Published in final edited form as:

Am J Surg. 2018 June ; 215(6): 995–999. doi:10.1016/j.amjsurg.2017.11.030.

Improving Diagnosis in Healthcare: Local Versus National Adoption of Recommended Guidelines for The Clinical Breast Examination

Jay N. Nathwani, MD, Anna Garren, Shlomi Laufer, PhD, Calvin Kwan, BS, and Carla Pugh, MD, PhD

University of Wisconsin, General Surgery, Madison, WI, USA

Abstract

Background—This study explores the long-term effectiveness of a newly developed clinical skills curriculum.

Methods—Students (N=40) were exposed to a newly developed, simulation-based, clinical breast exam (CBE) curriculum. The same students returned one year later to perform the CBE and were compared to a convenience sample of medical students (N=15) attending a national conferences. All students were given a clinical vignette and performed the CBE. CBE techniques were video recorded. Chi-squared tests were used to assess differences in CBE technique.

Results—Students exposed to a structured curriculum performed physical examination techniques more consistent with national guidelines than the random, national student sample. Structured curriculum students were more organized, likely to use two hands, a linear search pattern, and include the nipple-areolar complex during the CBE compared to national sample ($p < .01$).

Conclusions—Students exposed to a structured skills curriculum more consistently performed the CBE according to national guidelines. The variability in technique compared with the national sample of students calls for major improvements in adoption and implementation of structured skills curricula.

Keywords

Medical student education; Curriculum Development; Physical Examination

Introduction

While recognized as essential in patient work up, major deficiencies in performance of physical examination skills from the medical student to the staff physician level have been

Corresponding Author: Carla M. Pugh MD, PhD, Department of Surgery, University of Wisconsin Hospital and Clinics, 600 Highland Avenue, K6/135, Madison WI 53792, 608-263-5218, pugh@surgery.wisc.edu.

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

identified (1). Two, recent studies found that staff physicians do not follow national guidelines for the clinical breast examination (CBE) (2, 3). For example, recent work relating to the CBE found that disregarding national guidelines can result in unacceptable mass detection rates (2). Furthermore, studies exploring quality and frequency of teaching physical examinations have identified an overall decrease in prevalence, with time dedicated to teaching being as low as 14% while rounding on patients (4, 5, 6).

The medical community has recently pushed for direct assessments of physical examination skills in order to ensure delivery of safe and competent patient care. In response to this push, the National Board of Medical Examiners added a physical exam assessment to the United States Medical Licensing Examination Step 2 (7, 8) and the Education Commission for Foreign Medical Graduates now requires skills testing for medical licensure (9). This emphasis on formal evaluation of physical examination technique has fueled motivation at the medical school level to develop and introduce formalized physical examination curricula (8).

Studies exploring proper teaching of physical examination emphasize the importance of having a formal lecture component complimented by a hands-on component (10, 11). In addition to using a hands-on component in teaching, the use of simulated, silicone breast models have been widely tested and accepted as mediums for teaching physical examination (10, 14, 12, 13). Based on our own literature search, we have developed a structured, hands-on physical examination curriculum based on previous literature findings for teaching the CBE.

The purpose of this study was to investigate whether medical students adhere to national guidelines for the Clinical Breast Examination after having been exposed to a newly developed, structured curriculum. We hypothesize that a random sample of medical students at national meetings would perform the CBE differently compared to students exposed to a structured curriculum.

Methods

Students from Mid-western Medical School

Medical students at a mid-western medical school were introduced to the clinical breast exam as part of their clinical skills curriculum during their first and second years of medical school. Students rotated through stations for breast anatomy, pathology and physical exam technique station:

Anatomy station: focused on an overall review of breast anatomy, using illustrations and photographs of the relevant soft tissue structures and lymphatic drainage of the breast and axilla. Two physical models of healthy breasts were presented to allow students to appreciate normal breast densities.

Pathology station: exposed students to abnormal exam findings using a variety of interchangeable materials in silicone breast models to simulate various pathologies such as fibroadenoma, cysts, and malignant disease.

Technique station: consisted of two silicone breast models with no pathological findings in addition to a third wearable breast model with palpable supraclavicular nodes. Students were taught physical examination methods with special emphasis placed on performance of the examination adhering to current guidelines (15, 2). Visual aid cards provided pictorial directions for performing the exam. Students were first instructed to perform visual examination. Students were instructed to use the middle three fingers for palpation and were introduced to three techniques: circular, up-and-down, and radial search patterns. Palpation was to occur at three depths. Teachers observed students during practice and provided feedback and correction on technique elements when indicated in order to follow current, national guidelines.

During their third year of medical school (one year after initial teaching), video data was collected from the same students during their Objective Structured Clinical Examination (OSCE) as they performed a physical examination using a breast simulator with a palpable mass during an objective, structured clinical examination.

