Assessment of Clinical Reasoning: A Script Concordance Test Designed for Pre-Clinical Medical Students

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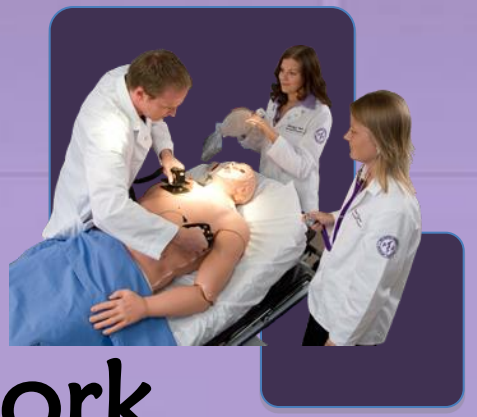
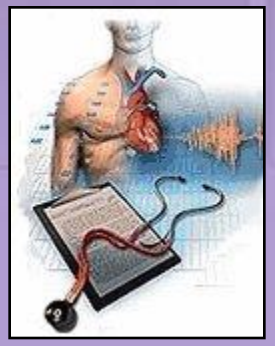
Outline



- Clinical reasoning:
  A Conceptual Framework
  - Uncertainty
  - Diagnosis
  - Analytic or non analytic ?
  - “Illness Scripts” and Clinical Diagnosis
- Script Concordance Test
  - Principles
  - Applications and Results

Uncertainty



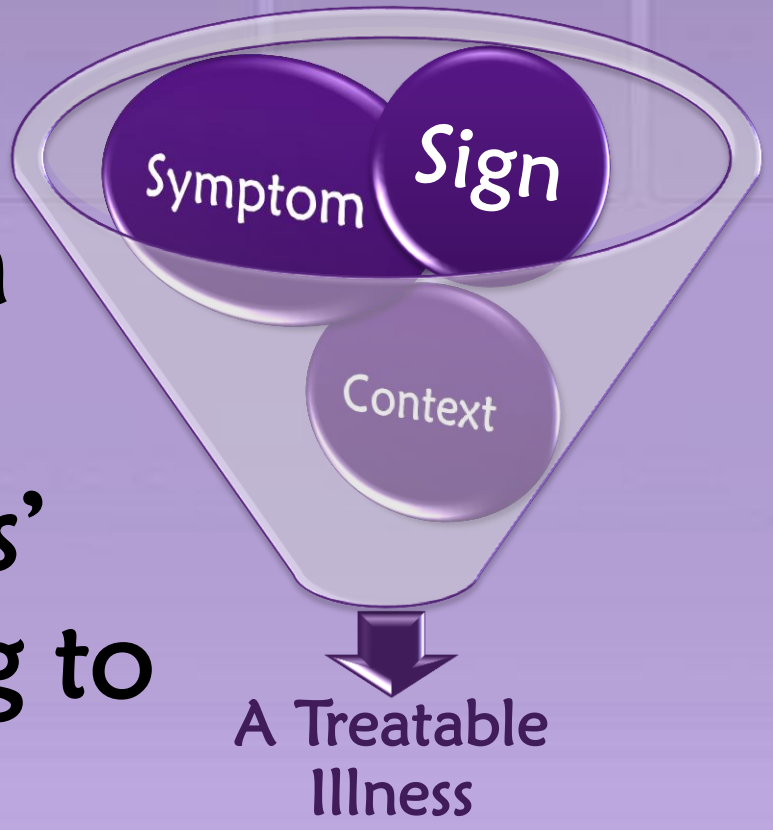
- Healthcare professionals must constantly make decisions in the face of uncertainty.
- Medical students are challenged by ambiguous situations & need practice in this area to become expert clinicians.

Uncertainty

Uncertainties are related to:

- Limited information
- Data subject to more than one interpretation
- New context for an illness, precepts of EBM don't apply

Diagnosis: A Categorization Task



- Grouping patients' illnesses according to known attributes
- Allows clinicians to take action

Charlin et al, *Acad. Med. 2000, 75: 182*

Analytic or non-analytic?

