

Title: A model teaching session for the Hypothesis-driven Physical Examination

Running title: Hypothesis-driven Physical Exam

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Abstract

Introduction

The physical examination (PE) is an essential clinical competence for all physicians. Most medical schools have students learn the physical examination maneuvers using a head-to-toe (HTT) approach. However, this promotes a rote approach to the physical exam, and it is not uncommon for students later on to fail to appreciate the meaning of abnormal findings and their contribution to the diagnostic reasoning process. The purpose of the project was to develop a model teaching session for the hypothesis-driven physical examination (HDPE) approach in which students could practice the physical examination in the context of diagnostic reasoning.

Methods

We used an action research methodology to create this HDPE model by developing a teaching session, implementing it over 100 times with approximately 700 students, conducting internal reflection and external evaluations, and making adjustments as needed.

Results

A model nine-step HDPE teaching session was developed, including: 1) Orientation, 2) Anticipation, 3) Preparation, 4) Role Play, 5) Discussion-1, 6) Answers, 7) Discussion-2, 8) Demonstration, and 9) Reflection.

Discussions and Conclusions

A structured model HDPE teaching session and tutor guide were developed into a workable instructional intervention. Faculty are invited to teach the physical examination using this model.

(193 words)

Key Words

teaching and learning, physical examination, hypothesis-driven, diagnostic reasoning

INTRODUCTION

The physical examination is an essential clinical competence for all physicians (Reilly 2003, Yudkowsky et al. 2004). It provides information that is critical to the diagnosis and treatment of patients. Even in today's world of sophisticated investigations and imaging, physicians still rate the physical examination as their most valuable skill (Mangione 1996), including building good doctor-patient rapport (Kravetsz 2009). Most medical students learn to master the physical examination through a screening, head-to-toe (HTT) approach where they practice over a 140 maneuvers (Benbassat 2005, Yudkowsky et al. 2004).

Although an HTT approach helps students learn individual physical examination maneuvers, it is not uncommon for students later on to fail to appreciate the meaning of abnormal physical examination findings and their contribution to the diagnostic reasoning process (Yudkowsky et al. 2009). The de-contextualized HTT approach may explain why students have difficulty selecting relevant physical examination maneuvers at the bedside and interpreting the findings to reach a diagnosis (Benbassat 2005). The same difficulties are also seen during student assessments. In Japan, for example, one of the criticisms raised by faculty who assess students during the Nationwide CATO (Common Achievement Test Organization) OSCE (Objective Structured Clinical Examination) (Kozu 2006) is the low content validity of the exam because the physical examination maneuvers are assessed in isolation and their meaning is ignored (Akaike, 2008).

To avoid this de-contextualization, the physical examination and the meaning of the individual maneuvers should be taught and assessed

simultaneously and systematically during the undergraduate curriculum (Benbassat 2005). In a previous publication, we presented initial validity evidence for a “hypothesis-driven physical examination (HDPE)” approach to learning and assessing the physical examination in the context of diagnostic reasoning, through individual, one-to-one interactions with highly trained standardized patients or patient instructors (Yudkowsky et al. 2009). The purpose of the present project was to develop a model teaching session in which students could learn a hypothesis-driven physical examination in a small group setting.

METHODS

We used an action research methodology (Meyer 2000, Cohen 2008) to develop this HDPE model teaching session. Action research is defined as a form of collective self-reflective inquiry undertaken by participants in social situations in order to improve the rationality and justification of their own social or educational practices, as well as their understanding of these practices and the situations in which they occur (Waterman 1998). We chose this method because of its great potential to generate solutions to practical problems (Meyer, 2000), in this case, students’ difficulty to associate technical maneuvers and their meaning to sort out a differential diagnosis when learning the physical examination (Benbassat 2005). The study design includes four phases: planning, action, observation, and reflection (Cohen 2008).

Phase 1: Planning

The goal of the HDPE session is for medical students to learn the physical examination in the context of diagnostic reasoning. We designed the educational experience as a small-group learning session to engage students in active learning while interacting with a tutor (Crosby 1996). We initially developed it as a three-hour session for fifth-year Japanese undergraduate medical students, with six students, one tutor, and three case scenarios. Fifth-year students were chosen because they have already learned the basic head-to-toe physical examination maneuvers, so that they could focus here on anticipating, eliciting and interpreting findings. The first author (HN), a general physician with experienced in teaching the physical examination and clinical reasoning (Nishigori, 2009), first constructed an overall frame for the session. He wrote three case scenarios, with advice from the last author (JO), a general physician with experience in teaching the physical examination. Each scenario contains a brief history and three plausible diagnoses as well as guides for the student roles during each scenario.

