ILLUMINATIONS

A preference for peers over faculty: implementation and evaluation of medical student-led physiology exam review tutorials

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Submitted 11 May 2020; accepted in final form 16 July 2020

peer-assisted learning; review tutorials; small-group teaching

INTRODUCTION

Review sessions before examinations are an effective method to reduce anxiety and improve understanding of exam material in first-year undergraduate medical education (UGME). This study investigates the effectiveness of peer-assisted learning (PAL) for small-group preexam physiology review sessions led by second-year students (MS2) compared with faculty-led, large-group review sessions.

PAL has been widely implemented within UGME curricula (2). Medical students are both effective as peer teachers and are receptive to instruction from their peers (11). PAL reduces exam-related stress (8) and increases student satisfaction with their education (11). In addition to being an effective teaching methodology for technical procedures, including ultrasound (7) and clinical skills (18), PAL has been successfully integrated within basic science courses in the preclerkship curriculum and shown to be a beneficial tool for both learners and teachers (5). In anatomy courses, students perceived PAL as an effective method for learning anatomy using cadaveric specimens (1), and student experiences with peers were rated favorably (14). In physiology courses, implementation of a large-scale PAL program has been demonstrated to benefit both tutors and tutees to complement the formal curriculum (4). Successful PAL execution results in well-described, short-term improvements in students’ perceived understanding of physiological principles and satisfaction with preclerkship instruction (3, 6), demonstrating benefits for student tutors, tutees, and medical education programs (16).

The usage of faculty-led, small-group teaching is a more traditional method used to improve student engagement and understanding in medical education (17). Small-group instructional sessions enable individualized attention, enhancing interaction among all participants and allowing students to take part in instruction. Effective small groups create a nonthreatening learning environment that enables mastery of basic science material by encouraging independent thinking and problem solving (15). Peer tutors have also been shown to be effective at leading small-group teaching sessions, where each tutor is responsible for preparation of PAL content, including lecture slides and practice problems (19). The small-group format allows tutors to cover several subjects simultaneously. This reduces preparation time for individual tutors and enables tutors to make a greater impact for a single subject compared with the large-group lecture hall setting. Medical students also often find great value in learning from their peers and benefit from their participation in a community of practice (10).

At the University of California, Irvine, School of Medicine, the first-year physiology course continuously evaluates and implements innovative instructional technologies to modernize the medical classroom experience. These teaching methods include frequent low-stakes testing, clinical correlate lectures, active-learning laboratory activities, narrative assessment modules, online self-directed learning forums, and E-learning instructional technologies (9). Before organ system-focused examinations, physiology faculty have led review sessions to discuss practice problems and emphasize important content from previous lectures in a lecture hall format.

In this study, we sought to combine both PAL and small-group approaches to complement our existing faculty-led physiology preexam review sessions to improve student mastery of the material, student perceptions of their education, and reduction of exam anxiety. In an ideal comparison, faculty-led, small-group sessions would be compared with PAL small-group sessions. Although faculty-led, small-group sessions are extremely effective, the cost and resources needed for hiring multiple faculty often make it difficult in practice.

We detail conceptualization, implementation, and evaluation of a small-group format PAL tutorial session, which can be broadly applied throughout the medical curriculum. To our knowledge, this is the first study that combines small-group learning with PAL and compares it to larger faculty-led review sessions in medical physiology education.

METHODS

Two different educational strategies (peer-led small-group and faculty-led large-group reviews) were implemented within the physiology course. Students were evaluated to determine their self-reported mastery of the material and learning style preference. Peer
the new review session style. physiology performance and their desire and availability to pilot 20% of their class. Leads were selected based on their previous physiology performance as an MS1, which constituted placing in the top through an application process. The applicants were then selected for the physiology course. The MS2 General Tutors were selected for individual academic performance in physiology general tutors (General Tutors). General Tutors and second-year (MS2) physiology lead tutors (Leads) and 18 MS2s were given 5 days before the exam and structured as 2-h sessions with rotations of small-group PAL conducted in five different rooms covering unique subtopics of the content. The basement of the UCI Medical Education building has multiple rooms designed for small-group learning that hold up to 15 people. Two of the four Leads were present at each review session. The Leads’ role during the review sessions was to prepare the rooms for small-group learning and to inform the rooms to rotate after 20 min. Leads did not teach during presentations were compiled by the Leads and then distributed to all MS1s on the day of the review. Tutorials were offered 5 days

Participants. One hundred and four UCI first-year medical students (MS1s) had the option to attend both the peer-led and faculty-led review session. Undergraduate physiology is not a prerequisite before medical school enrollment. Physiology is not a required prerequisite for the medical physiology course, and our students have varied exposure to physiology content before enrollment in the course and participation in the preexam review sessions. This was not controlled for in the present study. The review sessions were not considered a mandatory component of the course. Students voluntarily participated in the research study by responding to solicited surveys following each physiology examination. This study was qualified as exempt by the UCI Institutional Review Board.