- Non analytic reasoning

Fast, unconscious, perceptual-based

- Analytic reasoning: hypothetico-deductive model

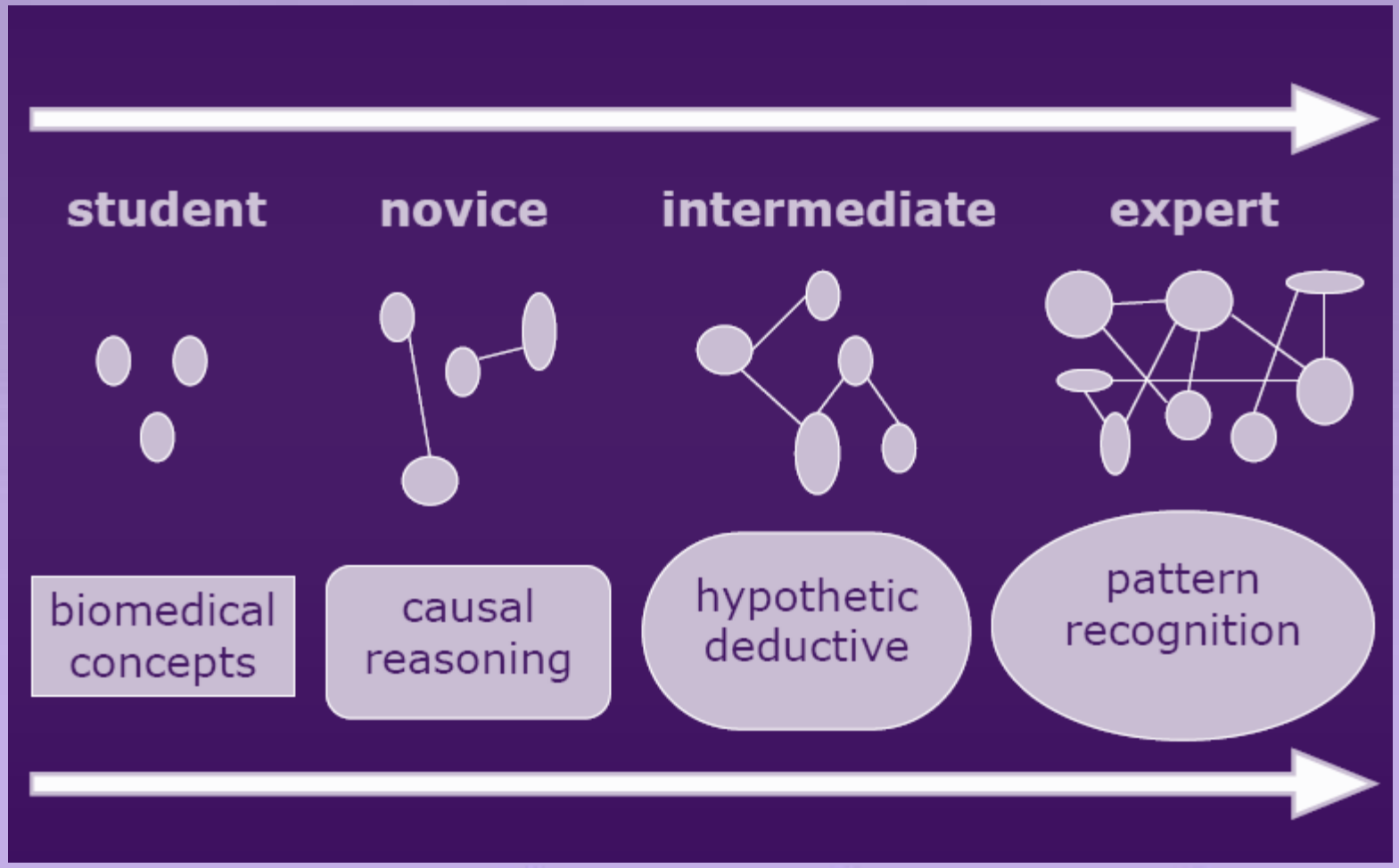
Deliberate, reflective, slower

The Hypothetico-Deductive Model

- Think aloud studies
- Initial clues allow a hypothesis to be developed
- Data is collected to affirm or rule out the hypothesis; iterative process
- Both experts and novices do this, but experts take shortcuts

