

Teaching diagnostic reasoning: using simulation and mixed practice to build competence

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ABSTRACT

The acquisition of competence in diagnostic reasoning is essential for medical trainees. Exposure to a variety of patient presentations helps develop the skills of diagnostic reasoning, but reliance on ad hoc clinical encounters is inefficient and does not guarantee timely exposure for all trainees. We present a novel teaching series led by emergency physicians that builds upon the existing medical education literature to teach diagnostic reasoning to preclinical (2nd year) medical students. The series used emergency department simulations involving patient actors and simulated vital signs to provide students with exposure to three acute care presentations: chest pain, abdominal pain, and headache. Emergency physicians coached and provided immediate feedback to the students as they actively worked through diagnostic reasoning. The participating medical students reported benefit from these sessions immediately following the sessions and in an 18-month follow-up survey where the students could consider the impact of the sessions on their clinical clerkship. Students felt that the sessions had assisted them in recognizing the key features of relevant diagnoses during clerkship as well as providing a helpful adjunct to their in-class learning.

RÉSUMÉ

Il est essentiel que les stagiaires en médecine acquièrent de la compétence dans le raisonnement diagnostique. L'exposition à divers tableaux cliniques peut certes aider à l'acquisition des connaissances dans le raisonnement diagnostique, mais le fait de placer les étudiants devant divers cas cliniques de manière aléatoire n'est pas une méthode efficace ni un gage d'exposition suffisante. Il sera donc question d'une série novatrice de cours, dirigée par des urgentologues et fondée sur la documentation existante sur l'enseignement de la médecine, qui visait à présenter le raisonnement diagnostique à des étudiants en médecine, en phase préclinique (2^e année). La série consistait en des simulations de cas au service des urgences et avait pour but d'exposer les étudiants à trois tableaux cliniques aigus, soit aux douleurs thoraciques, aux douleurs abdominales et aux céphalées, actualisés par de faux malades ayant des signes vitaux factices. Les urgentologues surveillaient les étudiants et faisaient immédiatement de la rétroaction à mesure que ces derniers progressaient laborieusement dans le raisonnement diagnostique. Les étudiants en médecine qui avaient participé à la série de cours ont indiqué que celle-ci leur avait été utile, dans un questionnaire d'enquête rempli immédiatement après les séances de formation ainsi que 18 mois plus tard alors qu'ils étaient en mesure d'évaluer la portée durant leur stage clinique. Les étudiants étaient d'avis que ces

séances les avaient aidés à reconnaître les éléments clés de diagnostics justes durant leur stage clinique, en plus de leur fournir un complément de formation utile à l'apprentissage en classe.

Keywords: simulation, diagnostic reasoning, medical education

BACKGROUND

Teaching diagnostic reasoning to medical trainees is important but challenging to accomplish. Instructors must identify and correct learner deficiencies in medical content knowledge, patient assessment abilities, and problem-solving skills. The recommended methods for optimally teaching diagnostic reasoning include:

- 1) Early case-based teaching, which allows students to create illness scripts, aiding in the development of essential content knowledge.^{1,2}
- 2) Teaching with multiple similar cases (mixed practice) to encourage students to compare the differentiating features of illnesses with similar presenting symptoms.¹
- 3) Active student involvement in the problem-solving process to facilitate metacognition.³
- 4) Ensuring that case practice mimics the clinical setting as much as possible as this is where trainees will apply their knowledge.⁴

Errors in diagnostic reasoning have been implicated as a challenge to patient safety, particularly in emergency departments (ED).^{5,6} Additionally, concerns have been raised about the inefficiency of the clinical environment in providing systematic exposure to specific clinical conditions for both undergraduate and postgraduate trainees.^{7,8} The importance of work-based learning through actual patient encounters cannot be overstated.

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However, with a random collection of clinical exposures during training, not all trainees experience the repeated practice that develops diagnostic acumen across a spectrum of clinical conditions. Geoff Norman suggests the addition of “carefully engineered simulated settings” for clinical learning as a solution.⁷

It has also been suggested that simulation may be useful for improving diagnostic education to reduce errors.⁵ Clinical teachers should explicitly foster the ability of students to incorporate both analytical and non-analytical reasoning strategies into their diagnostic approach.^{4,9} For preclinical medical students, realistic patient encounters can contribute to the experiences they may draw upon for non-analytical reasoning strategies such as pattern recognition.