Phase 2: Action

HN facilitated the first session in April 2005 and bi-weekly sessions thereafter in the Department of General Medicine at the Nagoya University Hospital. Six fifth-year medical students participated in each session. In August 2005, the second author (KM), also a general physician with experience in teaching the physical examination and clinical reasoning, took over the tutor's role. A tutor guide was created based on Rudland's approach (2009). KM conducted the HDPE teaching sessions more than 60 times since

then with approximately 400 medical students. In addition, other members of the research team (MK, AK and JO), also experienced in teaching the physical examination and clinical reasoning, facilitated three HDPE teaching sessions for about 100 students and residents across Japan, as part of workshops for the Japanese Academy of Family Medicine (JAFM) in August 2007, 2008 and 2009 (Takamizawa 2007, Kusanagi 2008, Kobayashi 2009), and for 16 students for the Japanese Society of General Medicine (JSGM) in March 2008 (Masuda & Nishigori 2008). JAFM and JSGM workshops included a range of participants from third-year medical students to residents. Since the JAMF workshops lasted only two hours, only two case scenarios were used. Finally, HN facilitated weekly HDPE sessions more than 30 times since September 2008 for about 200 fourth-year students at the University of Tokyo. These were one-hour sessions with only one case scenario. In total we have conducted over 100 HDPE sessions with approximately 700 students. A summary of the HDPE sessions are presented in Table 1.

Phase 3: Observation

Following the sessions held in 2006 at the Nagoya University Hospital, KM conducted four focus groups to evaluate the sessions with 22 volunteer and consenting medical students (Masuda et al. 2007). The focused discussions were tape-recorded and transcribed verbatim. The data were iteratively read and analysed by KM using a thematic synthesis method, in which text coding was performed, followed by descriptive theme development and analytical theme generation (Thomas, 2008). HN independently read the transcripts and analyses and verified the themes as a means of inter-coder agreement.

We also administered an open-response evaluation questionnaire to the participants in the JAFM and JSGM workshops and the medical students at the University of Tokyo. The responses were analysed by HN using a thematic synthesis method. KM read and verified the analyses separately.

Phase 4: Reflection

Immediately after the workshop sessions held for JAFM and the JSGM, five research team members (HN, KM, MK, AK and JO) held formal debriefing meetings to evaluate the HDPE sessions. The evaluations were recorded, summarised by MK, and shared by e-mail among all five members. Each member was asked to confirm or amend the summaries within a two-week period.

Based on the results of the various evaluations, HN and JO modified the initial HDPE sessions. All the modifications were first shared among the five members (HN, KM, MK, AK and JO), either during official meetings or by e-mail, and approved through an interactive process until consensus was reached.

Finally, HN and JO discussed the framework of the model session with GB and RY in November 2009 for an external, international validation. Further modifications were made following this review and a revised final version of the HDPE session has been conducted at the University of Tokyo since then.

RESULTS

The results will be presented under two main headings: structure of the

model HDPE teaching session, and themes identified from the observations and reflections. The differences between the initial and final models are described in Table 2.

Structure of the model HDPE teaching session

The purpose of the HDPE sessions is for students to learn the physical examination in the context of diagnostic reasoning. The specific objectives are for students to:

- A. Anticipate and select relevant physical examination maneuvers given a history and differential diagnosis;
- B. Execute the relevant physical examination maneuvers correctly;
- C. Identify findings from the physical examination maneuvers;
- D. Interpret the findings to sort out a differential diagnosis; and
- E. Justify a working diagnosis.

The target audience is medical students.

The teaching method is small-group interaction and discussions (4 to 8 students with 1 tutor).

The materials needed are documents (Case Scenarios (Table 3), Anticipated Findings Form (Table 4), Student-Patient Guide (Table 5)), a white board with pens, desks and chairs, and an examination table.

The session unfolds in a nine-step fashion (see Figure 1).

1. Orientation

After individual introductions and an icebreaking activity (Rajecki, 1992),

the tutor asks the students to comment on their previous experience with the physical examination. This is a process of schema activation for students to learn the physical examination (Rumelhart 1980). The tutor then explains the purpose and objectives of the session and the rationale for learning the physical examination using a HDPE approach.

