

Conference Didactic Planning and Structure: An Evidence-based Guide to Best Practices from the Council of Emergency Medicine Residency Directors

D. Brian Wood, MD*
Jaime Jordan, MD†
Rob Cooney, MD, MSMEd‡
Katja Goldflam, MD§
Leah Bright, DO¶
Michael Gottlieb, MD||

*St. Joseph's Medical Center, Department of Emergency Medicine, Stockton, California
†Ronald Reagan UCLA Medical Center, David Geffen School of Medicine, Department of Emergency Medicine, Los Angeles, California
‡Geisinger Commonwealth School of Medicine, Department of Emergency Medicine, Scranton, Pennsylvania
§Yale University, Department of Emergency Medicine, New Haven, Connecticut
¶Johns Hopkins University, Department of Emergency Medicine, Baltimore, Maryland
||Rush University Medical Center, Department of Emergency Medicine, Chicago, Illinois

Section Editor: John Burkhardt, MD, MA

Submission history: Submitted February 4, 2020; Revision received April 2, 2020; Accepted May 12, 2020

Electronically published July 3, 2020

Full text available through open access at http://escholarship.org/uc/uciem_westjem

DOI: 10.5811/westjem.2020.5.46762

Emergency medicine residency programs around the country develop didactic conferences to prepare residents for board exams and independent practice. To our knowledge, there is not currently an evidence-based set of guidelines for programs to follow to ensure maximal benefit of didactics for learners. This paper offers expert guidelines for didactic instruction from members of the Council of Emergency Medicine Residency Directors Best Practices Subcommittee, based on best available evidence. Programs can use these recommendations to further optimize their resident conference structure and content. Recommendations in this manuscript include best practices in formatting didactics, selection of facilitators and instructors, and duration of individual sessions. Authors also recommend following the Model of Clinical Practice of Emergency Medicine when developing content, while incorporating sessions dedicated to morbidity and mortality, research methodology, journal article review, administration, wellness, and professionalism. [West J Emerg Med. 2020;21(4)999–1007.]

BACKGROUND

Graduate medical educators are responsible for training well-rounded physicians who are prepared to practice their specialty independently following graduation. A significant component of their education comes from “regularly scheduled didactic sessions” as prescribed by the Accreditation Council for Graduate Medical Education (ACGME) Common Program Requirements.¹ Specialty-specific ACGME requirements provide further recommendations regarding the amount of dedicated didactic time that must be provided and general themes that must be covered such as journal review, morbidity and mortality (M&M) conference, and research seminars.²

Beyond these general requirements, programs have the flexibility to develop their conference structure and content however they choose. This has led to much variation in conference structure, content, and how specific conferences

such as M&M are conducted at each individual program. This variation leads to very different experiences for residents based on the residency they attend and has the potential of producing graduates with uneven exposure to key didactic topics during their training. To our knowledge, no evidence-based guidelines or best practices exist to aid educators in the design or implementation of residency didactic curricula. This article provides an evidence-based summary of the literature and best practice recommendations for didactics as it pertains to conference structure and content with a focus on emergency medicine (EM) residency programs.

CRITICAL APPRAISAL OF THE LITERATURE

This is the fifth article in a series by the Council of Emergency Medicine Residency Directors (CORD) Best Practices Subcommittee.³⁻⁶ A medical librarian performed a

search of Medline, Embase, Web of Science, CINAHL, and ERIC for articles published from inception of each database through February 7, 2019, using keyword combinations of education level (medical, graduate, internship, house staff, PGY, and residency), as well as didactics (or conference or lecture) with differing frequency (daily, weekly, bi-weekly, and monthly). Two authors then screened each of the articles independently for papers addressing the three themes: conference structure; conference topics; and M&M sessions. Given the extent of M&M literature obtained, the authors decided to separate articles dedicated specifically to that topic.

The initial literature search yielded 1,199 articles, which were then categorized and provided to content experts for consideration of inclusion in this review. A total of 101 articles were selected for inclusion in this review. Each best practice statement has a corresponding level of evidence and grade based on the Oxford Centre for Evidence-Based Medicine criteria (Tables 1 and 2).⁷ When there was insufficient

supporting data, the authors based recommendations on their experience and consensus opinion. The entire CORD Best Practices Subcommittee reviewed the manuscript after which time it was posted on the CORD website for review by the entire CORD community.

OVERALL CONFERENCE STRUCTURE

Many factors may influence programmatic decisions regarding timing, frequency, and duration of didactic curricula in addition to the desire to optimize education. These may include regulatory requirements, clinical work schedules, locations of faculty and trainees, personnel (teachers and learners), and space availability. The concentrated blocked weekly didactic format (i.e., a single, dedicated conference half day per week) is highly prevalent in other specialties such as family medicine and neurology, in addition to EM.^{8,9}

Residents appreciate having protected educational time and, compared to shorter daily formats, the blocked weekly didactic structure has demonstrated higher learner satisfaction, improved attendance, and fewer interruptions.¹⁰⁻¹³ While learners perceive improved learning with this format, studies have failed to demonstrate differences in objective outcomes such as scores on standardized tests or board examinations.¹⁰⁻¹⁴ However, given the perceived and logistical benefits, including improved attendance, which is essential to maintaining accreditation, combined with the nature of EM clinical schedules, the authors recommend the blocked weekly format.

