPI GASTRIC PAIN THAT STARTED OVER A MONTH AGO.

You may now examine your patient.

Item Number: 100 CHARACTER OF PAIN-BURNING

Item Number: 102 HOW LONG DO THE PAINS LAST?-MOST OF THE TIME. OCCA - SIGNALLY EASES

Item Number: 103 HAVE YOU EVER BEFORE HAD THIS KIND OF pAIN?--SEVERAL

YEARS AGO

Item Number: 107 VOMITING--YES

Item Number: 108 FEVER--NONE

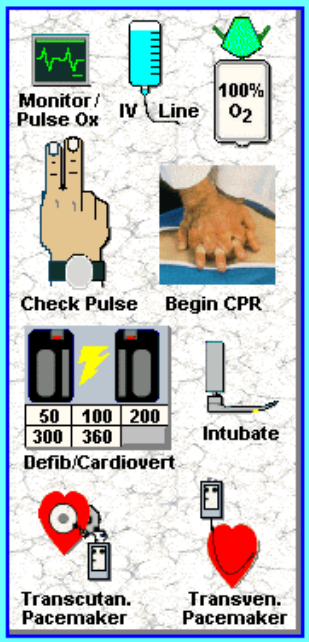
Dynamic simulation

NetMedicine ACLS Megacode Simulator

This simulator is Netscape enhanced. For best results, use Netscape 1.1 or higher.

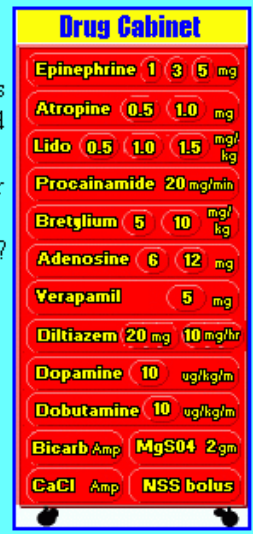
Read the case below and then select an intervention from either of the tool bars by simply clicking on it with your mouse. When selecting a drug, be sure to click on the proper dose.

Objectives for this Learning Module



The patient is a 67 year old male who presents complaining of lightheadedness of two hours duration. His wife states that he lost consciousness for about 30 seconds. He denies having any chest pain. His past medical history is significant for mild hypertension and diet-controlled diabetes. His only medication is hydrochlorothiazide. He is pale and diaphoretic on initial examination. His vital signs are below. The remainder of his exam is unremarkable except for mild jugulovenous distention and slight crackles at both lung bases. What would you like to do for this man?

Pulse: 35 and regular
BP: 100/60
RR: 16
Temp: 97.8



Feedback and guidance

- Feedback
  - Correct vs. incorrect
  - Summaries
  - References
- Guidance
  - Tailored feedback
  - Hints
  - Interactive help

Intelligent tutoring

- Sophisticated systems can
  - Intervene if a student goes down an unproductive path
  - Gets stuck
  - Appears to misunderstand a detail
  - Mixed initiative systems
  - Coaching vs. tutoring

Graphics and Video

- Storage of images, video etc as part of a multimedia stream
  - General appearance
  - Skin lesions
  - Xrays
  - Sounds (cardiology, breath sounds)

Authoring systems

- Generic authoring systems
  - McGraw Hill, Boeing
  - Simple (constraints) vs. comprehensive (difficult to master)

Examples

- USMLE
- Lister Hill
- Stanford anatomy
- Digital anatomy
- Penn curriculum
- Medical matrix

Continuing medical education

- Echo
- PAC
- CME

Simulators

- ACLS
- Visible human
- Eye simulator
- Other simulators

Future

- Forces for change
- Impediments
  - Cost
  - Immaturity of authoring tools
  - Bandwidth
  - Barriers to sharing
    - Institutional jealousy
    - Copyright

Future

- Lack of standard approach
  - Authoring software
  - Platform
- Explicit integration of CAI into curriculum
- Access to PC's and LAN