Promoting Clinical Reasoning through a Hypothesis-driven Physical Examination

Anticipating, Eliciting & Interpreting Physical Findings

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The OSU College of Medicine, November, 2011
HDPE... the work of many

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“Screening”
Head-to-toe PE

- 140 **maneuvers** for healthy pts
  *(Stillman consortium, '80s)*

- Checklist driven exercise
“What are you thinking?”

“Oh, I haven’t started thinking yet. First I gather all the data and then I think about it.”
“Screening” Head-to-toe PE

- Mechanical thoroughness
- Rote exercise, no processing
- Out of context
  ...not linked to patient complaints
- Students not thinking, just executing
Csqs during clerkships...

- Difficulty to:
  - Select relevant maneuvers/signs
  - Recognize abnormal findings
  - Interpret what they find

- Checklist thoroughness is not enough

Context & Thinking
Hypothesis-driven PE

Given brief Hx [& DDx]:

1. **Anticipate** findings for each Dx
2. **Elicit** physical findings
3. **Interpret** findings... working Dx
4. Immediate SP **feedback**; redo prn
   Revise, **re-interpret** Dx
5. **Document** findings & Dx
1. HDPE procedure:
   - Rationale
   - Development

2. Research: 3 validity studies

3. Implement: variations on a theme
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Aid for Scientific Research
Ministry of Education, Gvt of Japan, Tokyo, Japan
Rationale
4 main res. findings

- Have a Dx in mind
- Sort out a differential dx *(analytical reasoning)*
- Create solid foundation k. & skills
- Transfer into practice

⇒ See more findings
⇒ Looking for discriminating features
⇒ Less is more *(prototypes)*
⇒ Mixed practice with feedback

Bordage, 1998,99
140 PhEx maneuvers

19 chief complaints \( (23 \text{ CC} \approx 80\%) \)

- 3-4 prototypical competing diagnoses/ CC
- Maneuvers & findings for each Dx
  \( \ldots by \text{ anatomical regions} \)
Shoulder pain

16 maneuvers:
- Point to painful area
- Flexion
- Int. & external rotation
- Neck flexion & extension
- L & R rotation of neck
- Lateral bending neck
- Palpation: top, lat., ant.
- Shoulder abduction & add

4 diagnoses:
- Bicipital tendonitis
- Adhesive capsulitis
- Rot. cuff tendonitis
- Referred pain
Dx: Pathophys. mechanisms

- Progressive, chronic inflammation of the internal part of joint (*intra* artic.)
- Sub-acute inflammation of a tendon (*extra* artic.) due to overuse
- *Referred* pain, dermatomes
Why 3-4 Dx/cc?

Why not 10? 15?...

All 34 causes of shoulder pain in the textbook?
r = -.58

Nbr disorders/ syst. course

Prototype formation in memory
(\textit{anchor points})

\textit{...less is more}

Bordage, 1987
"... the student tries to learn too much, and we the teachers try to teach too much – neither, perhaps, with great success"

- Wm. Osler

1899

Pneumonia & typhoid

"if thoroughly understood by the students, [they] give them a satisfactory foundation on which to build their later experience."

- 1925 -
Select PE Maneuvers

- EBM: - Sensitivity
  - Specificity

- 3 steps:
  - Initial development (U Tokyo: JO, HN, GB)
  - Pilot test & refinement (UIC: JR, RY, GB, TL)
  - External content validation (n=8)

...McGee, JAMA, uptodate® +...
Review cases, Dx & signs
Add references (*evidence-b.*)

226 revisions:
- Maneuvers & signs (65%)
- Dx (21%)
- Added references to EBM base

Went from **anatomical** organization
to **Dx reasoning** organization

*Ex.: Chest: lungs only
to lungs + JVD + pedal edema*
HDPE for teaching & learning

Student study guide*

19 CC
160 PE man.
60 Dx

...a solid foundation to begin clerkships

Data gathering

Select new discriminating info.

Interpret existing data

Data interpretation

Gruppen et al, 1991
Students select (use) irrelevant or non-discriminating info to bolster Dx (Motrin relieves pain...thus RA)

Premature closure

Friedman, 85% M3
Discriminating features for strep. throat

Age
Nodes
Imp.m. status
No cough
Tachyp-cyan.
Sex - lung exp.
CA/imm-supp.
IV drug abuse
Asthma exac.
Exudate/red th.
Fever
...