The ACGME places certain requirements on programs regarding faculty participation in didactics. These include that each core faculty member must attend at least 20% of planned didactic experiences and that EM faculty members must present at least 50% of resident conferences.² While there is limited data evaluating faculty conference attendance and objective learning outcomes, one study found that higher faculty conference attendance was associated with higher pass rates on EM oral boards for trainees.¹⁵ Additionally, residents perceive that faculty presence at conference facilitates learning.^{16,17} One approach to increase faculty presence at conference would be to offer incentives for attending conference.¹⁸ Providing continuing medical education credit for didactic conferences can also increase faculty attendance.¹⁹

Conference didactics are most often presented by faculty or residents.^{8,9,16,15,20} Some have advocated for residents to give didactic lectures to ease the burden on faculty time and sharpen resident public speaking skills.²¹ While residents perceive that faculty lectures greatly contribute to their educational experience,^{11,16} limited data has demonstrated that residents can learn from resident-given lectures, and that no difference in learning outcomes (e.g., test scores, board passage rates) were found between resident-given lectures vs faculty-given lectures.^{15,20,22} Additionally, it may be appropriate to incorporate other professionals (e.g., nurses, pharmacists) as lecturers depending on the topic. Smith et al found no difference between lecture evaluation scores for nurse-given lectures compared to

Table 1. Oxford Centre for Evidence-Based Medicine criteria.⁷

Level of Evidence	Definition
1a	Systematic review of homogenous RCTs
1b	Individual RCT
2a	Systematic review of homogenous cohort studies
2b	Individual cohort study or a low-quality RCT*
3a	Systematic review of homogenous case-control studies
3b	Individual case-control study**
4	Case series or low-quality cohort or case-control study***
5	Expert opinion

*<80% follow up; **, includes survey studies; ***, studies without clearly defined study groups.
RCT, randomized controlled trial.

Table 2. Oxford Centre for Evidence-Based Medicine grades of recommendation.⁷

Level of Evidence	Definition
A	Consistent level 1 studies
B	Consistent level 2 or 3 studies or extrapolations* from level 1 studies
C	Level 4 studies or extrapolations* from level 2 or 3 studies
D	Level 5 evidence or troublingly inconsistent or inconclusive studies of any level

*“Extrapolations” are where data is used in a situation that has potentially clinically important differences than the original study situation.

faculty- and resident-given lectures.²³

Given that the specialty of EM interfaces with many other disciplines, it may also be beneficial to incorporate multidisciplinary conferences with other medical professionals into the didactic curriculum to enable collaborative learning, coordinated patient care, and a better understanding of the roles of other professions.^{24–26} The ACGME recommends the inclusion of multidisciplinary conferences as part of the resident didactic experience.² Limited research suggests that trainees value this type of experience^{24,27}; however, robust objective data on learning outcomes are lacking.

Instruction should be tailored to the level of the learner.^{28,29} However, this may be especially challenging in program-wide didactic conferences in which the learners differ significantly in terms of stages of training and faculty are at varying career stages and experience. In recent years, we have seen the development of a national EM curriculum specific to the training level and the nearly universal presence of a dedicated intern orientation in residency programs.^{30,31} To date, there are no objective data evaluating training level-specific didactics on learning outcomes; however, faculty and residents have been shown to view this targeted instruction positively.^{32,33}

Resident didactic instruction has traditionally been delivered via lectures despite calls for alternatives.^{34,35} Common criticisms of lectures include lack of engagement due to an emphasis on passive learning,³⁶ overwhelming students' ability to learn by providing too much information,³⁷ and waning attention due to the duration of the session.³⁸ Despite calls to minimize the use of lectures, data support their continued effectiveness as a teaching modality.^{39–41} The common criticisms can be overcome through intentional learner-centered instructional design.

Cognitive load theory states that there are three main components involved in the creation of long-term memories: intrinsic load; extraneous load; and germane load.²⁸ While

intrinsic load and germane load are generally fixed, extraneous load is highly modifiable and heavily influenced by the manner in which material is presented to learners.²⁸ Since the amount of working memory is generally fixed for a given person at a set time, increases in extraneous load (i.e., presenting information in an overly complex manner) will detract from learning and retention.²⁸ Therefore, instructors should focus on ensuring that talks are focused on delivery of information, while limiting unnecessary information or overly complex presentations of the information. Multimedia learning theory informs principles of slide design and is one effective method that can be used to increase the long-term retention of taught material⁴² (Table 3).

With regard to the duration of lectures given at conference, the notion that shorter may be better is based on data of learner attention spans.⁴⁵ In a classic study of medical students, Stuart and Rutherford found that the attention span peaked at 10-15 minutes and fell steadily thereafter, with the authors recommending that lectures not exceed 25-30 minutes.⁴⁵ In more recent years, we have seen the implementation of shorter lectures in EM both at the local and national level.^{34,46} Limited studies have compared shorter (8- to 30-minute) segments compared to the more traditional 50- to 60-minute lecture and found the learners typically prefer the shorter format^{47–49}; however, few have looked at objective learning outcomes. One study by Bryner did evaluate knowledge acquisition and retention between 20-minute and 50-minute lectures and found no significant difference.⁵⁰ More research is needed to determine the optimal length of didactic sessions with an emphasis on outcome-based evaluations.⁵¹ When it is not possible to reduce the duration of a lecture, incorporating pauses, interactive questioning, and intermittent summarization can re-engage learners and improve attention to the content.⁵²