2. Anticipation

The tutor distributes a scenario that contains a brief history and 3 plausible diagnoses (see example in Table 3) and an “Anticipated Findings Form” (Table 4). Students are asked first to read the brief scenario along with its 3 plausible diagnoses and to rank each diagnosis based only on the limited history (Bowen 2006). They are asked to record the pre-physical exam probability of each diagnosis (in percentages) on the Anticipated Findings Form (see Table 4); for example, 40% for acute appendicitis, 20% for right side pyelonephritis and 40% for acute cholecystitis. The tutor also asks the students to list the physical examination maneuvers and professional behaviours (e.g. warming one’s hands before palpating the abdomen) that are relevant for this case, and to list (anticipate) the positive and negative discriminating findings for each hypothesis (Yudkowsky et al. 2009). An example from these tasks is shown in Table 4 and 6. All the first tasks are performed by each student individually. When the students are done, the tutor asks them to work together to develop a consensus list of anticipated findings.

3. Preparation for role-play

The tutor then asks the students to pick one student to play the role of the

doctor (student-doctor) and one to play the role of the patient (student-patient) (Joyner & Young 2006). The student-patient leaves the room with the tutor and is instructed by the tutor on the physical examination findings to be simulated using a Student-Patient guide (illustrated in Table 5). Separately, the student-doctor is given brief instructions for her/his role play. In order to maintain the focus on the physical examination and diagnostic reasoning, the student-doctor is asked not to take any further history beyond what is provided in the scenario. The student-doctor can begin by saying, for example, "Hello, Mr. Sakamoto. I am Mr. Katsura, a fifth-year medical student at Tokyo University Hospital. I understand that you have some abdominal pain and I would like to examine you, please." The student-doctor is asked to perform each examination maneuver based on the completed Anticipated Findings Form. The other students are asked to support the student-doctor (e.g. by making suggestions about the physical examination maneuvers).

4. Role Play

When the student-doctor and student-patient are ready, the tutor asks them to begin the role play. The student-doctor asks the student-patient to come in the room and performs the physical examination that is needed to differentiate among the three diagnoses. The other students are encouraged to make suggestions to support the student-doctor. This takes about 10 minutes. The student-doctor conveys each physical examination finding to the other students and the tutor. When the student-doctor has completed the physical examination, she/he tells the tutor that she/he is done.

5. Discussion-1

After the role play, the students are asked to individually write their revised (post-physical exam) probabilities for each diagnosis on the Anticipated Findings Form. When done, the tutor shares the probabilities using a white board or a flip chart. The tutor asks the students to provide reasons for their estimates, for example, justify why their probability estimates for appendicitis went from 20% to 70%.

6. Answer

Once all the students have given their estimates and justifications, the student-patient gives the group the correct diagnosis.

7. Discussion-2

The tutor then conducts a brief presentation-discussion with the students. The tutor gives the students her/his own ideas about the probability estimates for the three diagnoses, and comments on the clinical diagnostic reasoning process for the case, comparing her/his approach to that of the students. The tutor also highlights the sensitivity and specificity of each physical examination signs (for example based on McGee 2007 or Simel 2009).

8. Demonstration

After the discussion, the tutor demonstrates her/his physical examination of the student-patient while thinking aloud and highlighting the student-doctor's omissions if any occurred (Gordon 2003, Ramani 2008). The tutor also distributes model answers (see Table 6).

9. Reflection

Finally the tutor asks the students for (1) their take-home messages (lessons learned) from the session and (2) case specific things to look up as a result of the session. This oral debriefing process is a key element to foster student learning (Moulaert 2004, Ziv 2009).

Main themes identified during the observation and reflection phases

During the action-research observation and reflection phases, the following evaluations occurred, from which modifications were made to develop the final HDPE model teaching session described above.

1. Student readiness

Some participants at the JAFM workshops had never learned the physical examination maneuvers before. In that case, the tutors had to spend time teaching basic examination skills, resulting in less time for discussion and compromising the goal of integrating recognition and interpretation of findings. Tutors can adjust this teaching balance between physical examination skills and diagnostic reasoning based on the readiness of the students.