National Medical Students

A convenience sample of medical students were recruited from two national medical specialty meetings: the American Congress of Obstetricians and Gynecologists (ACOG) and American Academy of Family Physicians (AAFP). Students were given a clinical vignette and asked to perform the clinical breast exam using a breast simulator that contained a solitary, deep, hard mass 2 cm in size (2). Video data was collected at designed exhibit booths equipped with a breast simulator, a dedicated laptop computer, one primary webcam (either Logitech C920 or Logitech Webcam Pro 9000) positioned directly above and focused on the simulator, and a secondary webcam on standby in case of data corruption or fragmentation.

Video data

Each video was reviewed by two blinded raters who separately coded physical examination techniques based on the criteria mentioned below, including a systematic approach, search pattern, search technique, number of hands used, amount of fingers used, and whether the nipple-areolar complex was included.

Systematic refers to participants who performed the CBE in a predictable, ordered and methodical manner. Search pattern was classified as a) linear, b) circular, c) radial, or d) other. Search technique described the finger movements of the participant, independent of the search pattern used, and was categorized as a) circular rubbing, b) linear rubbing, c) up and down or “button pushing”, d) piano fingers in which each finger separately performs an up and down motion, and e) mixed technique (2). Hand number assessed the number of active hands used during the exam. Amount of fingers categorized the use of fingers as either finger tips only, 50% full fingers, full fingers or mixed. Finally, coding included whether or not the nipple-areolar complex was incorporated into the physical examination. Inter-rater reliability was assessed using Cohen’s kappa (κ).

Data Analysis

A Pearson chi-square test was used to compare national and mid-western medical students in the categories of systematic approach, search pattern, search technique, number of hands used, amount of fingers used, and nipple-areolar palpation. Statistical analysis was performed using SPSS 23 (16). The study was approved by University of Wisconsin IRB panel. Involvement in the study was voluntary and students had the opportunity to opt out.

Results

40 medical students (58% female) from a single mid-western medical school and 15 medical students (67% female) recruited from national conferences completed the video-recorded structured CBE. Mid-western medical students were all in the third year of medical school while those from national conferences ranged from the first to fourth year of medical school (Median = 3, SD = 1) (Table 1). Inter-rater reliability was calculated ($k=.79$) (2).

Assessment of Mid-western Medical School Students During OSCE

95% were very systematic while performing the exam. 93% of students used a linear search pattern. 73% used a circular rubbing search technique. 75% of students used two hands. 83% used their fingertips to palpate the breast. 90% of students included the nipple-areolar complex in the physical exam. Medical students exposed to the physical examination curriculum had an 83% pathology detection rate (Figure 1).

Assessment of National Medical Students

67% were very systematic while performing the exam. 73% used a circular search pattern. 40% used a circular rubbing search technique. 66% of students used one hand while performing the exam. 93% used their fingertips to palpate the breast. 33% included the nipple-areolar complex in the physical examination. National medical students had a 56% pathology detection rate (Figure 1).

Comparison of Medical School Students and National Students

The mid-western medical school students exposed to the physical exam curriculum performed a physical exam more consistent with national guidelines than the national sample. Students trained with the physical exam curriculum were more systematic compared to the national sample ($\chi^2 = 8.55, p = .014$). Most of the medical school students used a linear search pattern in contrast to the national sample who mostly used a circular search pattern ($\chi^2 = 34.28, p < .001$). Medical school students were more likely to use a circular rubbing technique compared to national students ($\chi^2 = 7.92, p = .095$). Medical students were also more likely to use two hands together while performing the physical exam ($\chi^2 = 11.51, p = .009$). Medical students and national students had a similar frequency in using their finger tips ($\chi^2 = 1.117, p = .290$). Medical school students were also more likely to include the nipple-areolar complex in the physical exam compared to the national sample ($\chi^2 = 11.89, p = .003$).

Discussion

The medical community is placing increasing emphasis on physical examination training and assessment. This study examined how a newly developed, structured physical exam curriculum designed to teach the clinical breast examination could affect medical student performance over time. We hypothesized that a random sample of medical students at national meetings would perform the CBE differently compared to students exposed to a structured curriculum. Our analysis shows that one year later, students who were exposed to the CBE curriculum were more consistent in performing the exam using techniques that aligned with standard guidelines as compared to students from a convenience sample. We also found that individuals exposed to the curriculum had significantly higher mass detection rates. These findings suggest that a standardized curriculum is an effective intervention to teach students how to consistently perform a physical exam skill and maximize the utility of physical examination.

Evaluating Differences in Medical School Students and the National Sample

Medical students who were exposed to the CBE curriculum showed a significant preference for following national guidelines compared to their national cohort counterparts. In particular, they were more systematic, likely to use a linear search pattern with a circular rubbing search technique, and include the nipple-areolar complex. The high levels of consistency within categories of assessment (i.e. search pattern, number of hands used, etc...) may be due to the following reasons.