Wigton 1986, ’87, ’89;
Tape 1991; Poses 1992
## Homework: Shoulder pain

<table>
<thead>
<tr>
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<tbody>
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<td>S1</td>
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<td>S16</td>
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</tr>
</tbody>
</table>
## Discriminating features

Positive – signif. negative findings

<table>
<thead>
<tr>
<th>Sh. pain</th>
<th>B. tendo.</th>
<th>Adh. cap.</th>
<th>Rot. cuff t.</th>
<th>Ref. pain</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>Sign +</td>
<td></td>
<td>Sign +</td>
<td></td>
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<tr>
<td>S2</td>
<td></td>
<td>Sign +</td>
<td>Sign +</td>
<td></td>
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<tr>
<td>S3</td>
<td>Sign +</td>
<td></td>
<td>Sign +</td>
<td>Sign +</td>
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<tr>
<td>S4</td>
<td></td>
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<td>Sign +</td>
<td>Sign +</td>
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<tr>
<td>S5</td>
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<td>Sign +</td>
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<td>…</td>
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<tr>
<td>S16</td>
<td></td>
<td></td>
<td>Sign +</td>
<td></td>
</tr>
</tbody>
</table>
Practice...

- Live & video demos *(Novi)*
- System-based workshops
- Practice with SPs
- Practice on ward & in outpt
- ...

HDPE - Exam procedure

Given CC, brief Hx [& DDx]:

1. **Anticipate** findings for each Dx
2. **Elicit** physical findings
3. **Interpret** findings... working Dx
4. SP **feedback**: redo if needed
   Revise, **re-interpret** Dx
5. **Document** findings & Dx
Ann, 50 yrs old, sees you because of pain in her right shoulder for the past four weeks, especially when she picks things up that are high as on a top shelf.

You’re thinking of possible rotator cuff tendonitis or adhesive capsulitis. In anticipation of your physical exam of the shoulder, list the positive sign(s) associated with each diagnostic hypothesis.
Why anticipate?
Clinical features are more evident with a Dx in mind

<table>
<thead>
<tr>
<th>Physical signs</th>
<th>If looking right Dx</th>
<th>If looking something (DDx)</th>
<th>Just looking, thorough:</th>
<th>If looking wrong Dx</th>
</tr>
</thead>
<tbody>
<tr>
<td>Most</td>
<td></td>
<td>Many</td>
<td>Fewer</td>
<td>Least</td>
</tr>
<tr>
<td>++++</td>
<td></td>
<td>++++</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

Norman, 1996, 2000
Hatala, 1999
...avoid collecting data simply for its own sake, for being thorough

*Elstein et al 1978 – Thoroughness, sign of poor performance*

You see what you’re looking for...
Exam procedure

Given brief Hx & DDx:

1. **Anticipate** findings for each Dx
2. **Elicit** physical findings
3. **Interpret** findings... working Dx
4. SP **feedback**: redo if needed
   Revise, **re-interpret** Dx
5. **Document** findings & Dx
### Hearing loss

<table>
<thead>
<tr>
<th>S31: Auditory acuity</th>
<th>Reduced auditory acuity</th>
<th>Sudden viral hearing loss</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>McGee 839</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reduced auditory acuity</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>S32: Inspect external ear</th>
<th>No lesions present</th>
<th>Possible vesicles in herpes</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>S33: Inspect internal ear</th>
<th>Otitis media of right side: Immobile bulging tympanic membrane, dull opaque red color</th>
<th>Normal tympanic appearance without fluid</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>(M)</em></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>S34: Rinne test (air conduction &gt; bone)</th>
<th>Bone conduction longer than air conduction on right side</th>
<th>Air conduction longer than bone conduction bilaterally</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>(S)</em></td>
<td><strong>McGee 839</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>S35: Weber (apex skull) (toward air conduction; away bone conduction)</th>
<th>Sound better in the right side. <strong>McGee 839</strong></th>
<th>Sound better in the left side</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>(S)</em></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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www.uptodate.com  v15.2 Evaluation of hearing loss in adults
Exam procedure

Given brief Hx & DDx:

1. **Anticipate** findings for each Dx
2. **Elicit** physical findings
3. **Interpret** findings... working Dx
4. SP **feedback**: redo if needed
   Revise, **re-interpret** Dx
5. **Document** findings & Dx
Data interpretation

SP asks:  Given the results of your physical exam, which Dx is most likely?

1. [ ] Rotator cuff tendonitis
2. [ ] Adhesive capsulitis (frozen shoulder)
3. [ ] Neither because the findings are ambiguous or contradictory
4. [ ] Don’t know; would be guessing
Exam procedure

Given brief Hx & DDx:

1. **Anticipate** findings for each Dx
2. **Elicit** physical findings
3. **Interpret** findings… working Dx
4. **SP feedback**: redo if needed
   Revise, **re-interpre**t Dx
5. **Document** findings & Dx
SP feedback

Immediate feedback: Ericsson, 1993
If: - incorrect maneuvers → SP demo
    - omitted → SP demo or prompt

Student to redo

Do you wish to revise your Dx?
Exam procedure

Given brief Hx & DDx:

1. **Anticipate** findings for each Dx
2. **Elicit** physical findings
3. **Interpret** findings... working Dx
4. SP **feedback**: redo if needed
   Revise, re-interpret Dx
5. **Document** findings & working Dx

