The Reliability and Validity of Simulation-Based Assessments

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Purpose

- To provide
  - examples of where simulations are currently used for assessment and evaluation (e.g., certification/licensure)
    - Types of simulations
  - a synopsis of some of the unique challenges of using simulations for assessment and evaluation
    - Psychometrics (reliability, validity)
  - Future directions

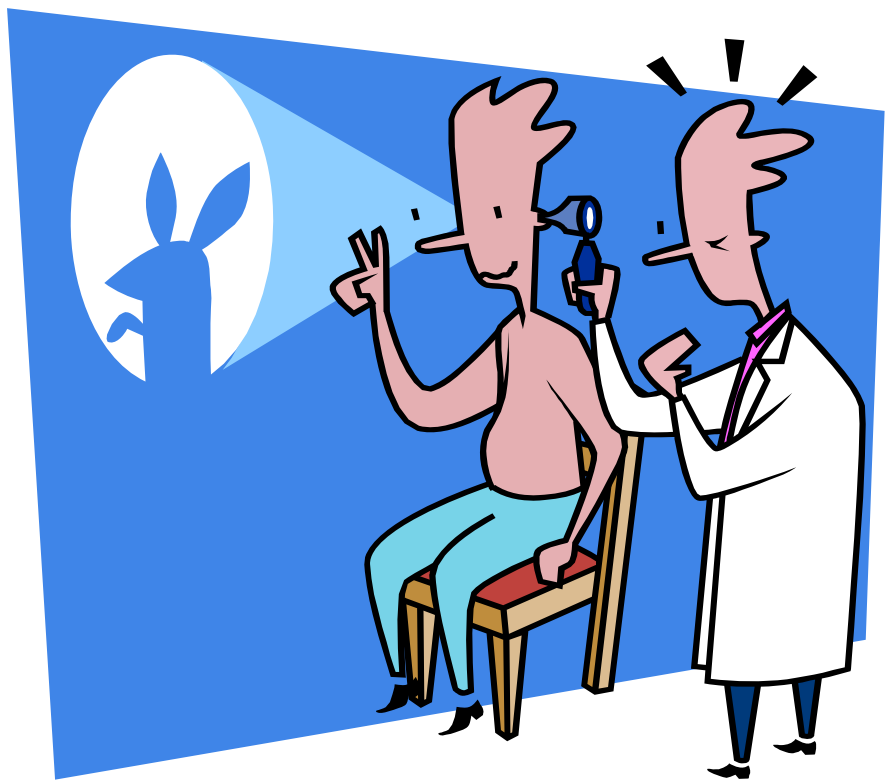
Assessment Simulations in Medicine

- United States Medical Licensing Examination (USMLE™)
  - Step 2 CS (ECFMG Clinical Skills Assessment)
  - Step 3
- National Board of Osteopathic Medical Examiners
- Medical Council of Canada
- General Medical Council (UK)
  - Professional Linguistics and Assessment Board
- Various specialty board examinations
  - American Board of Emergency Medicine
- etc.

- Dillon, G.F., Boulet, J.R., Hawkins, R.E. & Swanson, D.B. (2004). Simulations in the United States Medical Licensing Examination™(USMLE™). Quality & Safety in Health Care, 13(Suppl 1), i41-i45.

Types of Simulations

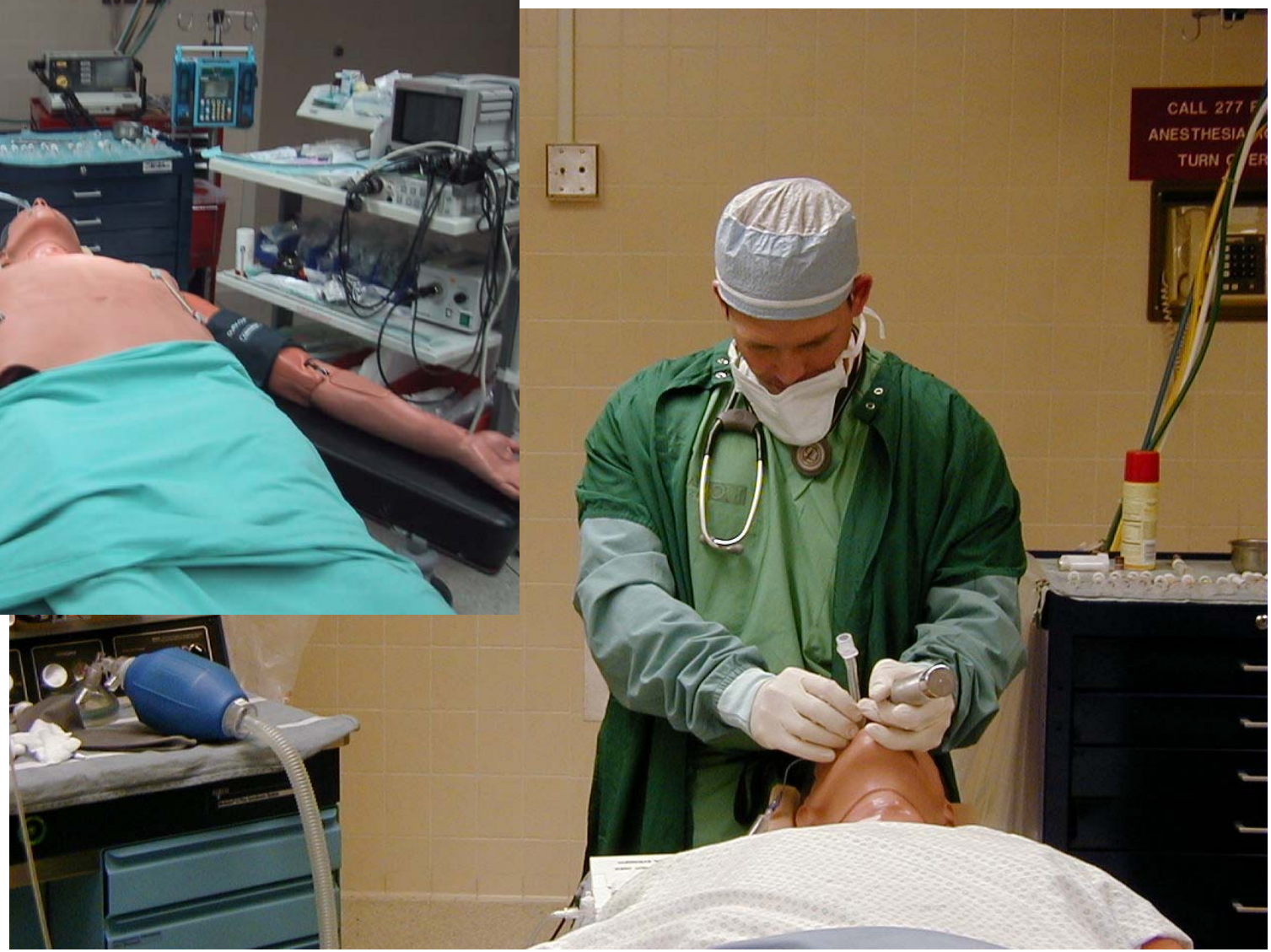
- Paper-based patient management problems
- Computer-based clinical scenarios
- Part-task trainers
- **Electromechanical mannequins**
- **Standardized (simulated) patients**