First, our standardized curriculum highlights and integrates important aspects of teaching identified by other studies. Particularly, we were careful to include both a lecture and practice session for medical students to immediately exercise physical examination techniques (10, 11). During the practice session, teachers would immediately prevent development of potential poor physical examination skills by guiding students to perform proper techniques (11). In addition to a lecture and hands on component, we were careful to integrate national guidelines and high quality research regarding the clinical breast examination and aspects that are considered critical to successful outcomes. These critical aspects include appropriate minimal force requirements when palpating for masses and excluding physical examination techniques that are recognized to have high false negative rates (2, 17). For example, it was shown that having a rubbing search pattern increased the chances of detecting a breast mass by nearly four times in comparison to the inferior piano finger technique. Placing an emphasis on national guidelines, which highlights the importance of a rubbing search technique immediately encourages students to perform physical examination in an ideal fashion, eliminating distracting methods with lesser value.

We believe many potential reasons exist for why students both at the levels of medical school and national sample may not have performed an examination consistent with national guidelines. Medicine has traditionally been taught by apprenticeship model (18). Specifically, students follow both resident and staff physicians in clinical rotations and are exposed to a variety of physical examination techniques. While formal curricula that emphasizes particular exam skills are gaining traction, experiences in the clinical years of medical school may cause students to adopt their mentors' techniques (18). Medical students

may be influenced by their resident and staff physician teachers who were not taught according to a standardized curriculum. This influence may lead to the performance of physical examination techniques associated with lower mass detection rates.

Maintaining and Improving Resident and Physician Training Standards

If resident and staff physicians can play an influential role in how medical students perform physical examination, then additional physical examination assessment checkpoints may be warranted in order to maintain standard performance. Currently, physical exams are formally assessed in the medical school OSCE and during physician licensing in Step 2 clinical skills (7, 8). After this period, there are currently no formal assessments of exam skills, allowing individuals past this particular level of training free reign on physical examination techniques may lead to selection of techniques associated with lower pathology detection rates.

Some groups have recognized the potential danger in not providing additional training or assessment to resident physicians and started to introduce curriculums to improve practice (13, 19). Studies relating to teaching the breast examination describe that training periods lasting as little as 20 minutes can improve physical examination performance and breast mass detection rates (20). As methods similar to these published studies remain in their infancy, we believe our developed standardized curriculum could serve as a blue print for how trainees could be effectively taught to maintain or improve upon examination techniques. In addition to a possible curriculum for residents, research shows that staff physicians use continuing medical education events (CME) as opportunities to learn and improve upon medical knowledge and skills (3). Similar to resident physicians, staff could be exposed to an abbreviated curriculum at CME events to maintain and improve upon their physical exam skills. Overall, such work towards maintaining and improving skills would hopefully result in proper teaching of medical students during clinical rotations, eliminating potential opportunities of learning incorrect technique.

This study has several limitations. Our cohort is small as we evaluated only medical students from a single institution. In addition, our sample of national students is subject to selection bias as we included only those who chose to attend a national conference and approach our booth, and therefore may not be representative of the average medical student. Although the mid-western medical students demonstrated remarkable uniformity after training, little is known about skill decay over time and the influence of other teaching and clinical environments on how they perform the CBE. Thus, long term analysis is necessary to determine the longevity of our intervention. Finally, we examined only the technique and execution of the CBE using video data. Future work should look at accuracy using sensor data as well as post participation surveys that explore specific exam findings.

Conclusion

This study explores the long term effectiveness of a newly developed physical examination curriculum. Our results suggest that a structured curriculum guided by evidenced-based practice can lead to higher quality performance.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

Funding: Funding sources included an NIH R01 Grant (R01 EB011524) and National Institute of Health, T32 Educational Grant (T32CA090217).