Handouts are an additional method to increase the effectiveness of lectures. While many lecturers will distribute copies of their presentations, a more effective technique is the

Table 3. Mayer's 12 principles of multimedia learning.^{43,44}

1. **Coherence Principle:** Avoid extraneous words, pictures, and sounds. They can detract from learning.
2. **Signaling Principle:** Add cues to highlight the essential materials.
3. **Redundancy Principle:** On-screen text can detract from learning. People learn better from graphics and narration alone as opposed to graphics, narration, and on-screen text.
4. **Spatial Contiguity Principle:** Corresponding words and pictures should be presented near each other rather than far from each other on the screen.
5. **Temporal Contiguity Principle:** Corresponding words and pictures should be presented simultaneously rather than successively.
6. **Segmenting Principle:** Multimedia lessons should be presented in learner-controlled segments rather than as a continuous unit.
7. **Pre-training Principle:** When students already know the names and behaviors of system components, they will learn more from the session.
8. **Modality Principle:** Learning is more effective when words are presented as narration rather than on-screen text.
9. **Multimedia Principle:** Learning is more effective when words are combined with pictures as opposed to include words alone.
10. **Personalization Principle:** Information delivery is more effective when words are presented in a conversational style rather than formal style.
11. **Voice Principle:** Learning is more effective when narration is spoken in a friendly human voice rather than a machine voice.
12. **Image Principle:** Learning is not necessarily more effective when the speaker's image is added to the screen

concept of guided notes. Guided notes are a hierarchical outline of the presentation with key information intentionally left blank. Learners will “fill in the blanks” as the lecture progresses, thus increasing attention and discovering the relationships in the presented material. Additionally, the fact that the notes are mostly complete allows for effective note-taking and allows attention to be directed at the presenter instead of the notebook.⁵³

While lectures can still be effective, active learning has been shown to positively impact objective learning outcomes, by incorporating other instructional techniques.⁵⁴⁻⁶³ Active learning is “any instructional method that engages students in the learning process”⁶⁴ and can include techniques such as games, flipped classroom, audience response systems, case-based problems, and team-based activities.⁶

Real-time electronic broadcasts of lectures and video conferencing can be another good use of technology to support resident education.⁶⁶ This has been demonstrated to be an effective educational model that is positively viewed by trainees and can improve access and attendance at didactic offerings for both residents and faculty.⁶⁷⁻⁶⁹ For training programs with multiple sites or that have struggled with maintaining the required attendance percentage for accreditation, this may be a valuable option to consider.

Our understanding of how learning occurs has evolved as cognitive scientists continue to refine effective methods for teaching and learning. Unfortunately, effective methods are often not incorporated into medical curricula. Educators should avoid using or encouraging the use of learner-initiated summarization, highlighting and underlining, mnemonics, imagery, and rereading as these techniques have not been shown to enhance learning.⁷⁰ Effective techniques with a strong effect size include practice testing and distributed practice. Additionally, there is likely some benefit from the use of elaborative interrogation, self-explanation, and interleaving.⁷⁰

Practice testing is the use of no- or low-stakes tests that can be completed independently by the learners. These can include recall via flashcards, practice problems, or traditional types of test questions.⁷⁰ Teachers may choose to implement this technique using shared card decks or applications (apps), or web-based asynchronous question banks. Anonymous audience-response systems are popular and have also been shown to improve student learning in medical education.^{71,72} Distributed practice (also known as spaced repetition) refers to the spreading out of learning over time as opposed to massed practice or “cramming.”⁷⁰ Implementation of this technique can be accomplished by content mapping that allows for repeated exposure to the concepts from prior didactics, the use of handouts or summarization materials between didactic sessions, or by using email to re-expose learners to the material.⁷³

Elaborative interrogation involves the use of self-questioning to enhance learning. This would involve the learner seeking out the underlying rationale or etiology using questions such as “why does this occur?” Similarly, self-explanation involves directing learners to explain their logic during task

completion.⁷⁰ Educators can easily incorporate this technique through simple questioning exercises during their lectures. Interleaving is an education organizational technique in which multiple topics and themes are mixed and covered over time instead of having discrete blocks dedicated to single topics.⁷⁴

The flipped classroom, also known as the reverse classroom,⁷⁵ is an instructional design method in which independent learning, often via previously-viewed video lectures or pre-reading, is combined with face-to-face classroom activities.⁷⁶ When studied, the flipped classroom appears to be effective⁷⁷⁻⁷⁹; however, caution should be exercised as recent systematic reviews have found high methodological diversity, inconsistent results, and risk of bias.^{76,80-82} Gamification is another active learning technique, which involves the utilization of games and competition to support learning.⁸³ As a technique, gamification may support learning of skills,⁸⁴ emergency department (ED) throughput,⁸³ decision-making,⁸⁵ and medical knowledge.⁸⁶⁻⁸⁹

Team-based learning (TBL) is an instructional method used with increased frequency in both undergraduate medical education and graduate medical education, which is often combined with the flipped classroom model.⁹⁰⁻⁹³ Prior to TBL, learners are expected to prepare and complete a pre-session test individually ahead of time. During the TBL sessions, learners then work in teams to solve a series of realistic, complex problems. Faculty serve as facilitators encouraging peer-learning, cooperation, and ensuring the discussion stays on track. This approach requires upfront training of faculty in discussion facilitation and learner buy-in to prepare for sessions.^{91,94}