Electromechanical Mannequins

- Life-sized simulators with realistic airway and cardiovascular attributes
  - real-time responses to therapeutic interventions
  - can model rare events
  - errors are ‘reversible’
- Provide a standardized high-fidelity simulated environment to train and evaluate students/residents

Electromechanical Mannequins

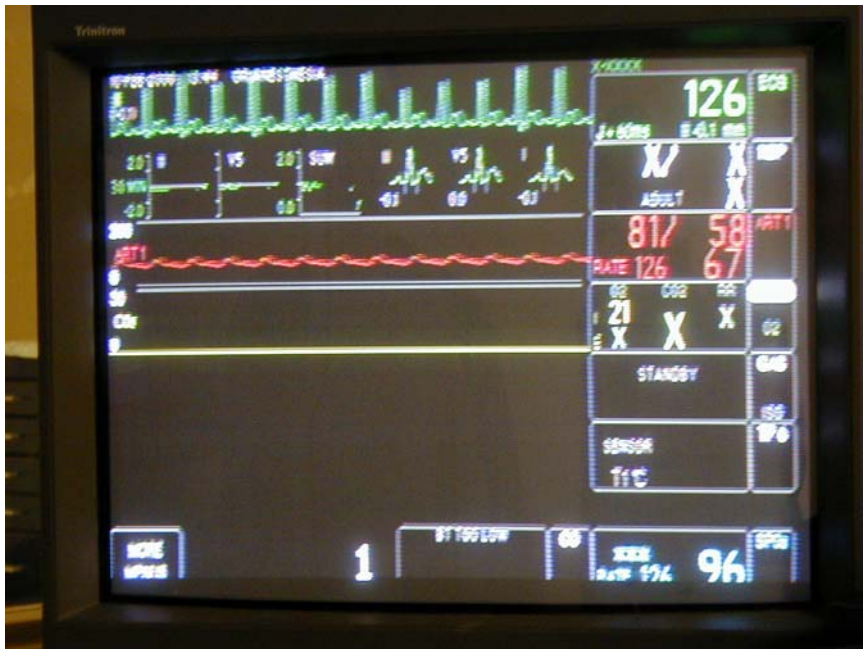


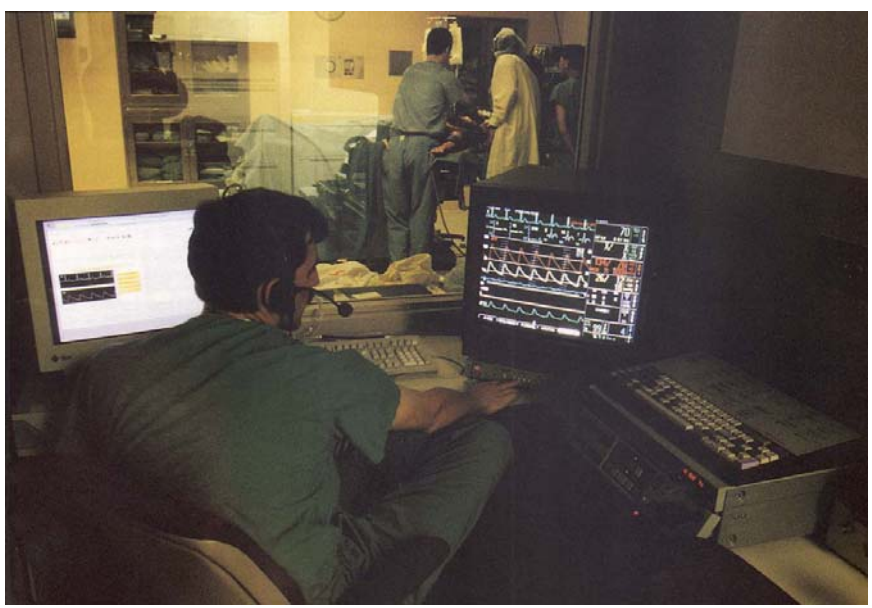
Standardized (Simulated) Patient Examinations

- Performance-based
- "Standardized"
  - Same conditions for all test takers
- Series of interactions in simulated encounters
- Numerous scoring options
  - Explicit process
  - Implicit process

Why Use Simulation for Assessment and Evaluation?