References

1. Janjigian MP, Charap M, Kalet A. Development of a hospitalist-led-and-directed physical examination curriculum. *J Hosp Med*. 2012 Oct; 7(8):640–3. See more at: <https://www.functionalmedicine.org/conference.aspx?id=2963&cid=0§ion=t592#sthash.dDiWb96Q.dpuf>. [PubMed: 22791266]
2. Laufer S, D'Angelo AL, Kwan C, Ray RD, Yudkowsky R, Boulet JR, McGaghie W, Pugh CM. Rescuing the Clinical Breast Examination: Advances in Classifying Technique and Assessing Physician Competency. *Annals of Surgery*. 2017 In Press.
3. Cheng TM, Freund KM, Winter M, Orlander JD. Limited Adoption of Current Guidelines for Clinical Breast Examination by Primary Care Physicians Educators. *Journal of Women's Health*. 2015; 24(1):11–17.
4. Germanakis I, Petridou ET, Varlamis G, et al. Skills of primary healthcare physicians in paediatric cardiac auscultation. *Acta Paediatr*. 2013 Feb; 102(2):e74–8. See more at: <https://www.functionalmedicine.org/conference.aspx?id=2963&cid=0§ion=t592#sthash.dDiWb96Q.dpuf>. [PubMed: 23082851]
5. Beran MC, Awan H, Rowley D, et al. Assessment of musculoskeletal physical examination skills and attitudes of orthopaedic residents. *J Bone Joint Surg Am*. 2012 Mar 21.94(6):e36. See more at: <https://www.functionalmedicine.org/conference.aspx?id=2963&cid=0§ion=t592#sthash.dDiWb96Q.dpuf>. [PubMed: 22438009]
6. Stickrath C, Noble M, Prochaska A, et al. Attending rounds in the current era: what is and is not happening. *JAMA Intern Med*. 2013 Jun 24; 173(12):1084–9. See more at: <https://www.functionalmedicine.org/conference.aspx?id=2963&cid=0§ion=t592#sthash.dDiWb96Q.dpuf>. [PubMed: 23649040]
7. Papadakis. The Step 2 Clinical-Skills Examination. *New England Journal of Medicine*. 2004; 350(17):1703–1705. [PubMed: 15102993]
8. Gilliland WR, La Rochelle J, Hawkins R, Dillon GF, Mechabor AJ, Dyrebye L, Papp KK, Durning SJ. Changes in clinical skills education resulting from introduction of the USMLE Step 2 clinical skills examination. *Medical Teacher*. 2008; 30(3):325–327. [PubMed: 18484462]
9. Whelan GP, Boulet JR, McKinley DW, Norcini JJ, Van Zanten M, Hambleton RK, Burdick WP, Peitzman SJ. Scoring standardized patient examinations: lessons learned from the development and administration of the ECFMG Clinical Skills Assessment. *Medical Teacher*. 2005; 27(3):200–206. [PubMed: 16011942]
10. Pilgrim C, Lannon C, Harris RP, Cogburn W, Fletcher SW. Improving Clinical Breast Examination Training in a Medical School. *Journal of General Internal Medicine*. 1993; 8(12):685–688. [PubMed: 8120686]
11. Fagan MJ, Griffith RA, Obbard L, O'Connor CJ. Improving the Physical Diagnosis Skills of Third-year Medical Students: A Controlled Trial of a Literature-based curriculum. *J Gen Int Med*. 2003; 18(8):652–655.
12. Adam CK, Hall DC, Pennypacker HS, Goldstein MK, Hench LL, Madden MC, Stein GH, Catania AC. Attention, Perception, & Psychophysics. 1976; 20(3):163–167.
13. Hall DC, Goldstein MK, Stein GH. Progress in manual breast examination. *Cancer*. 1977; 41(1): 364–370.

14. Pennypacker HS, Bloom HS, Criswell EL, Neelakantan P, Goldstein MK, Stein GH. Towards an effective technology of instruction in breast self-examination. *Int J Ment Health*. 1982; 11(3):98–116.
15. Saslow D, Hannan J, Osuch J, Alciati MH, Baines C, et al. Clinical breast examination: Practical recommendations for optimizing performance and reporting. *CA: A Cancer Journal for Clinicians*. 2004; 54:327–344. [PubMed: 15537576]
16. IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp;
17. Laufer S, Cohen ER, Kwan C, D'Angelo ALD, Yudkowsky R, Boulet JR, McGaghi WC, Pugh CM. Sensory Technology in Assessments of Clinical Skills. *NEJM*. 2015; 372(8):784–786.
18. Max J. The lost art of the physical exam. *Yale Medicine*. 2009; 43(2) [Accessed 05/19/2017] <http://yalemedicine.yale.edu/winter2009/features/feature/51079>.
19. Chalabian J, Garman K, Wallace P, Dunnington G. Clinical breast evaluation skills of house officers and students. *The American Journal of Surgery*. 1996; 62(10):840–845.
20. Hall DC, Adams CK, Stein GH, Stephenson HS, Goldstein MK, Pennypacker HS. Improved detection of human breast lesions following experimental training. *Cancer*. 1980; 46(2):408–414. [PubMed: 7388779]

Figure 1.
Comparison of physical examination performance between mid-western medical school students and national conference medical students.

Table 1

Demographics for students who participated in the study.

	Mid-western Medical Students (n=40)	National Conference Medical Students (n=15)	Total (n=55)
Gender:			
Female	23 (58%)	10 (67%)	33 (60%)
Number of exams performed per week:			
0–5	11	12	23
6–10	8	1	9
11–15	4	1	5
16–20	10	0	10
21–25	0	1	1
26+	4	0	4
Year in medical school:			
1	0	2	2
2	0	1	1
3	40	7	47
4	0	5	5