BEST PRACTICE RECOMMENDATIONS:

1. Didactic lectures should be administered as blocked, weekly sessions (Level 2b; Grade B).
 2. Encourage faculty attendance and participation in conference (Level 3b; Grade B).
 3. Lecture can still be an effective method to present didactic content. When this technique is used, the lecturer should ensure that their presentation complies with cognitive load theory, multimedia learning theory, and active learning principles (Level 1a; Grade B).
 4. Real-time video conferencing can be considered to improve access and attendance (Level 3b; Grade C).
 5. Educators should incorporate the use of spaced repetition and no- or low-stakes testing into didactic instruction to increase long-term retention of content (Level 1a; Grade A).
 6. Utilization of recorded lectures, flipped classroom, and gamification can supplement or replace the traditional lecture (Level 1a; Grade B).
-

Conference Topics

After a thorough review of the literature, we found no prospective studies evaluating which specific topics should be included in the conference didactic curriculum. For this reason,

the core content as described by the Model of the Clinical Practice of Emergency Medicine, or the “EM Model,”⁹⁵ is most commonly used as the de facto foundation of the conference curriculum in most residencies. While this was designed using expert consensus data, it is heavily informed by those areas most relevant to the emergency physician. In fact, during the creation of the EM Model, hospital data from over 90 million ED visits were compared to its content and found to have 82% overlap, validating the content of the EM Model.⁹⁶ The EM Model is further refined every three years to identify new areas to cover.⁹⁷ As it is used to inform board certification examinations, it is important for residents to be familiar with all of the topics covered and is a critical initial reference for most conference planners.⁹⁸ While there is no strong data to help prioritize specific subject matter during conference time, in-training examination coverage of various areas may help guide emphasis on high-yield topics.

While the EM Model may be used as a guide for resident education, conference didactics should be viewed only as one component of resident education with its unique strengths and weaknesses. As such, rather than focusing solely on “covering” all topics in the EM model, the priority of conference didactic design should be on maximizing the learning potential of this modality.⁹⁹ Additionally, some topics can best be taught through other components of resident education including clinical experience, outside reading, simulation and use of Free Open Access Medical Education (FOAM).⁴

The ACGME Program Requirements for Graduate Medical Education (GME) in EM mandate specific conference content to be taught as part of didactics.² These include five main components listed in Table 4.

Additionally, the ACGME requires a number of other specific themes to be included in residency training.² We suggest incorporating the following into your conference topics to assure completion of these requirements.

Patient Safety and Quality Improvement

Residents should be educated in a culture of safety, including understanding safety goals, diagnostic error, response to adverse events, continuous quality improvement, and ultimate accountability of the physician for the care of the patient. This can also be combined with M&M conference

Table 4. Main components of conference didactics.

1.	Curriculum presentations
2.	Quality improvement/morbidity and mortality
3.	Research seminars (including education on how to conduct and understand research in a clinical context)
4.	Journal review and evidence-based medicine concepts
5.	Administrative seminars (to include operations and administrative practices in emergency medicine)

sessions.¹⁰⁰*Professionalism*

Residents must be aware of their professional responsibilities toward their patients and peers, as well as their relationship with the health system on a local and national level. Residents should also appreciate the necessity of their own need for ongoing education after residency and how to obtain and maintain board certification.

Well-Being

In recognition of the prevalence of depression, burnout, substance abuse, and suicidality among residents and medical students, the ACGME now mandates teaching on the identification and mitigation of these concerning issues. While there is no set curriculum provided or recommended by the ACGME itself, materials are available, such as the Educational Toolkit provided by the 2017 Resident Wellness Consensus Summit.¹⁰¹ This incorporates modules on second victim syndrome, mindfulness and mediation, and positive psychology.

Fatigue mitigation

All residents must be able to recognize limitations in their ability to care for patients due to sleep deprivation and fatigue; they should be made aware of options for fatigue management and transition of care to another provider, should the need arise.

Given the limited evidence-based data on curricular content of didactics further dedicated research on possible curricular content and the weighting of topics taught may be beneficial.

BEST PRACTICE RECOMMENDATIONS:

1. Core content topics for conference should be derived from the conditions and skills described in the EM Model (Level 5, Grade D).
 2. Curriculum presentations, morbidity and mortality sessions, research seminars, journal review, and administrative seminars should be included as part of the conference design (Level 5, Grade D).
-

LIMITATIONS

There are several limitations to consider for this review. First, it is possible that some articles were not identified using our search strategy; however, an experienced medical librarian conducted the search with a broad search strategy using multiple databases. Additionally, we searched bibliographies of all included articles, contacted topic experts, and underwent pre-submission peer review by the entire CORD community.

Given the breadth of this topic, we were unable to address all aspects of conference planning and some components (e.g., simulation, journal club) were therefore not included in the current review. However, journal club was previously covered

in a prior best practice manuscript,³ and other topics may be covered in future best practice recommendations. Moreover, some areas did not have EM-specific data available. When data specific to EM residency conference didactics was limited, relevant data from other specialties and fields was also incorporated.

CONCLUSION

This article provides a summary of the best practice guidelines in developing resident didactic structure and content based on current literature and expert consensus. It offers a set of recommendations regarding the various didactic modalities, techniques to maximize the benefit from these sessions, and addresses effective incorporation of technology to improve participation. With regard to content, the authors recommend following the EM Model as a scaffold as well as incorporating other topics as specified by the ACGME such as research, professionalism, journal review, and wellness. More research is needed to better guide what content should be included in didactics and to what extent.