PURPOSE

We designed a practice-based simulation program to teach diagnostic reasoning to undergraduate medical students. These sessions were facilitated by experienced emergency physicians and allowed the students to practice diagnosis in a supervised setting with feedback.

DESCRIPTION OF THE INNOVATION

In these sessions, the second-year medical students were exposed to patient actors in a simulated ED environment with one of three acute care presentations: chest pain, abdominal pain, or headache. These complaints were chosen by consensus as common ED presentations that were synchronized with the content of the second-year curriculum. For example, the chest pain sessions (featuring patient actors with symptoms suggestive of pulmonary embolism and aortic dissection) were taught in the autumn during the circulation and respiration course. Each of the three sessions exposed students to two different patient actors with the same chief complaint but different key features and diagnosis (for example, a middle-aged female actor presenting with a headache and features typical of viral meningitis, and then a second patient actor with features typical of subarachnoid hemorrhage). After learning about the key diagnoses in their pre-reading, the students were given a stem and then guided through both an interview with the standardized patient and a physical exam, with ongoing faculty feedback. The session was designed to model the diagnostic reasoning process explicitly and is shown in Figure 1.

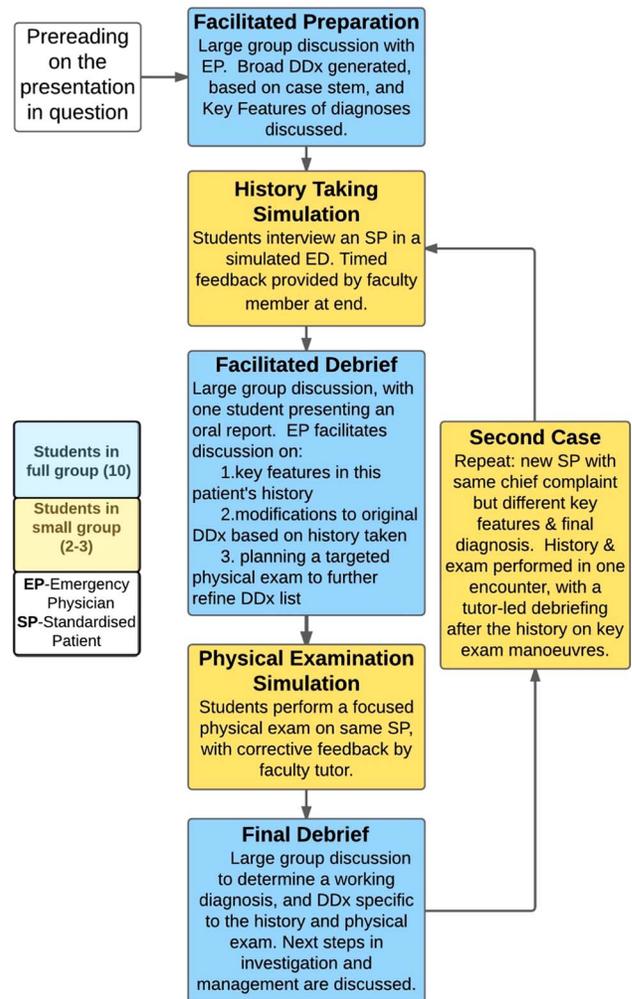


Figure 1. Flow chart of clinical reasoning session design.

Students were encouraged to identify key features from the history and physical exam to discriminate between possible diagnoses, an evolution for them from a “head to toe” rote physical examination. After every stage, students were stopped and asked what they thought the diagnosis was and why. Students were given feedback by tutors on their identification of key features, their physical examination skills, and the manoeuvres chosen for their targeted physical examinations. Having two cases with the same clinical complaint but contrasting diagnoses allowed the learners to engage in mixed practice, maximizing efficiency in the development of illness scripts for these presentations.¹ Realism and a sense of urgency were provided by attaching the actors to monitors, showing simulated vital signs reflective of the diagnosis, such as hypoxia and tachycardia. Props were used (such as spray

water indicating diaphoresis), and the actors were asked to be restless, uncomfortable, or tachypneic as appropriate during the interviews.