- Model “real” situations
- “standardization”
  - Variability of “real” patients
  - Introduce complexity in controlled way
- Many events are rare
- Errors not reversible
- Errors are expensive
- Patient safety



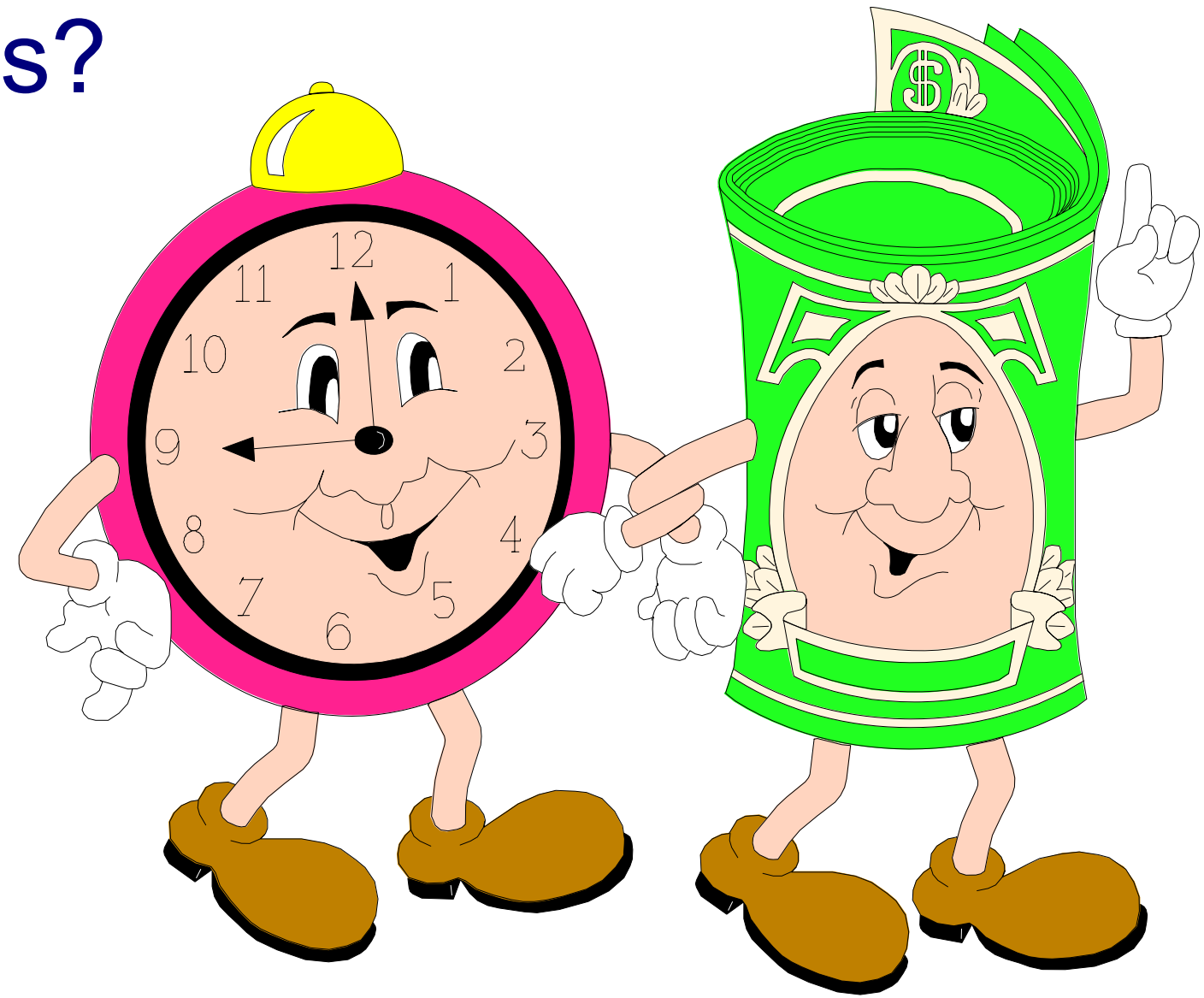


Patient Safety

Challenges

- Cost
- Logistics
- Interdisciplinary cooperation
- Integration
- Measurement Issues
  - Scoring
  - Generalizability/ Reliability
  - Validity

What is the Societal Cost of Having Providers with Inadequate Skills?

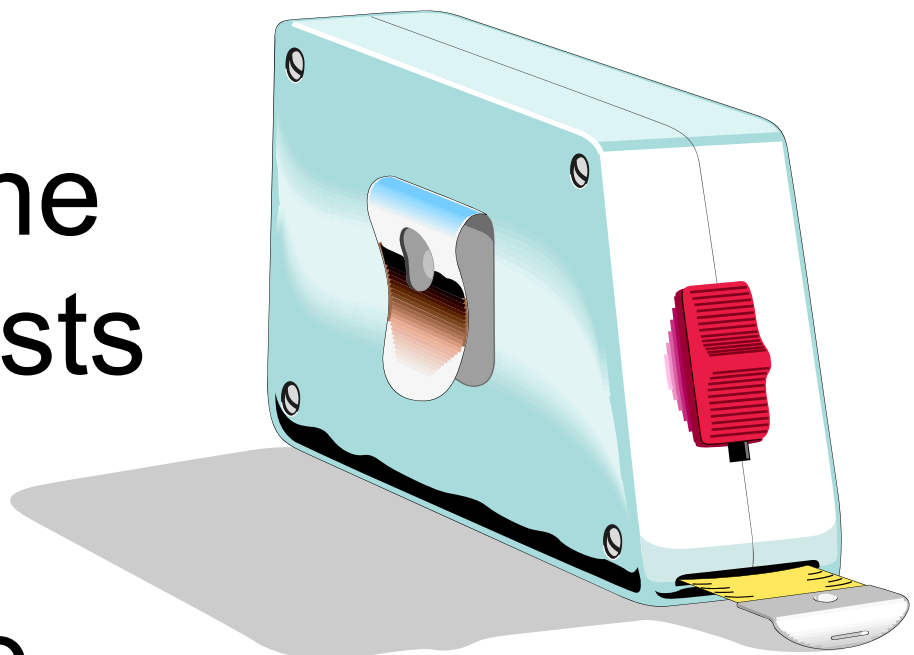


Logistics

Cooperation/ Teamwork

Key Measurement Issues

- Evaluation (scoring) of the performance
- Generalization of the results to similar tests
  - reliability
- Extrapolation of the assessment results
  - validity



Types of Scores

- Explicit Process
  - Checklists
  - Key actions
- Implicit Process
  - Rating scales
    - Timing
    - Sequencing