The authors hope that this review will serve as a blueprint for programs to optimize their conference curriculum, ensuring a more uniform, high-quality level of education for their residents. Ultimately, educational designers must create a curriculum in the context of their specific institution, balancing pedagogically robust didactic content and structure with the resources available to them including money, time, equipment, and space. It is our hope that this review can be used by educators to advocate for additional resources from their department or institution to better facilitate evidence-based education for residents.

ACKNOWLEDGMENTS

We would like to thank the Council of Emergency Medicine Residency Directors in Emergency Medicine for their support of our committee and this project. We would also like to thank Alexandria Brackett, MA, MLIS for her work performing the literature search.

CORD Best Practice Committee 2019-2020

Michael Gottlieb, MD – Co-Chair
Rush University Medical Center

Sreeja Natesan, MD – Co-Chair
Duke University

John Bailitz, MD
Northwestern University, Feinberg School of Medicine

Brian Barbas, MD
Loyola University

Jennie Buchanan, MD
Denver Health Medical Center

Richard Byyny, MD
Denver Health Medical Center

Guy Carmelli, MD
University of Massachusetts Medical School

Molly Estes, MD
Loma Linda University

Katja Goldflam, MD
Yale University

Andrew Grock, MD
University of California - Los Angeles

Jaime Jordan, MD
University of California - Los Angeles

Andrew King, MD
The Ohio State University

Krystin Miller, MD
The Ohio State University

Melissa Parsons, MD
University of Florida - Jacksonville

Alexander Sheng, MD
Boston Medical Center

Brian Wood, MD
St. Joseph's Medical Center

Address for Correspondence: D. Brian Wood, MD, St. Joseph's Medical Center, Department of Emergency Medicine, 2102 N. California St., Stockton, CA 95204. Email: david.wood@dignityhealth.org.

Conflicts of Interest: By the WestJEM article submission agreement, all authors are required to disclose all affiliations, funding sources and financial or management relationships that could be perceived as potential sources of bias. No author has professional or financial relationships with any companies that are relevant to this study. There are no conflicts of interest or sources of funding to declare.

Copyright: © 2020 Wood et al. This is an open access article distributed in accordance with the terms of the Creative Commons Attribution (CC BY 4.0) License. See: <http://creativecommons.org/licenses/by/4.0/>

REFERENCES

1. ACGME Common Program Requirements. Available at: <https://www.acgme.org/What-We-Do/Accreditation/Common-Program-Requirements>. Accessed April 2, 2020.
2. ACGME Program Requirements for Graduate Medical Education in Emergency Medicine. Available at: <https://www.acgme.org/Portals/0/>