A cohort of 50 medical students assessed the program at two time points: immediately following the sessions, and in an 18-month follow-up survey during the clerkship, 4 months prior to graduation. Immediately afterwards, student evaluations were universally positive. Students commented that experiencing the process of diagnostic reasoning in action had allowed them to understand “what a doctor actually does,” unmasking a process previously unrecognized by them. Students labelled them as “the best sessions in medical school,” appreciating the high yield of simulated realistic clinical practice. The purpose of the follow-up survey was to understand whether (and how) these sessions might have changed perceived diagnostic reasoning ability and patient care during the clerkship. Fifty students (50%)

responded to the four-question survey. Their prompted comments following the questions were recorded in free text, without cueing for content or theme, and a thematic analysis of comments was performed by two separate raters. If the raters differed, the themes were assigned after discussion to reach consensus. The results are shown in Table 1. These responses suggest that the sessions were memorable to students and significant in helping them develop an approach to assessing undifferentiated patient complaints during the clerkship.

DISCUSSION

With the advent of competency-based medical education, the need to document specific learner outcomes throughout students’ development is increasingly important. This simulation-based learning program was developed for novice learners to introduce the process

Table 1. Results from anonymous medical student survey 18 months after the last simulation session on diagnostic reasoning

Survey question (<i>n</i> = 50)	Yes	No	Unsure
Q1: Do you remember taking the three clinical reasoning sessions (Chest Pain, Abdominal Pain, and Headache) during the second year of Clinical Skills?	49 (98)	0 (0)	1 (2)
Q2: Do you feel that these sessions have had a positive impact on the development of your clinical reasoning skills?	46 (92)	2 (4)	2 (4)
Q3: Are there any skills, lessons, or pearls that you remember learning specifically from one of these sessions?	27 (54)	12 (24)	11 (22)
Q4: Do you feel that any aspect of these sessions has influenced either a specific patient care encounter or your general ability to care for patients during clerkship?	28 (56)	8 (16)	14 (28)
Thematic analysis of comments for Q3 (<i>n</i> = 27)*			Number of responses (%)
*Note: Totals exceed 27 as some comments had multiple themes.			
Contributed toward system-based diagnostic reasoning			6 (22)
The importance of broad differentials			10 (37)
Reinforced key features of dangerous pathologies			17 (63)
Simulation was valuable for remembering presentations			4 (15)
Thematic analysis of comments for Q4 (<i>n</i> = 20)			
Identified patient pathology during clerkship based on content from the sessions			5 (25)
Student self-reports that the sessions improved their approach to diagnostic approach in clerkship			13 (65)
Excerpted comments			
Q3 - “The most important and memorable lesson of these simulations was how you felt during an acute situation. I remember the distressed patient very clearly and the importance of recognizing a serious acute clinical scenario.”			
Q3 - “Taking into account the overall appearance of the patient [gestalt]. In AAA, they look really unwell, hypotensive, sweaty, radiating back pain. That really stood out to me, was a helpful addition to didactic learning and was immediately relevant when I saw one in real life.”			
Q3 - “Chest pain session was particularly useful. I use those skills almost daily.”			
Q4 - “I was able to recognize temporal arteritis in a family medicine office [later confirmed].”			
Q4 - “Having seen how ER [emergency room] docs approach clinical scenarios, I have developed a similar systematic and organized approach.”			
Q4 - “These sessions have definitely improved my ability to formulate differentials and begin to decipher causes of these multi-system chief complaints. Specifically, within primary care [emergency, family, and internal medicine], I have had a more robust approach to patients presenting with these symptoms, and at times have caught some atypical presentations of diseases...that would not have been on my radar.”			

of diagnostic reasoning and allow coached, deliberate practice of this skill. Medical students participating in the program had self-reported gains in understanding of diagnostic reasoning and perceived improved diagnostic ability, which persisted 18 months later. While this curricular innovation was developed for preclinical medical students, its design principles could be transferable to more advanced learners using modified cases and higher-level assessment.

Most Canadian emergency medicine (EM) programs have incorporated simulation into their training, with learning outcomes most commonly being the development of resuscitation and crisis resource management skills.¹⁰ Simulation is also effective for learning procedural skills, particularly infrequently performed critical procedures.¹⁰ This program demonstrates the potential utility of the simulated clinical environment as a complementary venue to the busy ED where novice learners' ability in diagnostic reasoning can be fostered and assessed.

SUMMARY

We describe a practical teaching series that builds upon existing medical education literature to teach diagnostic reasoning skills to medical trainees. The use of a simulated clinical environment, mixed case practice, and immediate feedback from emergency physicians is shown to be a feasible framework, which has benefited medical students in their clinical clerkship. These sessions could be scaled and tailored to advance the diagnostic

reasoning of trainees at higher levels, including those in postgraduate EM training programs.

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