Elstein, Shulman & Sprafka, Medical Problem Solving, 1990

Development of Clinical Reasoning



Activation of Relevant Hypotheses

Expert practitioners:

- A non analytic process (usual)
  - Pattern recognition*
  - Memories of previous patients & experiences (spontaneous, unconscious, automatic)
- An analytic process (less usual)
  - Deliberate induction of possible explanations** (logical, conscious, carefully controlled)

** Norman, Medical Education, 2007*
***Mamede & Schmidt, Medical Education, 2004*

Knowledge Organization

- Activated hypotheses:
  Physicians access networks of relevant knowledge
- Script theory:
  - How information is processed
  - Knowledge organized for specific tasks
  - Networked knowledge
  - Links between clinical features and diagnostic entities

Charlin et al. (2007) Scripts and clinical reasoning. Medical Education, 41: 1178

The Illness Script: A Fit?


Crestock Photos

EXAMPLE - sinusitis attributes:
pain, rhinorrhea, fever…

- If the value is *ACCEPTABLE* → raises the Hypothesis activation level
- Level sufficiently high = Dx Decision
- If the value is *UNACCEPTABLE* → the Hypothesis is rejected (in this case, bloody secretions, bone destruction)

Script Theory Implications

- Clinicians constantly evaluate new information for the impact on an activated hypothesis
- Multiple micro-judgments are involved in Clinical Diagnosis
- Each micro-judgment can be assessed to understand a clinician's reasoning

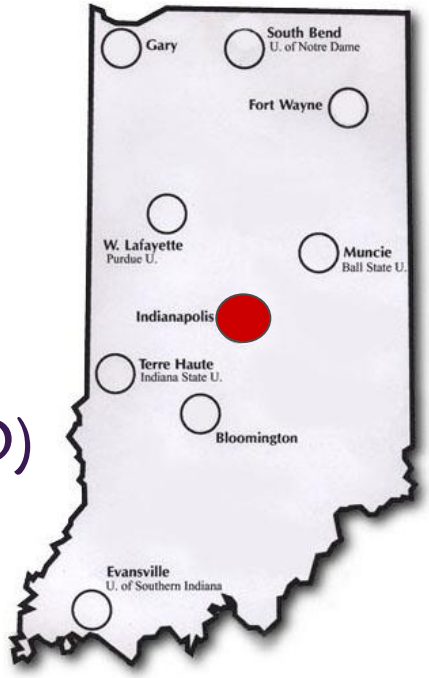
Towards Holistic Assessment

- Traditional MCQ Testing
- Direct observation evaluation (Simulation & OCSE; Clerkships)
- ePortfolio: learner reflection and self-assessment
- Script Concordance Test – SCT Expert-referenced evaluation of a learner's clinical reasoning

What is the SCT?

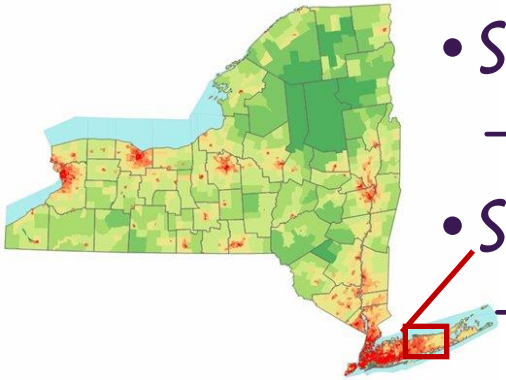
- Method of assessment for clinical data interpretation
  - Examines steps used in clinical reasoning
  - Case-based assessment
  - "Real Life" scenarios allow uncertainty
- Standardized
  - Same stimulus for each learner
  - Objective automated scoring replaces subjective judgment of skilled observers

The Indiana Statewide System for Medical Education



- 9 Sites for preclinical education - variability in formats (PBL, TBL, integrated, mostly "traditional 2 plus 2" curriculum, MD)
- All 320 students: Indianapolis Health Sci Ctr clerkship training (+ emerging regional sites)