Intraoperative Asthma Episode

- Review Vital Signs
- (Key)Increase $FI0_2$ to 100 %
- Increase Anesthesia Depth after Increase Fi02
- Establish Lung Compliance is Increased by Hand Ventilation
- (Key) Auscultate Chest
- (Key)Diagnose Presence of Bilateral Wheezing
- Above Steps in Less than 60 seconds
- Pass Suction Catheter Through Endotracheal Tube
- (Key)Begin Nebulizer Therapy (Any B-agonist or Combined Atrovent)
- Corticosteroid IV
- Beta-Agonist IV
- Suggest Arterial Blood Gas
- Order Chest X-ray

Checklist for “Atypical Pneumonia” Standardized Patient Case

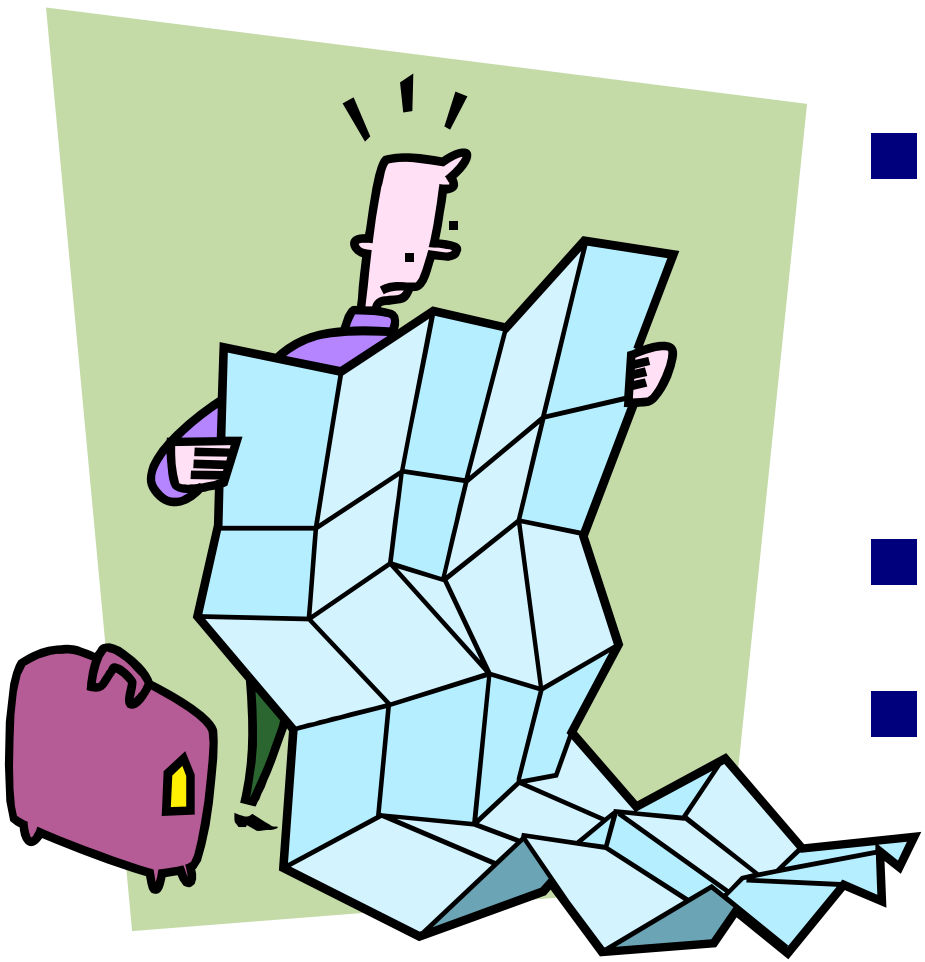
- Muscle or body aches
- Fever, chill, sweats
- Pain when taking a deep breath
- Medications
- Vomiting, diarrhea
- Etc.

- Examines throat
- Palpates for anterior cervical lymph nodes
- Flexes neck
- Etc.