Procedure. The Physiology Tutorial Team was composed of 4 second-year (MS2) physiology lead tutors (Leads) and 18 MS2 physiology general tutors (General Tutors). General Tutors and Leads were selected based on individual academic performance in the physiology course. The MS2 General Tutors were selected through an application process. The applicants were then selected by the physiology course director based on their previous physiology performance as an MS1, which constituted placing in the top 20% of their class. Leads were selected based on their previous physiology performance and their desire and availability to pilot the new review session style.

For each exam, two of the four Leads met with the course director once the exam questions were compiled. The Leads reviewed the exam material and identified the high-yield topics. The Leads then e-mailed the five designated General Tutors for the review with the topics pertinent to the upcoming exam. Each General Tutor prepared materials for a specific topic to avoid redundancy. For example, the cardiovascular tutorials included the following subtopics: cardiac cycle, hemodynamics, electrophysiology, electrocardiogram, and pharmacology. The General Tutors created a topic-specific presentation composed of 50% material review and 50% questions to discuss. The General Tutors’ presentations were compiled by the Leads and then distributed to all MS1s on the day of the review. Tutorials were offered 5 days

Student evaluation of peer-led, small-group review session:
The small-group review session led by MS2s helped me identify my strengths and weaknesses in physiology.
The small-group review session led by MS2s improved my understanding and ability to apply physiological concepts.
The small-group review session led by MS2s reduced my anxiety regarding the upcoming exam.
Student evaluation of faculty-led review sessions:
The review session led by physiology faculty improved my understanding and ability to apply physiological concepts.
The review session led by physiology faculty reduced my anxiety regarding the upcoming exam.
Student overall evaluation of the review sessions:
MS2s (i.e., my peers) are acceptable alternatives to faculty members as review session leaders.
Additional optional information:
For physiology exam review, I attended (select all that apply):
Small-group review session led by MS2s
In-class review session led by physiology faculty
Podcast of the review session led by physiology faculty
None of the above
Which type of exam review session do you feel is most effective? (select one):
Small-group review session led by MS2s
Review session led by physiology faculty
None of the above
Comments
Students were asked to evaluate tutors on each item on a Likert-type scale of 1–4 for the “Student evaluation of peer-led small-group review session,” “Student evaluation of faculty-led review sessions,” and “Student overall evaluation of the review sessions” questions. For the “Additional optional information,” students were presented with set answer choices to select or an open-ended response option. MS2, second-year medical students.
review sessions. Each General Tutor led a group of students for 20 min. Each 20-min session was divided into 10 min of review and 10 min of questions and answers. After 20 min, the MS1s rotate to a different tutor (Fig. 1). During the final 15 min of the 2-h session, students were able to return to any of the General Tutors for further clarification on a subtopic.

The faculty-led review sessions were held in the lecture hall 2–3 days before an examination. The duration of the review sessions was ~1.5–2.5 h, depending on the topics covered. Each teaching faculty member prepared a 20- to 30-min presentation that included slides from previous lectures and summaries of exam-relevant content in a standard lecture hall format. Faculty members then answered questions. Individual faculty members were responsible for making test questions relevant to their lecture material, ensuring that the review session was relevant to the material on which the students would be tested. Review sessions consisted of multiple faculty members presenting their corresponding lectures, with the course director filling in as a lecturer for any faculty member who was unable to attend. A live recording of the review session and review materials were distributed to all students following the review session.

Evaluation. Following each physiology exam, online satisfaction surveys were conducted. Table 1 is the questionnaire provided to MS1 students after the review sessions and exam. Questions were rated on a scale of “strongly agree,” “agree,” “disagree,” and “strongly disagree.” MS1 students were also asked to evaluate how effective the sessions were in reducing their anxiety in anticipation for their exam. MS1 students also used the survey to record their attendance. In addition, the MS2 General Tutors completed an online survey to determine their perceptions of the PAL review sessions. This one-time questionnaire was administered at the end of the physiology course and was rated on the same scale as the MS1 questionnaire (Table 2). To minimize bias in questionnaire responses, General Tutors were not involved in the planning, data analysis, or authorship of this project.