WebSP® - Lionis, Hungary
Debriefing with attending

- Discuss their strengths & errors in a non–threatening setting
  "Disclosure without blame"

- Feedback... to link
  - Discriminating findings & Dx
  - Errors vs. optimal strategy
Effective feedback

When immediate

- Outcome fdbk (+/-) No
- Cognitive (optimal vs. S’s cue weights) Use in practice
- Cognitive + Probabilities Calibration

Ericsson, 1993

Wigton
## Cognitive feedback

<table>
<thead>
<tr>
<th>Sh. pain</th>
<th>Adh.cap.</th>
<th>Rot.Cuff T</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>Sign +</td>
<td>Sign +</td>
</tr>
<tr>
<td>S2</td>
<td>Sign +</td>
<td>Sign +</td>
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<tr>
<td>S3</td>
<td>Sign +</td>
<td>Sign +</td>
</tr>
<tr>
<td>S4</td>
<td>Sign +</td>
<td>Sign +</td>
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<tr>
<td>S5</td>
<td>Sign +</td>
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<tr>
<td>...</td>
<td>Sign +</td>
<td></td>
</tr>
<tr>
<td>S16</td>
<td></td>
<td>Sign +</td>
</tr>
</tbody>
</table>
1. Anticip. signs:
   - Dx-1: 29% (57)
   - Dx-2: 50 (75)

2. Elicit PhEx man.
   - 29 (71)

3. Interpret: Working Dx
   - 0 (53)

4. Interpret: Revised Dx
   - 0 (60)

5. Documentation
   - 0 (54)

Case-1: 75 (68)
Case-2: 75 (78)
**Group feedback – Case #34**

<table>
<thead>
<tr>
<th>Name</th>
<th>Antic. signs-Arter. Oblit.</th>
<th>Antic. signs-Stenosis</th>
<th>Elicit PhEx man.</th>
<th>Interpret: Working Dx</th>
<th>Interpret: Revised Dx</th>
<th>Docum. findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student-2</td>
<td>86%</td>
<td>100%</td>
<td>71</td>
<td>100</td>
<td>100</td>
<td>40</td>
</tr>
<tr>
<td>Student-3</td>
<td>57</td>
<td>100</td>
<td>71</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Student-4</td>
<td>43</td>
<td>100</td>
<td>71</td>
<td>100</td>
<td>100</td>
<td>80</td>
</tr>
<tr>
<td>Student-5</td>
<td>57</td>
<td>100</td>
<td>86</td>
<td>100</td>
<td>100</td>
<td>50</td>
</tr>
<tr>
<td>Student-6</td>
<td>71</td>
<td>50</td>
<td>71</td>
<td>100</td>
<td>100</td>
<td>80</td>
</tr>
<tr>
<td>Student-9</td>
<td>57</td>
<td>100</td>
<td>86</td>
<td>0</td>
<td>0</td>
<td>20</td>
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<tr>
<td>Student-10</td>
<td>57</td>
<td>0.0</td>
<td>57</td>
<td>0</td>
<td>0</td>
<td>80</td>
</tr>
<tr>
<td>Student-12</td>
<td>29</td>
<td>50</td>
<td>29</td>
<td>0</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td><strong>Class aver</strong></td>
<td>56%</td>
<td>75%</td>
<td>68%</td>
<td>63%</td>
<td>63%</td>
<td>54%</td>
</tr>
</tbody>
</table>
## Student Profiles (8)

<table>
<thead>
<tr>
<th>Anticipate</th>
<th>Elicit</th>
<th>Interpret</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>6%</td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>x</td>
<td>2</td>
</tr>
<tr>
<td>✓</td>
<td>x</td>
<td>x</td>
<td>1</td>
</tr>
<tr>
<td>✓</td>
<td>x</td>
<td>x</td>
<td>5</td>
</tr>
<tr>
<td>✓</td>
<td>x</td>
<td>✓</td>
<td>5</td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>18</td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>x</td>
<td>17</td>
</tr>
</tbody>
</table>

Elicit: 47% (55/120)  
Interpret: 70% (85/120)
In summary...

From rote, out of context to...

- **Context**: Pt CC & DDx
- **Clinical reasoning**
  - *Anticipate* (discriminating findings)
  - *Execute* (sole purpose before)
  - *Interpret* (sorting DDx)
- **Feedback**, immediate
Validity studies

- How many cases for reliable measures?