Advantages and Disadvantages of Checklists

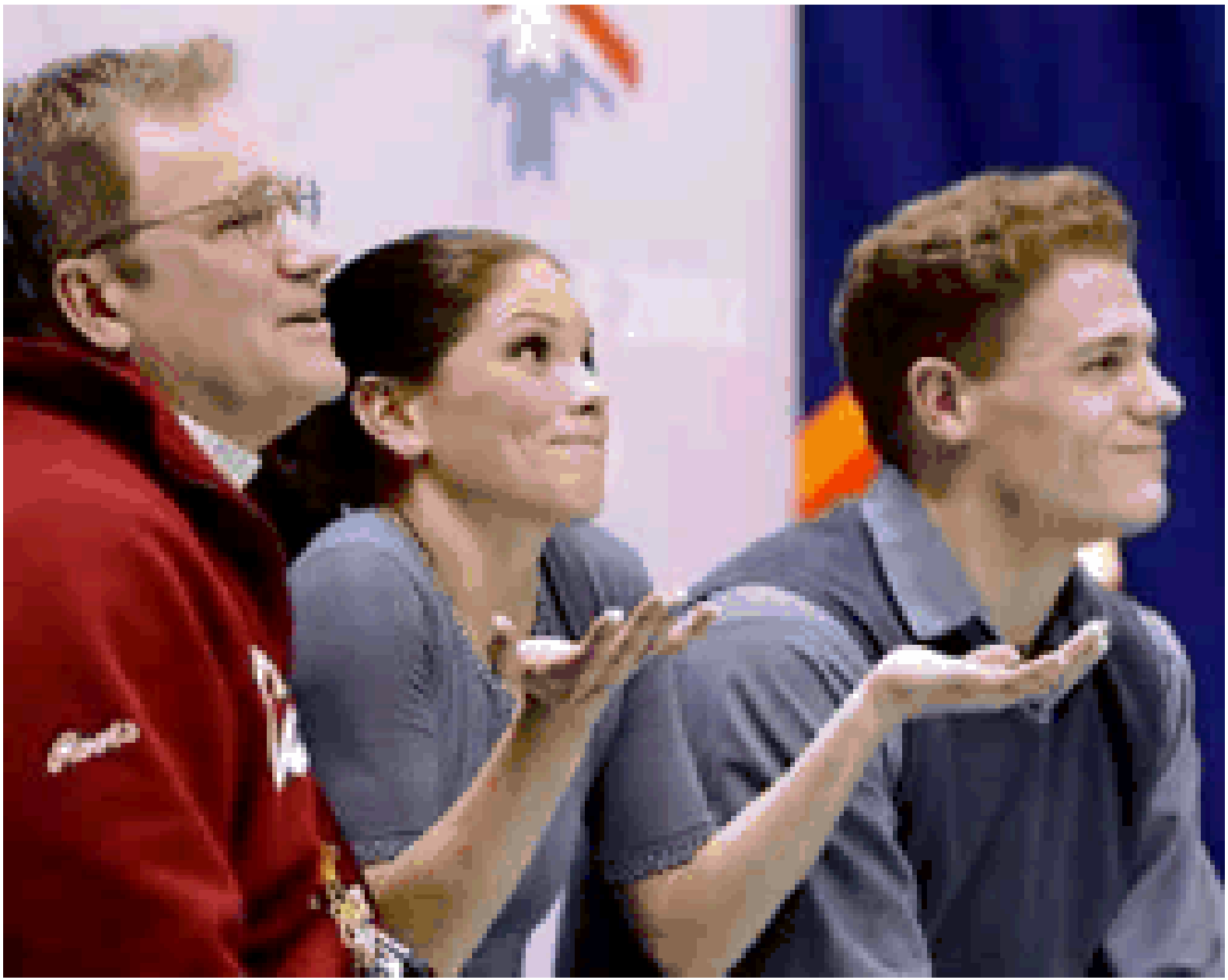
- Fairly easy to develop
- “Objective”
- Record of what was done (feedback)
- Can be used by non-physicians
- Students perceive that they are being evaluated by patients
- Difficult to assess complex skill sets

Checklists for Assessing Acute Care Skills



- Certain actions are much more important than others
- Sequence is important
- Timing is important

Holistic (“Expert”) Ratings



Patient Note Exercise

ECFMG CSA USMLE Step 2 CS

PN Number

Test Date | Session Number | Room Number
Candidate | Candidate Number
Rater ID | Encounter Number

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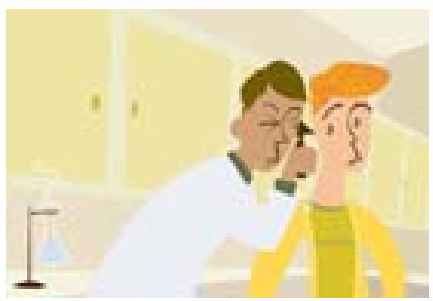
HISTORY - Include significant positives and negatives from history of present illness, past medical history, review of system(s), social history and family history.

PHYSICAL EXAMINATION - Indicate only pertinent positive and negative findings related to patient's chief complaint.

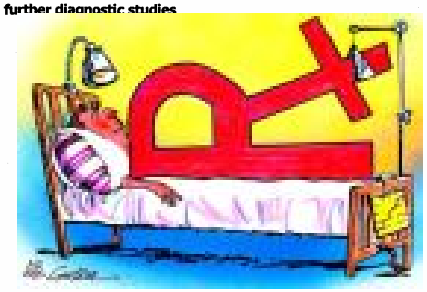


DIFFERENTIAL DIAGNOSIS - In order of likelihood write no more than 5 differential diagnoses for this patient's current problems.

1.
2.
3.
4.
5.

DIAGNOSTIC WORK UP - Immediate plans for no more than 5 further diagnostic studies

1.
2.
3.
4.
5.



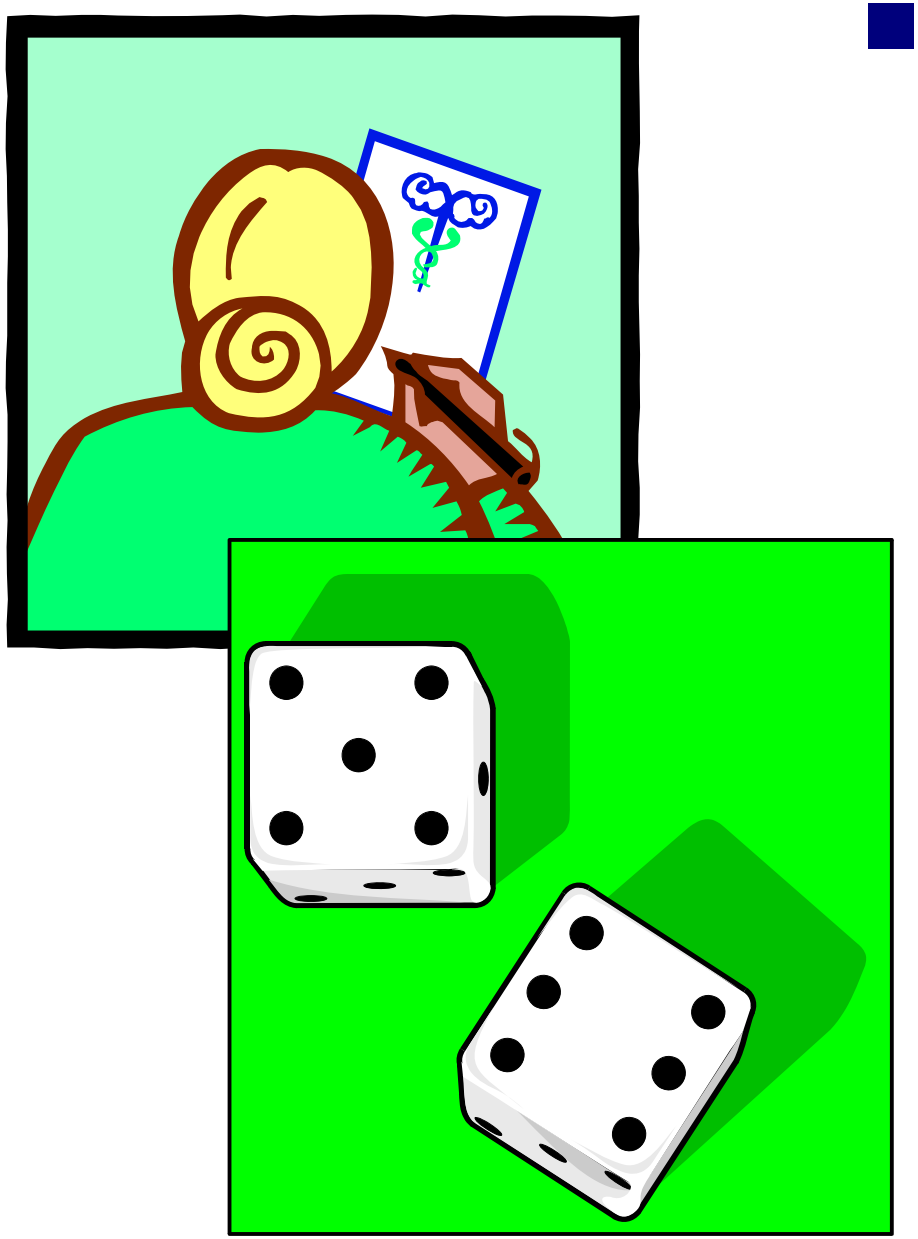
Advantages and Disadvantages of Global Ratings