RESULTS AND DISCUSSION

There were 146 MS1 responses collected over the course of three review sessions. Exam review sessions were well attended, with 69.8% of 104 MS1s attending both peer-led and faculty-led review sessions, 23.5% attending the peer-led session only, and 6.6% attending the faculty-led session only, either in-person or watching the live recording of the session at a later time.

MS2 peer-led sessions were compared with faculty-led sessions to evaluate the student mastery of the material and student perceptions of their learning (Fig. 2). For each of the three review sessions, students agreed that those led by MS2s were more effective in identifying strengths and weaknesses in physiology. The MS1 students were aware that both the faculty and PAL student Leads had seen the test questions before the review sessions to remove any preference bias for these sessions. Students agreed that the MS2-led review sessions helped them understand the application of physiological concepts more effectively than the faculty-led review sessions. Students also agreed that small-group sessions led by MS2s were better
at reducing anxiety than faculty-led sessions. Eighty-four per-
cent of students agreed or strongly agreed that MS2s were
acceptable alternatives to faculty in physiology exam review
sessions. The small-group review sessions recorded higher
attendance at all sessions, which may also suggest preference
for peer-led review.

The General Tutors’ responses to the end-of-course ques-
tionnaire are represented in Fig. 3. General Tutors agreed that,
among students attending the review, there was a high degree
of professionalism and engagement. There was strong agree-
ment that being a peer tutor did not impede personal studies.
General Tutors also felt that the role was helpful for their own
review of physiology for the United States Medical Licensing
Examination Step 1 exam. There was strong agreement that
MS2s would recommend serving as a peer tutor to others.

The small-group, peer-led sessions are novel in their design
and have demonstrated their effectiveness. Previous studies
demonstrated that students taught by peers display
similar knowledge and skills outcomes compared with stu-
dents taught by faculty (13). PAL in basic science medical
education has resulted in improved performance in written
tests but not practical exams (12). Although PAL implemen-
tation is becoming more widely adopted in UGME, faculty
remain the cornerstone of medical education instruction.
PAL in medical physiology teaching has commonly been
implemented as supplemental instruction to complement
faculty-led instruction (4, 6). This study suggests that small-
group-based PAL could effectively supplement faculty-led
review sessions, even in a discipline as complex as medical
physiology. Additionally, medical students showed a prefer-
ence for peer teaching, which could be attributed to the
MS2s’ ability to decrease MS1 anxiety because of their
recent experience completing the course. Taken together,
small-group-based PAL is a useful teaching strategy for
physiology instruction in UGME.

There were several limitations to this study. First, student
evaluations were completed after the exam, resulting in poten-
tial response bias based on the student’s performance. How-
ever, we felt this study design was necessary to avoid unnec-
essary burden to students, given high student anxiety preceding
exams, since it is understood that anxiety is higher closer to an
exam (20). Accordingly, due to the timing of the evaluations,
we were unable to obtain an assessment of baseline anxiety.
Another limitation of the study design was the potential of
group size differences, large versus small, introducing bias on
student responses of the faculty versus peer-led session com-
parison. Although faculty-led, small-group sessions are diffi-
cult to implement in practice due to scheduling and budgetary
issues, this is a comparison that would be worthwhile to
explore in future studies. Finally, this study lacked an objective
measurement of student performance based on the physiology
sessions that they attended. Future studies will be required to
determine the impact of these review sessions on student exam
scores and their utility in replacing traditional faculty led
reviews.

Conclusion. We have successfully developed, implemented,
and evaluated a small-group format, PAL exam review session,
which was effective at improving student-reported understand-
ing of physiology material and reducing medical school exam
anxiety. MS2s reported that peer teaching was a helpful review
of physiology material for their upcoming licensing exam. We
have now implemented this peer-led exam review format more
broadly in UCI’s preclerkship curriculum.

DISCLOSURES

No conflicts of interest, financial or otherwise, are declared by
the authors.

AUTHOR CONTRIBUTIONS

E.H.F., P.B., L.G., E.T., J.Y., and M.L.G. conceived and designed research;
E.H.F., P.B., L.G., E.T., J.Y., and M.L.G. performed experiments; E.H.F.,
L.G., E.T., J.Y., and M.L.G. interpreted results of experiments; E.H.F., P.B., L.G., E.T., J.Y.,
and M.L.G. prepared figures; E.H.F., P.B., L.G., E.T., J.Y., and M.L.G. drafted manuscipt;
E.H.F., P.B., L.G., E.T., J.Y., and M.L.G. edited and revised manuscript; E.H.F., P.B., L.G., E.T., J.Y.,
and M.L.G. approved final version of manuscript.

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