SUNY Stony Brook Medical School

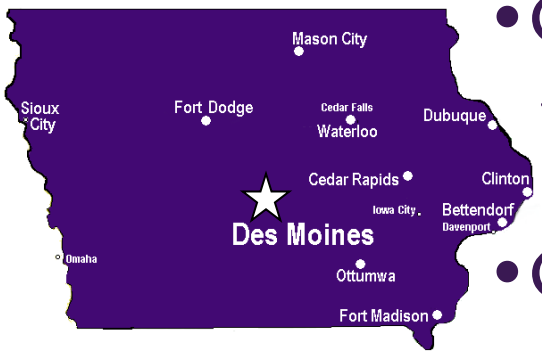


- State University of New York (SUNY)
  - Down State, Syracuse, Stony Brook
- Stony Brook University Medical Center
  - 120 students per class all in same pathway, traditional curriculum, clerkships (MD)

Florida State University College of Medicine

- Main Campus in Tallahassee
  - One site for preclinical education (MD)
- Regional campus model for clinical years
  - 120 students each class (some Rural Track)
  - Community physician preceptor model

DMU College of Osteopathic Medicine



- Campus in Des Moines, 221 students/yr
  - One site for preclinical training; Yr 2 systems curriculum (DO)
- Community physician preceptor model
  - 60% clerkship rotations are in Iowa; 90% of students are trained in the Midwest
  - Rural, Global Health, & Academic Medicine

SCT Approach

A Brief Clinical Problem

New Information:
- Physical sign
- Pre-existing condition
- Laboratory result
- Imaging study

Clinical scenario / stem		
If you were thinking of…	**And then you find…**	**This hypothesis becomes…**
The hypothesis	**New clinical data**	**-2 -1 0 +1 +2**

A Relevant Hypothesis is Posed

- 2 = much less probable
- 1 = less probable
0 = neither less or more probable
+1 = more probable
+2 = much more probable

Student Must Make a Decision

Example Question

The Clinical Problem

New Information: Relevant Patient History

An elderly African-American man presents to the primary care physician with a persistent cough and he complains of recently developing hoarseness in his speech. He has had some mild but persistent back pain for about 6 months. His temperature was normal and he is currently on medication for a sinus infection and chronic high blood pressure.

If you were thinking of…	And then you find…	This hypothesis becomes…
Lung cancer	Patient quit smoking 5 years ago	-2 -1 **0** +1 +2

The Proposed Hypothesis

- 2 = much less probable
- 1 = less probable
0 = neither less or more probable
+1 = more probable
+2 = much more probable

Student Must Make a Decision

SCT and scoring

- Do the clinical decisions chosen by the learner have *concord* with those of the "Reference Panel"
  - A group of experienced family medicine & generalist practitioners (hospitalists)
  - All answers are recorded
  - Points depend on the number of Reference Panel answers