- PFAssets/ProgramRequirements/110_EmergencyMedicine_2019.pdf?ver=2019-06-25-082649-063. Accessed April 2, 2020.
3. Gottlieb M, King A, Byyny R, et al. Journal club in residency education: an evidence-based guide to best practices from the Council of Emergency Medicine Residency Directors. *West J Emerg Med.* 2018;19(4):746-55.
 4. Estes M, Gopal P, Siegelman JN, et al. M. Individualized interactive instruction: a guide to best practices from the Council of Emergency Medicine Residency Directors. *West J Emerg Med.* 2019;20(2):363-8.
 5. Parsons M, Bailitz J, Chung AS, et al. Wellness in resident education: an evidence-based guide to best practices from the Council of Emergency Medicine Residency Directors. *West J Emerg Med.* 2020;21(2):299-309.
 6. Natesan S, Bailitz J, King A, et al. Clinical Teaching: An Evidence-based Guide to Best Practices from the Council of Emergency Medicine Residency Directors. *West J Emerg Med.* 2020;21(4):985-998.
 7. Phillips R, Ball C, Sacket D. Oxford Centre for Evidence-based Medicine - Levels of Evidence (March 2009) - CEBM. Available at: <https://www.cebm.net/2009/06/oxford-centre-evidence-based-medicine-levels-evidence-march-2009/>. Accessed June 19, 2019.
 8. Butler DJ, Brocato J, Yeazel M. Family medicine didactics revisited. *Fam Med.* 2017;49(10):778-84.
 9. Chalk C. The academic half-day in Canadian neurology residency programs. *Can J Neurol Sci.* 2004;31(4):511-3.
 10. Rapaport H, Loomis J, Kagetsu NJ, et al. Megaconference: a radical approach to radiology resident education with full-day weekly conferences. *J Am Coll Radiol.* 2013;10(1):51-6.
 11. Parikh JA, McGory ML, Ko CY, Hines OJ, Tillou A, Hiatt JR. A structured conference program improves competency-based surgical education. *Am J Surg.* 2008;196(2):273-9.
 12. Robbins R, Sullivan S, Smith B. Implementation of an academic half day in a vascular surgery residency program improves trainee and faculty satisfaction with surgical indications conference. *Surgery.* 2018;163(6):1197-200.
 13. Zastoupil L, McIntosh A, Sopfe J, et al. Positive impact of transition from noon conference to academic half day in a pediatric residency program. *Acad Pediatr.* 2017;17(4):436-42.
 14. Farrohi ET, Jensen AR, Brock DM, et al. Expanding resident conferences while tailoring them to level of training: a longitudinal study. *J Surg Educ.* 2008;65(2):84-90.
 15. Ahn J, Christian MR, Allen NG, et al. Characteristics of emergency medicine residency curricula that affect board performance. *Ann Emerg Med.* 2009;54(3):S10.
 16. Lefebvre CW, Hiestand B, Bond MC, et al. Increasing faculty attendance at emergency medicine resident conferences: Does CME credit make a difference? *J Grad Med Educ.* 2013;5(1):41-5.
 17. Rosenblum ND, Nagler J, Lovejoy FH, Hafner JP. The pedagogic characteristics of a clinical conference for senior residents and faculty. *Arch Pediatr Adolesc Med.* 1995;149(9):1023-8.
 18. Carmody KA. An academic relative value unit system: Do transparency, consensus, and accountability work? *West J Emerg Med.* 2019;20(6):939-47.
 19. Kim H, Malatesta TM, Anné PR, et al. Increasing faculty participation in resident education and providing cost-effective self-assessment module credit to faculty through resident-generated didactics. *Pract Radiat Oncol.* 2017;7(4):241-5.
 20. Agee N, Komenaka IK, Drachman D, et al. The effectiveness of grand rounds lectures in a community-based teaching hospital. *J Surg Educ.* 2009;66(6):361-6.
 21. Kensinger CD, McMaster WG, Vella MA, et al. Residents as educators: a modern model. *J Surg Educ.* 2015;72(5):949-56.
 22. Collins J, Miller SS, Albanese MA. Resident learning and knowledge retention from resident-prepared chest radiology conferences. *Acad Radiol.* 1997;4(11):732-5.
 23. Smith T. Nursing lectures during conference time are well received by both residents and faculty. *West J Emerg Med.* 2017;18(5):S21.
 24. Patel S, Kim C, Hung E. Mental health education for medicine trainees through a primary care interprofessional case conference: Promoting collaborative learning and addressing challenges. *J Gen Intern Med.* 2013;472.
 25. Fanucchi L, Lia LS, Siegler E. CLER Look at Morbidity and Mortality Conferences. 36th Annual Meeting - Society of General Internal Medicine presented at the: Celebrating Generalism: Leading Innovation and Change; April 26, 2013; Denver, CO.
 26. Naik N, Farmer B. Development of a multidisciplinary curriculum for education of trauma teams during weekly emergency medicine residency conference. *West J Emerg Med.* 2017;18(5):S45.
 27. Naeger DM, Phelps A, Kohi M, et al. Cross-specialty integrated resident conferences: an educational approach to bridging the gap. *Acad Radiol.* 2012;19(8):1029-34.
 28. Young JQ, Van Merrienboer J, Durning S, Ten Cate O. Cognitive load theory: implications for medical education: AMEE Guide No. 86. *Med Teach.* 2014;36(5):371-84.
 29. Knowles M. (1973). *The Adult Learner: A Neglected Species*. Houston, TX: Gulf.
 30. McGrath J, Barrie M, Way DP. Emergency medicine resident orientation: how training programs get their residents started. *West J Emerg Med.* 2017;18(1):97-104.
 31. Foundations of Emergency Medicine. Available at: <https://foundationsem.com/>. Accessed April 2, 2020.
 32. Shappell E, Ahn J. A needs assessment for a longitudinal emergency medicine intern curriculum. *West J Emerg Med.* 2017;18(1):31-4.
 33. Lucas R, Roche C, Boniface K. PGY-specific conference in emergency medicine. *Ann Emerg Med.* 2013;62(5):S172.
 34. Gottlieb M, Riddell J, Crager SE. Alternatives to the conference status quo: addressing the learning needs of emergency medicine residents. *Ann Emerg Med.* 2016;68(4):423-30.
 35. Prober CG, Heath C. Lecture halls without lectures: a proposal for medical education. *N Engl J Med.* 2012;366(18):1657-9.
 36. Haidet P, Morgan RO, O'Malley K, et al. A controlled trial of active versus passive learning strategies in a large group setting. *Adv Health Sci Educ Theory Pract.* 2004;9(1):15-27.
 37. Russell IJ, Hendricson WD, Herbert RJ. Effects of lecture information density on medical student achievement. *J Med Educ.* 1984;59(11 Pt