- Rely on expert judgment
- Can consider many factors related to performance
  - Egregious actions
- Medical students/ residents prefer to be evaluated by their peers
- Need “experts”
- Some evaluators may not be objective

Who Should Provide the Scores?

- Expert (physician, nurse, etc.) examiners
  - "face" validity
  - Expertise
    - Practice of medicine is complex
  - Perceived subjectivity
- Other 'observers'
  - Objective
  - First-hand understanding of skill being measured
  - Economical/ efficient

Reliability



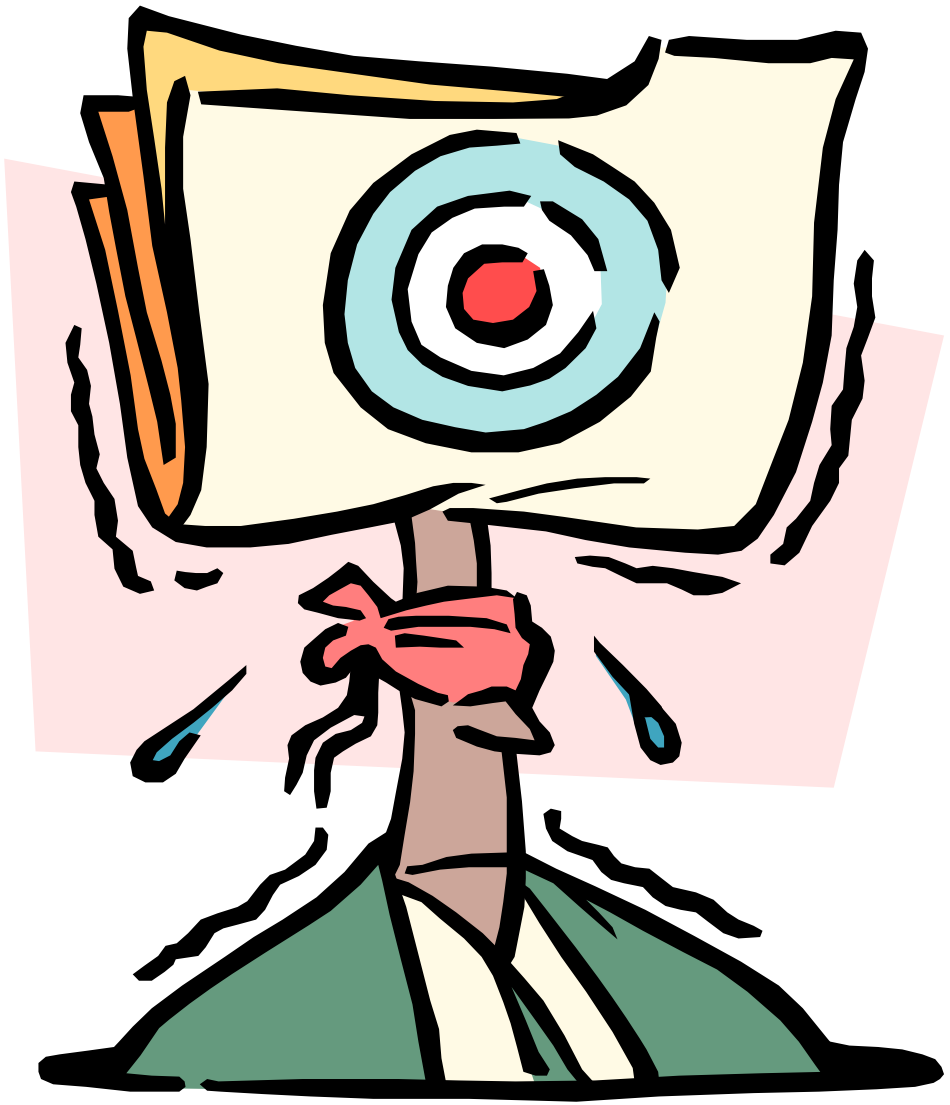
- **How consistent are the examinee/trainee scores?**
  - want to ensure that an examinee's observed score is a reasonable reflection of his/her "true" ability
  - minimize errors of measurement

Sampling Perspective

	Judge 1	Judge 2	Judge 3	…	Judge n
Case 1	A B C	A	A	A	A
Case 2	B	C			
Case 3	B		C		
…	B			C	
Case n	B				C

Enhancing Precision

- Choice and number of tasks
  - Task specificity
- Raters
- Settings
- Administration conditions
- etc.