Example: 13 panel members

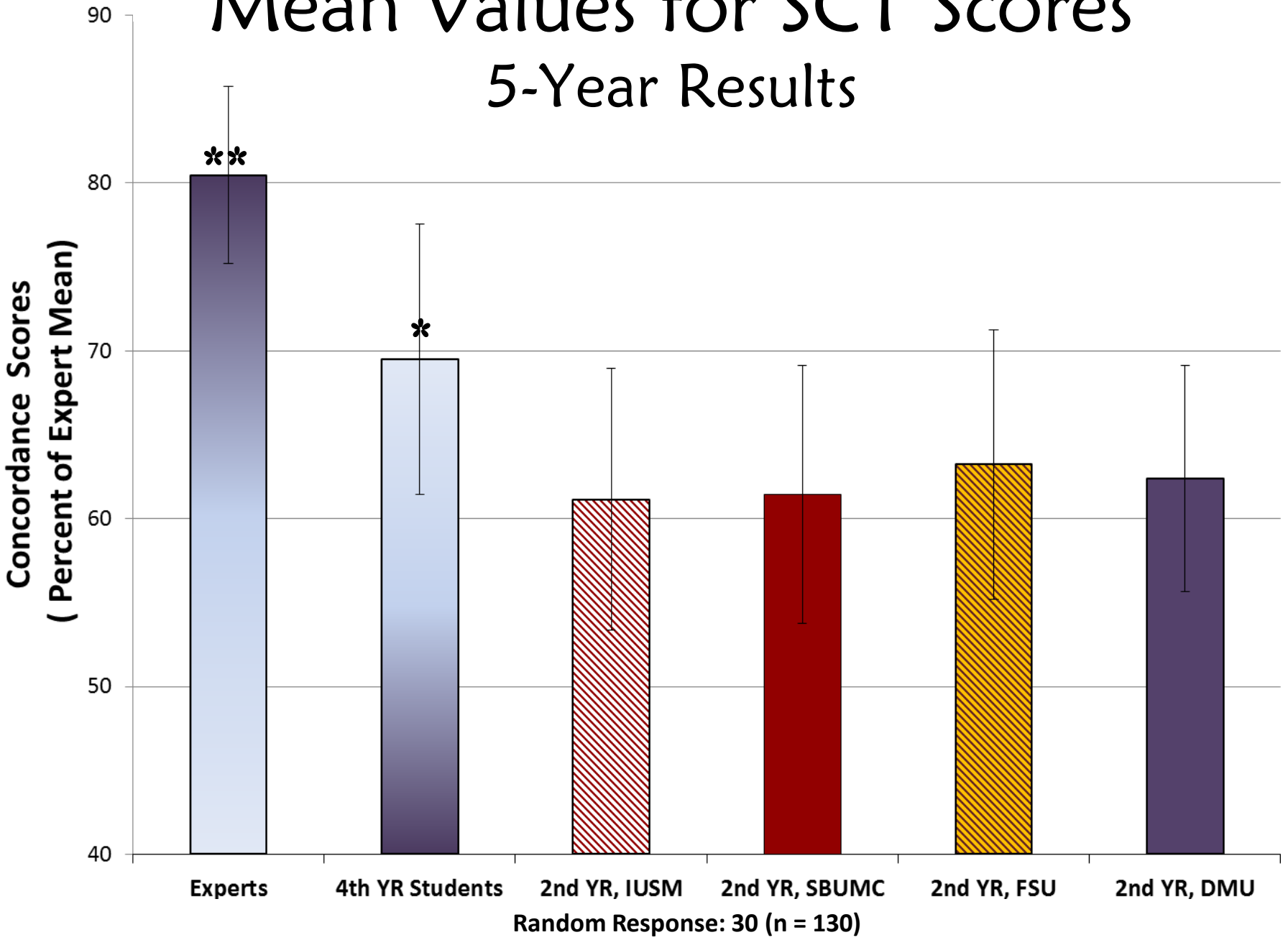
0 : 7 members	1 : 6 members	All other answers
7/7 = 1 point	6/7 = 0.86 point	0/13 = 0 point

SCT Data?

- Combined institution 3 tier vetting process for questions
- Combined institution expert panel for answer key
- Combined scores for comparison of test validity
- Combined institution 4th year medical student volunteer group
- IRB approval obtained, all 4 institutions

Mean Values for SCT Scores

5-Year Results



SCT Validation

- Internal Consistency
  - 75 test items
  - Cronbach's Alpha = 0.73
- Data Differentiation
  - 2nd year students compared to 4th's
    - 1 way ANOVA $p<0.0001$
  - 2nd and 4th years to experts
    - 1 way ANOVA $p<0.0001$
  - IUSM to SBUMC to FSUCOM to DMUCOM
    - No significant difference $p=0.20$

Good Reliability With Shorter Testing Time

Testing Time (hrs)	MCQ	SCT	Oral exam	Long case	OSCE
1	0.62	**0.80**	0.50	0.60	0.47
2	0.76	**0.85**	0.69	0.75	0.64
4	0.93		0.82	0.86	0.78