“Two students did not know how to use their stethoscopes. I taught them how, so I could not spend much time on discussing the meaning of the findings...” (A tutor participating in the JAFM workshop)

“It would be more valuable if I had completed the CATO OSCE and mastered basic examination maneuvers.” (A student participating in the JAFM workshop)

2. Peer physical examination

During the sessions, the students learned the physical examination by role-playing the physician and the patient. In this “peer physical examination” process (Outram & Nair 2008), students, when playing the role of a patient, also learned to appreciate the patient’s perspective. This was not intended in the initial planning.

“I learned the signs of each disease by being in the patient’s role” (A student from the Nagoya University)

“I learned how patients feel when they are examined by a doctor.” (A student from the Nagoya University)

3. Use of simulators

In the abdominal pain case scenario shown in Table 3, a student-patient is asked to show her/his abdomen. This might be difficult or embarrassing, especially in non-western cultures where students hesitate to reveal their body. When students cannot simulate the findings for cultural reasons, simulators can be used, and a combination of student-patients and simulators can be used during the sessions. (Issenberg et al. 1999)

“Using simulators should be considered. This time all but one of the members in my group were girls and I did not have any choice in picking a student-patient...”(A tutor participating in the JAFM workshop)

4. Professional role modeling

During the demonstration phase, students not only learned physical

examination skills and their meaning, but also learned how to behave as a professional doctor by seeing the tutor's role modeling. This was also not intended in the initial planning. The tutor conducting the session should be aware of the modelling effect of her/his professional behaviour.

"The tutor demonstration was really helpful to learn how doctors behave."

(A student from the Tokyo University)

5. Standardization of the session

While teaching faculty to conduct HDPE sessions, we developed a paper-based tutor guide and a DVD video to illustrate the structure and purpose of the session and to better standardize, to some extent, the way the sessions are conducted (Rudland 2009).

"Some contents of the discussion and the demonstration varied among tutors, but I think it is OK...We do not have to teach detailed knowledge and skills all in the exact same way." (A tutor participating in the JAFM workshop)

Discussion and conclusion

During this project, we used action research methods to build and refine a model HDPE teaching session. We conducted over 100 sessions with approximately 700 students, improved the quality of the sessions based on the various feedback received and self-reflection, and derived a workable model.

In many countries, medical students learn the physical examination before beginning their clinical rotations using a HTT approach (Yudkowsky et al.

2004). An advantage of the HTT is that all the basic physical examination maneuvers are covered systematically. However, in many cases, students do not learn to appreciate what abnormal or normal findings mean and their contribution to the diagnostic reasoning process (Yudkowsky et al. 2009). Students then have additional opportunities to learn the physical examination during clinical rotations at the bedside (Ramani 2008). Although students can learn both maneuvers and their meaning at the bedside, that type of learning can be opportunistic (Harden, 1984) and difficult to learn systematically. The proposed HDPE teaching session can help fill the gap between systematic HTT approach and opportunistic bedside learning as a systematic approach that combines technical skills and reasoning skills.

One of the benefits of this model teaching session is its structured aspect with a tutor guide (Rudland 2009). The session was easily transferable from institutions to institutions. Another benefit of the model is the fact that it requires only a tutor, a small room, documents, a white board (or flip chart) with pens, and desks, chairs and a bed, and no standardized patients. Thus, it can be easily used in countries where educational resources are limited. Other notable benefits include the fact that students can learn the patient perspective by peer physical examination and professional behavior through role-playing.

One of the limitations of our study is the fact that the proposed model teaching session was only validated in a limited number of institutions in one country. We encourage further validation throughout the world. We did not develop scenarios or teaching guides to cover all the physical examination maneuvers to be learned yet. More validated case scenarios are also needed.

A question raised from this project is whether students can learn the physical examination maneuvers in a hypothesis-driven manner right from the beginning. Some tutors had difficulty facilitating the sessions with students who had never learned the physical examination. In that case, a hybrid approach that allows time for teaching physical examination maneuvers as well as the recognition and interpretation of findings may be optimal. Some American medical schools are currently experimenting with this hybrid approach.

Summary

In this project, we focused on teaching the physical examination in conjunction with diagnostic reasoning in a structured approach and developed a workable model teaching session. We invite faculty to teach the physical examination using this model and to modify it if necessary.