- 1):881-9.
38. Cooper AZ, Richards JB. Lectures for adult learners: breaking old habits in graduate medical education. *Am J Med.* 2017;130(3):376-81.
 39. De Lorenzo RA, Abbott CA. Effectiveness of an adult-learning, self-directed model compared with traditional lecture-based teaching methods in out-of-hospital training. *Acad Emerg Med.* 2004;11(1):33-7.
 40. Stephens MB, McKenna M, Carrington K. Adult learning models for large-group continuing medical education activities. *Fam Med.* 2011;43(5):334-7.
 41. Sadeghi R, Sedaghat MM, Sha Ahmadi F. Comparison of the effect of lecture and blended teaching methods on students' learning and satisfaction. *J Adv Med Educ Prof.* 2014;2(4):146-50.
 42. Issa N, Mayer RE, Schuller M, et al. Teaching for understanding in medical classrooms using multimedia design principles. *Med Educ.* 2013;47(4):388-96.
 43. Mayer RE, Heiser J, Lonn S. Cognitive constraints on multimedia learning: When presenting more material results in less understanding. *J Educ Psychol.* 2001;93(1):187-98.
 44. Clark RC, Mayer RE. (2016). *e-Learning and the Science of Instruction: Proven Guidelines for Consumers and Designers of Multimedia Learning.* San Francisco, CA: Pfeiffer.
 45. Stuart J, Rutherford RJ. Medical student concentration during lectures. *Lancet.* 1978;2(8088):514-6.
 46. Gottlieb M, Riddell J, Njie A. Trends in national emergency medicine conference didactic lectures over a 6-year period. *J Contin Educ Health Prof.* 2017;37(1):46-9.
 47. Spicer J, Golub L, Manning K. Bstmode (bite-sized teaching mode): an innovative approach to maximizing residents' educational efficiency through a faculty-coached peer teaching exercise. Presented at the: Society of General Internal Medicine Annual Meeting; April 23, 2015; Toronto, CA.
 48. Barringer K, Nelson J. "Rapid fire" emergency medicine resident conference: a pilot. *Ann Emerg Med.* 2014;6(4):S145-S146
 49. Hedayati T, Bowman S, Amin D. The 30 minute minimum: implementation of a shorter resident lecture format in a large emergency medicine residency program. *West J Emerg Med.* 2019;4(1):S38
 50. Bryner CL. Learning as a function of lecture length. *Fam Med.* 1995;27(6):379-82.
 51. Sadosty AT, Goyal DG, Gene Hern H, et al. Alternatives to the conference status quo: summary recommendations from the 2008 CORD Academic Assembly Conference Alternatives workgroup. *Acad Emerg Med.* 2009;16 Suppl 2:S25-31.
 52. Matheson C. The educational value and effectiveness of lectures. *Clin Teach.* 2008;5(4):218-21.
 53. Terrell M. Anatomy of learning: instructional design principles for the anatomical sciences. *Anat Rec B New Anat.* 2006;289(6):252-60.
 54. Freeman S, Eddy SL, McDonough M, et al. Active learning increases student performance in science, engineering, and mathematics. *Proc Natl Acad Sci USA.* 2014;111(23):8410-5.
 55. Dversdal RK, Gold JA, Richards MH, et al. A 5-day intensive curriculum for interns utilizing simulation and active-learning techniques: addressing domains important across internal medicine practice. *BMC Res Notes.* 2018;11(1):916.
 56. Melo Prado H, Hannois Falbo G, Rodrigues Falbo A, Natal Figueirôa J. Active learning on the ward: outcomes from a comparative trial with traditional methods. *Med Educ.* 2011;45(3):273-9.
 57. Mumtaz S, Latif R. Learning through debate during problem-based learning: an active learning strategy. *Adv Physiol Educ.* 2017;41(3):390-4.
 58. Faisal R, Khalil-ur-Rehman, Bahadur S, Shinwari L. Problem-based learning in comparison with lecture-based learning among medical students. *J Pak Med Assoc.* 2016;66(6):650-3.
 59. MacDougall C. A novel teaching tool combined with active-learning to teach antimicrobial spectrum activity. *Am J Pharm Educ.* 2017;81(2):25.
 60. Guagliardo JG, Hoiris KT. Comparison of chiropractic student scores before and after utilizing active learning techniques in a classroom setting. *J Chiropr Educ.* 2013;27(2):116-22.
 61. Thomas MC, Macias-Moriarty LZ. Student knowledge and confidence in an elective clinical toxicology course using active-learning techniques. *Am J Pharm Educ.* 2014;78(5):95.
 62. Ozgonul L, Alimoglu MK. Comparison of lecture and team-based learning in medical ethics education. *Nurs Ethics.* 2019;26(3):903-13.
 63. Roca J, Reguant M, Canet O. Learning outcomes of "The Oncology Patient" study among nursing students: a comparison of teaching strategies. *Nurse Educ Today.* 2016;46:29-35.
 64. Prince M. Does active learning work? A review of the research. *J Eng Educ.* 2004;93(3):223-31.
 65. McCoy L, Pettit RK, Kellar C, Morgan C. Tracking active learning in the medical school curriculum: a learning-centered approach. *J Med Educ Curric Dev.* 2018;5:2382120518765135.
 66. Gottlieb M, Landry A, Egan DJ, et al. Rethinking residency conferences in the era of COVID-19. *AEM Educ Train.* 2020. In press.
 67. Morgan MH. Residency Building from your home office: effectiveness of videoconference based tele-education for emergency medicine residents and providers in Vietnam. *Ann Glob Health.* 2017;83(1):118.
 68. Markova T, Roth LM. E-conferencing for delivery of residency didactics. *Acad Med.* 2002;77(7):748-9.
 69. O'Regan K, Marsden P, Sayers G, et al. Videoconferencing of a national program for residents on evidence-based practice: early performance evaluation. *J Am Coll Radiol.* 2010;7(2):138-45.
 70. Dunlosky J, Rawson KA, Marsh EJ, et al. Improving students' learning with effective learning techniques: promising directions from cognitive and educational psychology. *Psychol Sci Public Interest.* 2013;14(1):4-58.
 71. Mains TE, Cofrancesco Jr. J, Milner SM, et al. Do questions help? The impact of audience response systems on medical student learning: a randomised controlled trial. *Postgrad Med J.* 2015;91(1077):361-7.
 72. Rubio EI, Bassignani MJ, White MA, Brant WE. Effect of an audience response system on resident learning and retention of lecture material. *AJR Am J Roentgenol.* 2008;190(6):W319-22.
 73. Blazek MC, Dantz B, Wright MC, Fiedorowicz JG. Spaced learning using emails to integrate psychiatry into general medical curriculum: Keep psychiatry in mind. *Med Teach.* 2016;38(10):1049-55.
 74. Weinstein Y, Madan CR, Sumeracki MA. Teaching the science of