- **H1:** Discriminating findings provide more reliable measures than entire set of maneuvers (checklist)

- **H2:** Long-term retention enhanced by receiving immediate SP fdbk
How many cases for reliable assessment? 0.80

Generalisability study: $\phi$ coefficient

**Total cklist**

**M3s**
- 3 cases: 0.35

**D-study**
- 6 cases: 0.56
- 12 cases: 0.68
- 22 cases: 0.80
## Discriminating clinical findings

<table>
<thead>
<tr>
<th>Noised &amp; Signal</th>
<th>Sh. pain</th>
<th>Adh.cap.</th>
<th>Rot.Cuff T</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Noise 16</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Signal 5</strong></td>
<td>S1</td>
<td></td>
<td>Sign +</td>
</tr>
<tr>
<td></td>
<td>S2</td>
<td>Sign +</td>
<td></td>
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<td></td>
<td>S3</td>
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<td>Sign +</td>
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<td>S4</td>
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<td>S5</td>
<td>Sign +</td>
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<td>Sign +</td>
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</table>
How many cases for reliable assessment? 0.80

Generalisability study: φ coefficient

Total checklist  Discrim. signs

M3s
3 cases: 0.35  →  0.50

D-study
6 cases: 0.56  →  0.71
12 cases: 0.68  →  0.80
22 cases: 0.80
2nd Q.: Does prior experiences (M3) effect retention (M4)?

66 M3s IM clkship
- Student cohorts prep. 6 CC/19 using guide
- OSCE: 3 of 6 complaints

125 M4s exam
- Osce: 3 of 6 CC /19
- 3 experimental gr.:
  1- Not studied complaint
  2- Studied, not tested
  3- Tested on same complaint /w SP fdbk
Impact of prior experiences (M3) on retention (M4)

<table>
<thead>
<tr>
<th>Dx accuracy (%)</th>
<th>Not studied</th>
<th>Studied Not tested</th>
<th>Studied + fdbk</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>68</td>
<td>73</td>
<td>85</td>
</tr>
<tr>
<td></td>
<td>NS</td>
<td>p&lt;.05</td>
<td></td>
</tr>
</tbody>
</table>

Not studied or seen
Studied but not tested
Seen with SP fdbk
Study guide alone did **not** have an effect.

**Cases tested with immediate SP fdbk**

enhanced long-term retention
HDPE... So What !!!

- Solid foundation 160 man. / 19 CC / 60 Dx
- In context: Pt complaints & DDx
  - Clinical reasoning:
    Key role of discriminating findings
  - Learning: Immediate feedback
- Measurement: 12 cases
Next steps...

- **Research**: Checklists based only on clinically discriminating items
  
  *(F-up Grant from NBME Stemmler)*

- **Development - Implementation**: ...
  
  *4 variations on a theme*
Implementation

- Timing during M1 & M2 yrs...
- Reinforcement during clerkships...
- Cqs for summative assessment...

See:
Variations on a theme...

- **M1**: Screening HTT/c paramedics
  **OSCE**: HTT

- **M2**: Small gr. of 4; each student
  - prepares 1 of 4 cases
  - 1 plays the role of the pt
  - 3 other do the PE /c 1 attending

  **OSCE**: HDPE
Variations on a theme...

- Prep. readings re: CC & 3-4 Dx
- Demo. By attending: HTT + HDPE... anatomo-pathology
- Practice among students /c video
- Small gr. /c attending & Sr res. (10:2) 1 case + HDPE
- **OSCE:** HTT + HDPE
Variations on a theme...

- **M1**: /c anatomy
  Attending demo. HTT & HDPE
  M1s examine M4s
  Reinforced during anatomy labs

- **M2**: /c sub specialties – HDPE
  Practice /c Pt Instr. & wksps

- **OSCE**: HDPE /c immediate fdbk
Variations on a theme...

M1-M2s: Student handbook during hospital practicums as guide

- **OSCE: HTT** *(sampled)*
  + HDPE
Kamel et al. from UCSF

A randomized trial of hypothesis-driven vs. screening neurologic examination

“…a HD approach resulted in greater sensitivity & a trend toward faster examinations, at the cost of lower specificity, compared with the traditional screening approach. Our findings suggest that a HD approach may be superior when the history is concerning an acute focal neurologic process.”
How Do Neurologists Think?
A Fresh Look at the Neurological Exam

“The problem is the students learn...[the neurol. screen exam] by rote. They learn the maneuvers, but they don’t learn how to recognize and interpret abnormal findings. The HD exam encourages students to start thinking very early on.”
Hypothesis-driven PE

Given brief Hx [& DDx] :

1. **Anticipate** findings for each Dx
2. **Elicit** physical findings
3. **Interpret** findings… working Dx
4. Immediate SP **feedback**; redo prn
   Revise, **re-interpret** Dx
5. **Document** findings & Dx

_Ark et al, Med Ed., 2007;41:281-87_
_Van der V. & Schuwirth, Med Educ 2005, 39, 309-317_
_Ericsson et al. Psychol Rev. 1993; 100:363-406_
_Hatala et al. J Gen Intern Med. 1999; 14:126-9_