Lessons from the Literature

- **There are problems with all scoring systems**
  - Find ways to minimize measurement errors
    - Training the raters
  - Generalizability studies to estimate error sources

Validity

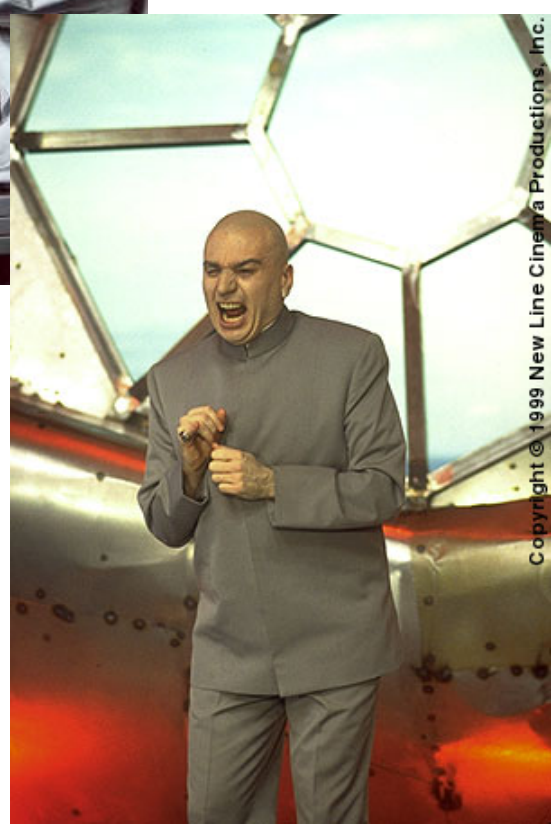
- Development of evidence providing "… a sound scientific basis for the proposed score interpretations"
- Does the assessment provide measure of what it is supposed to?

Assuring the Validity of the Assessment Scores

- Case/ simulation Development
  - Sampling
    - skills
    - content area
  - Scoring criteria
    - necessary tasks/questions to provide patient care

Validity Evidence

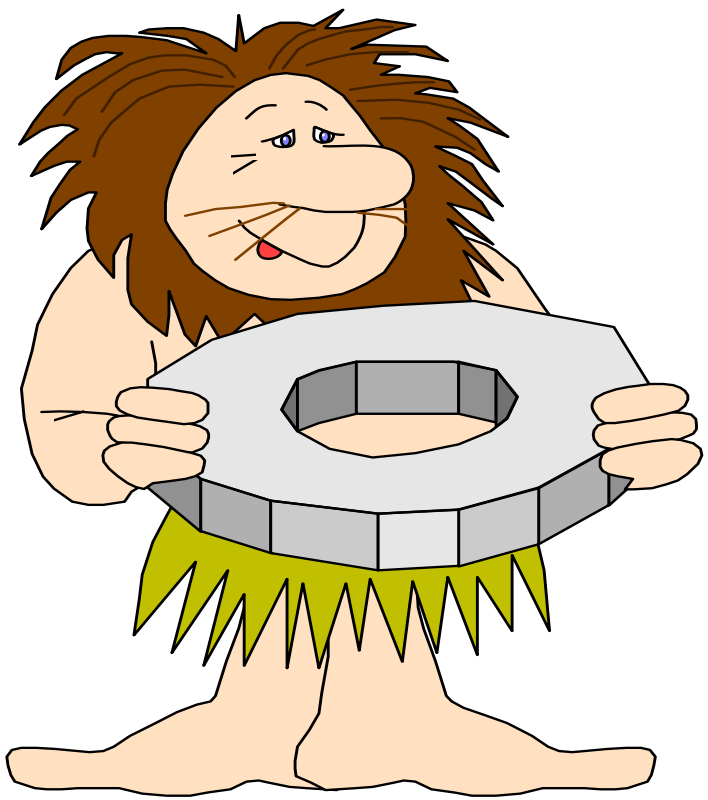
- Start process as evaluation is being developed
  - Content
  - Response processes
  - Internal structure
  - Relationships with criterion measures
  - Consequences
    - evaluation drives learning



Test Content for Simulations

- Skills
  - Data Gathering (History Taking & Physical Examination)
  - Doctor-patient communication
  - Written communication
- Defined by subject-matter experts
  - curriculum
- Content (Clinical Scenarios)
  - can be simulated
  - important
  - prevalence of 'reasons for visit' in health care settings
- Case content determined by local/national needs

Scenario Development Issues



- Cases (simulations) are "vehicles" to measure skills
  - Who are the "target" examinees?
  - Specificity
  - Difficulty
  - Essential maneuvers and questions?
  - Sampling from domain

Content Under-representation

- Some conditions cannot be simulated very well
  - Not as important for basic skills
- Programming for mannequins is imperfect

Response Processes

- Timing of scenarios
  - Evaluation is not “speeded”
- “Item” (scorer) issues
  - fatigue does not affect accuracy
  - candidate performance remains constant
- Feedback
  - realism, appropriateness of content, etc.
- Validation of standards
  - convergence of expert judgments and decisions based on scores

Internal Structure

- Internal correlations among assessment components
  - Biomedical skills - communication
- How scenarios function for identifiable subgroups (controlling for ability)
  - Interaction of rater-candidate characteristics does not appreciably impact assessment scores
  - Threats to validity

Relationship with Other Variables

- External associations with other medical test scores
- Survey of stakeholders
  - residents with successful performance judged to be “ready” for advanced training/ practice?
- Trainee characteristics
  - Individuals with more advanced training expected to perform better

Performance with “Real” Patients

- Difficult to establish “predictive” value … at least in the short term
  - Aviation simulation
  - Driver’s test

Consequences of Testing

- Candidate self-selection / preparation
  - want to learn
  - specialized preparation courses
- Changes in curriculum
- Development of training centers