- learning. *Cogn Research*. 2018;3(1):2.
75. Sherbino J, Chan T, Schiff K. The reverse classroom: lectures on your own and homework with faculty. *CJEM*. 2013;15(3):178-80.
 76. Chen KS, Monrouxe L, Lu YH, et al. Academic outcomes of flipped classroom learning: a meta-analysis. *Med Educ*. 2018;52(9):910-24.
 77. Lockman K, Haines ST, McPherson ML. Improved learning outcomes after flipping a therapeutics module: results of a controlled trial. *Acad Med*. 2017;92(12):1786-93.
 78. McLaughlin JE, Roth MT, Glatt DM, et al. The flipped classroom: a course redesign to foster learning and engagement in a health professions school. *Acad Med*. 2014;89(2):236-43.
 79. Missildine K, Fountain R, Summers L, Gosselin K. Flipping the classroom to improve student performance and satisfaction. *J Nurs Educ*. 2013;52(10):597-9.
 80. Riddell J, Jhun P, Fung C-C, et al. Does the flipped classroom improve learning in graduate medical education? *J Grad Med Educ*. 2017;9(4):491-6.
 81. Chen F, Lui AM, Martinelli SM. A systematic review of the effectiveness of flipped classrooms in medical education. *Med Educ*. 2017;51(6):585-97.
 82. King AM, Gottlieb M, Mitzman J, et al. Flipping the classroom in graduate medical education: a systematic review. *J Grad Med Educ*. 2019 Feb;11(1):18-29.
 83. Tsoy D, Sneath P, Rempel J, et al. Creating gridlockED: a serious game for teaching about multipatient environments. *Acad Med*. 2019;94(1):66-70.
 84. Dankbaar M. Serious games and blended learning; effects on performance and motivation in medical education. *Perspect Med Educ*. 2017;6(1):58-60.
 85. Hedrick TL, Young JS. The use of "war games" to enhance high-risk clinical decision-making in students and residents. *Am J Surg*. 2008;195(6):843-9.
 86. Shiroma PR, Massa AA, Alarcon RD. Using game format to teach psychopharmacology to medical students. *Med Teach*. 2011;33(2):156-60.
 87. Howard MG, Collins HL, DiCarlo SE. Survivor torches "Who Wants to Be a Physician?" in the educational games ratings war. *Adv Physiol Educ*. 2002;26(1-4):30-6.
 88. O'Leary S, Diepenhorst L, Churley-Strom R, Magrane D. Educational games in an obstetrics and gynecology core curriculum. *Am J Obstet Gynecol*. 2005;193(5):1848-51.
 89. Schuh L, Burdette DE, Schultz L, Silver B. Learning clinical neurophysiology: gaming is better than lectures. *J Clin Neurophysiol*. 2008;25(3):167-9.
 90. Fallon T, Strout TD. Free Open Access Medical Education (FOAM) resources in a team-based learning educational series. *West J Emerg Med*. 2018;19(1):142-4.
 91. Voleman A, Poepelman RS. A pilot study of team-based learning in one-hour pediatrics residency conferences. *BMC Med Educ*. 2019;19(1):266.
 92. Kamine TH, Sabe AA, Nath B, Barnes K, Kent TS. Use of learning teams to improve the educational environment of general surgery residency. *J Surg Educ*. 2018;75(6):e17-e22.
 93. Balwan S, Fornari A, DiMarzio P, et al. Use of team-based learning pedagogy for internal medicine ambulatory resident teaching. *J Grad Med Educ*. 2015;7(4):643-8.
 94. Poepelman RS, Liebert CA, Vegas DB, et al. A narrative review and novel framework for application of team-based learning in graduate medical education. *J Grad Med Educ*. 2016;8(4):510-7.
 95. Counselman FL, Babu K, Edens MA, et al. The 2016 Model of the Clinical Practice of Emergency Medicine. *J Emerg Med*. 2017;52(6):846-9.
 96. Hockberger RS, La Duca A, Orr NA, et al. Creating the model of a clinical practice: the case of emergency medicine. *Acad Emerg Med*. 2003;10(2):161-8.
 97. Counselman FL, Borenstein MA, Chisholm CD, et al. The 2013 Model of the Clinical Practice of Emergency Medicine. *Acad Emerg Med*. 2014;21(5):574-98.
 98. Hockberger RS, Binder LS, Graber MA, et al. The Model of the Clinical Practice of Emergency Medicine. *Ann Emerg Med*. 2001;37(6):745-70.
 99. Wiggins G. (2005). *Understanding by Design*. 2nd ed. Alexandria, VA: ASCD.
 100. Walker M, Rubio D, Horstman M, et al. Stop the blame game: restructuring morbidity and mortality conferences to teach patient safety and quality improvement to residents. *MedEdPORTAL*. 2016;12:10475.
 101. Chung AS, Smart J, Zdradzinski M, et al. Educator toolkits on second victim syndrome, mindfulness and meditation, and positive psychology: the 2017 resident wellness consensus summit. *West J Emerg Med*. 2018;19(2):327-31.