Coefficients = Cronbach alpha

Brian Jolly, Monash University 2007

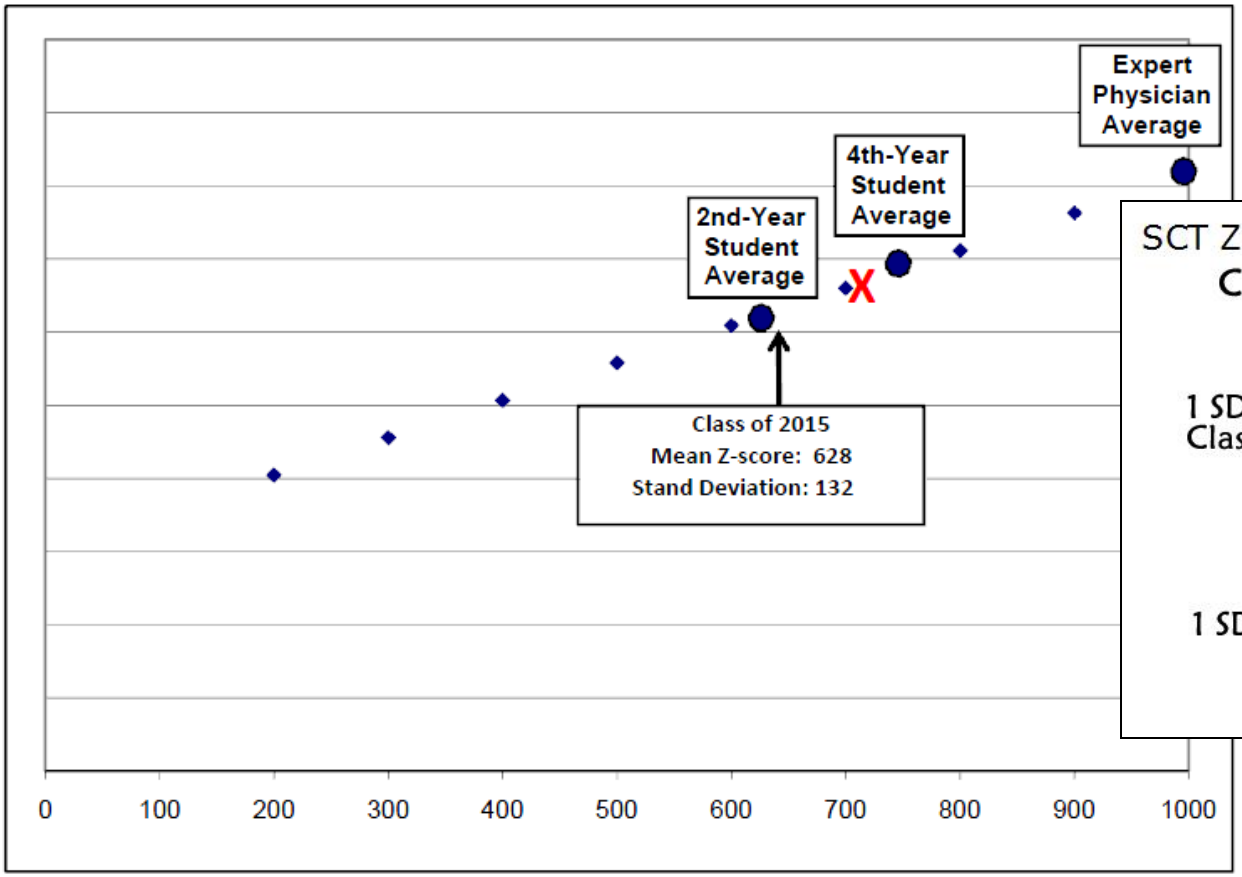
Z-Transform for Student Reports

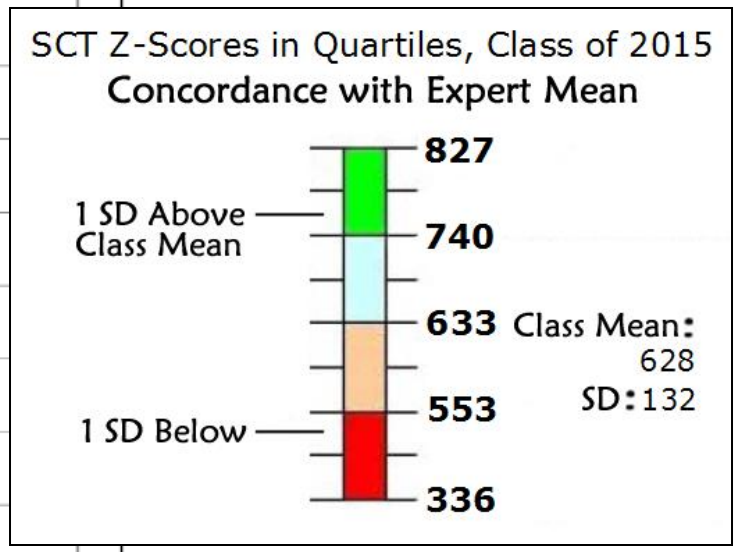
$$z_i = \frac{X_i - M}{SD}$$

where
X_i = any particular value in the data set;
M = the mean of the data set; and
SD = the standard deviation of the data set.

Script Concordance Test Results
Student X 714

The SCT is scaled to have an expert mean of 1000 and a standard deviation of 100. The important comparative metric is shown below, where individual results can be seen relative to other groups.



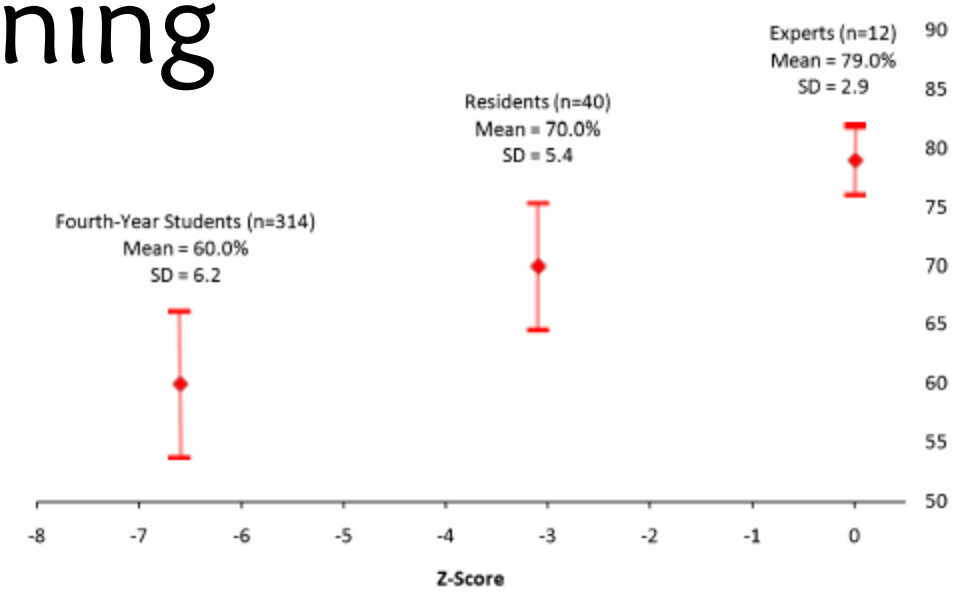


Conclusions

- 2-School Results published in 2011
  - *Medical Teacher* 33(6):472-7
  - First account of SCT used for preclinical medical student assessment
  - Similar to studies published with "less novice" medical learners (clerks/residents)
- Evidence of validity and reliability
  - Face validity with students remains high
- Costs lower than OSCE/SPAL examinations
  - Complements other assessments; doesn't replace
- Assesses learner response to clinical ambiguity

Ongoing Assessment of Clinical Reasoning

- IUSM: Assessment of Problem-Solving Competence
  - 2nd year general SCT; 4th year EM rotation
  - *Humbert, Besinger, and Miech, Academic Emergency Medicine 18*: 627-634 (2011)



- Convergent Validity with other EM evaluations
  - Med students: $r(266)=0.28$; $p<0.01$ with USMLE Step 2, CK Emergency Medicine section
  - Residents: $r(35)=0.69$; $p<0.001$ with in-training exam