(3073 words)

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Declaration of interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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Table 1: HDPE teaching sessions conducted according to sites

	Nagoya University	JSGM/JAFM Workshop	The University of Tokyo
Participants	5 th -year medical students	4 th to 6 th -year medical students / residents	4 th -year medical students
Model	Initial	Initial	Initial and Final
Number of scenarios	3-4	1	1-2
Number of students	Approximately 400	Approximately 100	Approximately 200

Table 2: Differences between initial and final models

	Initial model	Final model
Target	3 rd -year medical students to 2 nd -year residents	4 th to 6 th -year medical students
Simulator	None	Used
Anticipated Findings Form	Students are asked to write only pre and post examination probabilities. They discuss the physical examination maneuvers to be performed and the anticipated findings.	Students are asked to write the physical examination maneuvers to be performed and the anticipated findings
Tutor demonstration	No	Yes
Example of answers	None	Given to students at the end of the session

Table 3: Example of a case scenario for Abdominal Pain

Brief History: A 33-year-old man came to the internal medicine outpatient clinic complaining of right-sided abdominal pain and fever. The pain started last night and increased slowly but surely since then. He also had chills but no diarrhea, constipation, nausea, or vomiting. The pain is rather dull.

- 1) You are thinking of a possible appendicitis, right-sided pyelonephritis, or acute cholecystitis. Estimate, in percentages, the likelihood (pre-physical exam probability) of each diagnosis so that they sum up to 100%.
- 2) List the relevant physical examination maneuvers to perform in this case.
- 3) Describe the findings you anticipate for each diagnosis and identify the discriminating clinical findings that will be useful in differentiating among the three diagnoses.
- 4) Perform the physical examination, based on the maneuvers and findings you listed in step 2 and 3.
- 5) Once done with your physical exam, estimate the likelihood (post-physical examination probability) of each diagnosis as you did in step 1.

Table 5: Student-Patient Guide for the Abdominal Pain Case

For a diagnosis of “**Acute cholecystitis**”

You are asked to role play the following;

1. Walk in the room with your hands holding the right side of your abdomen.
2. Vital signs will be given by the tutor; BP 120/80mmHg, HR 115 reg, BT 38.4, RR 22/min, SpO2 98% (ambient air).
3. You DO have strong pain when the doctor percusses or palpates the right-upper quadrant of your abdomen.
4. You DO have moderate pain when the doctor checks if you have rebound tenderness anywhere on your abdomen.
5. You do NOT have punch pain on the right-upper quadrant of your abdomen.
6. You DO have a positive Murphy’s sign (right-upper quadrant pain during breathing when the doctor palpates).
7. You do NOT have any punch pain on your lower back.
8. You do NOT have a heel-drop sign.
9. You do NOT have any other physical examination abnormalities.

Table 6: Example of answers from the Anticipated Findings Form

for the Abdominal Pain Case (asterisks indicate discriminating clinical findings)

	Appendicitis	Right-sided pyelonephritis	Acute cholecystitis
Pre-/post- examination probabilities	40/35	20/5	40/60
Physical examination maneuvers to perform	Anticipated findings		
Blood pressure	Decreased	Decreased	Decreased
Pulse rate	Increased	Increased	Increased
Temperature	Increased	Increased	Increased
Bulbar conjunctiva*	No findings	No findings	Jaundice
Inspection of abdomen	No findings	No findings	Jaundice
Auscultation of abdomen	Normal	Normal	Normal
Percussion of abdomen*	Tenderness in RLQ	No findings	Pain in RUQ
Palpation of abdomen*	Tenderness in RLQ	No findings	Tenderness in RUQ
McBurney's point*	Tenderness	No tenderness	No tenderness
Psoas sign*	Positive	Negative	Negative
Obturator sign*	Positive	Negative	Negative
Murphy's sign*	Negative	Negative	Positive
Percussion tenderness in right hypochondrium*	Negative	Negative	Positive
Rectal examination*	Tenderness over the appendix	No findings	No findings
CVA tenderness*	Negative	Positive	Negative
Professional Behaviour 1	Use towels exposing the abdomen.		
Professional Behaviour 2	Expose the abdomen sufficiently.		
Professional Behaviour 3	Warm the stethoscope before auscultating the abdomen.		
Professional Behaviour 4	Warm the hands before palpating the abdomen.		
Professional Behaviour 5	Explain each examination maneuver to the patient before executing the maneuver.		

Figure 1: Nine steps of a model HDPE teaching session.