Discussion

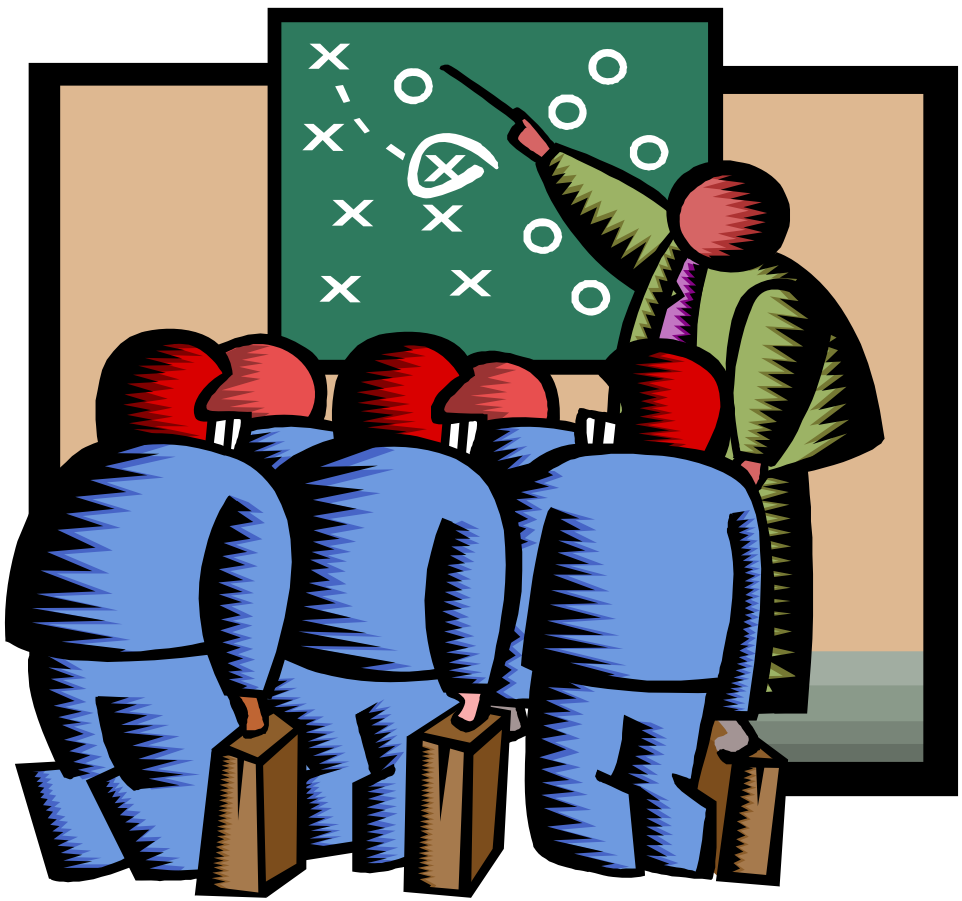
- Utility of simulations for assessment is dependent on
  - Content
    - Proper case development is the key
    - Expert judgment
    - Relevant to practice
  - Developing reliable and valid scoring systems
    - Psychometric analyses
    - Research

Going Forward

- Aligning the scoring system with the complexity of the task
- Generalization of results of the performance
- Research to support the validity of the scores

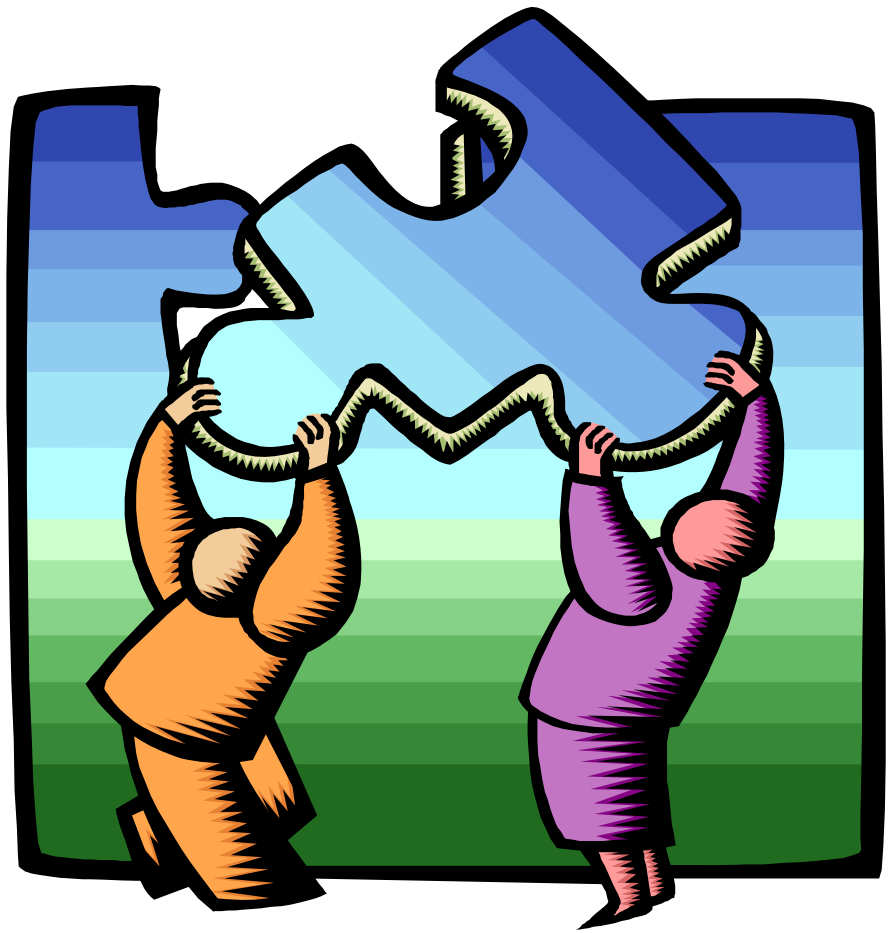
Scoring Systems

- Explicit outcome
  - Patient status
  - complications, etc.
- Combined criteria
  - Sequence
  - Timing



Generalization

- Selection of tasks
  - “evidence based”
- Structure/ length of the assessment
- Assessor training
- Familiarity with simulator



Research (Validity)

- Examinee responses
  - Effect of knowledge of scoring system
- Patient safety
  - Just-in-time training
- Other assessment domains
  - Teamwork
  - Integrated simulations