Implementation of a study skills program for entering at-risk medical students

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Miller CJ. Implementation of a study skills program for entering at-risk medical students. Adv Physiol Educ 38: 229–234, 2014; doi:10.1152/advan.00022.2014.—While the first year of medical school is challenging for all students, there may be specific issues for students from rural areas, economically disadvantaged backgrounds, ethnic minorities, or nontraditional age groups. A Summer Prematriculation Program (SPP) was created to prepare entering at-risk students for the demands of medical school. For the past 2 yr, an emphasis was placed on the development of appropriate study plans and skills. On presurveys, students predicted an increase in their number of study hours per lecture hour, from 7.6 h in undergraduate coursework to 9.1 h in medical school coursework (n = 35). These study plans were infeasible given the rigorous didactic lecture schedule in medical school. Interventions were made through lectures on study plans and modeling of appropriate study habits using engaging lectures in the SPP physiology course. At the end of the program, a postsurvey was given, and students reported a reduction in the planned hours of study to a more realistic 3.9 h of study time per hour of lecture. Furthermore, students planned to decrease their use of textbooks while increasing their use of concept mapping, videos, and peer teaching. The majority of students completing the SPP program with a study skills emphasis performed well in the Medical Physiology course, with 4 students honoring in the course, 27 students passing, and 2 students remediating the course after an initial failure. These results indicate that at-risk medical students may have inappropriate study plans that can be improved through participation in a program that emphasizes study skills development.

MEDICAL SCHOOLS frequently have trouble recruiting students from rural areas and ethnic minorities. Of the 2012 United States (U.S.) medical school applicants, only 8% self-identified as African-American and 8% as Hispanic or Latino (3). Compared with the general population in the U.S., this is well below the percentage of African-American (13%) and Hispanic (17%) individuals reported by the 2012 Census Bureau (30). Furthermore, upon entering medical school, minority and economically disadvantaged students are often at a higher risk for academic challenges, with a higher rate of medical school withdrawal or dismissal as well as lower pass rates on the U.S. Medical Licensing Examination Step 1 test (1, 7). In the early 1980s, faculty members and the administration at the University of Louisville (UofL) School of Medicine became concerned about the low matriculation and graduation rates for at-risk students and began brainstorming methods to improve the recruitment process and academic support services. A Summer Prematriculation Program (SPP) was created at the UofL in 1989 to assist entering at-risk students in preparing for the demanding medical school didactic schedule. Students enrolled in the program have been accepted into medical school, and priority is given to students from racial/ethnic groups underrepresented in medicine; rural, medically underserved geographical areas; economically disadvantaged backgrounds; and students from other disadvantaged backgrounds, such as students who speak English as a second language or are from nontraditional age groups. All students who fit within these broad categories are invited to participate in the program, and 15–25 students volunteer each year.

The program occurs for 4 wk in the summer immediately before the beginning of the school year and exposes entering freshman students to core content from the major first-year courses. Additionally, students are given tools to improve their stress management, familiarity with the medical school, exposure to tutoring resources, etc. Student performance in various prematriculation programs has been correlated with performance indicators in the first year of medical school (17, 29). Furthermore, prematriculation programs have reported an improvement in student scores during prematriculation programs as well as once the students enter medical school (9). Recent evidence suggests that early intervention with at-risk students in small groups is beneficial to student success in the first year of medical school (34). While the program at the UofL has made significant strides in improving the retention rate of at-risk students, the faculty members, staff, and administration continue to investigate potential weaknesses of at-risk students and evaluate intervention methods to ameliorate these deficiencies.

During a focus group interview, an SPP graduate, who was a second-year medical student at the time, stated that “I don’t struggle with the level of the content, but the information comes so quickly that I can’t keep up.” It is intuitive that an increased “time on task” could improve students’ performance levels. However, given the demanding medical school didactic schedule, students may not have the opportunity to simply increase their number of study hours. At the UofL School of Medicine, students are exposed to a very busy lecture schedule during the first year, with up to 25 h of lecture/wk. Therefore, what if the time on task is the issue rather than the solution? Students may be willing to dedicate a large amount of time to studying for medical school, but their study plans may be infeasible given the rigorous didactic schedule. Students must be able to master a large amount of material in a condensed amount of time. Therefore, the goal of this study was to determine if the study plans of an at-risk group of incoming medical students could be improved through lectures on study strategies and skills as well as appropriate modeling of these approaches within physiology lectures.

METHODS

Participants and Program Design

This study was completed over the course of 2 subsequent years of the SPP. In 2012, 16 students participated in the program; in 2013, 19
students participated. One student was removed from the 2012 cohort data due to not completing the program and withdrawing his admission to medical school. Each cohort also included two students enrolled in an MEd program at the medical school. The MEd program acts as a 1-yr preparatory program for medical school, and participants were invited from the at-risk population of medical school applicants. Thus, 10–12% of the entire medical school class of 160 students total participated in the program over the course of this study. The 4-wk program consisted of >60 h of content instruction in Genetics and Molecular Medicine, Gross Anatomy and Neurobiology, Histology, and Physiology. Lectures were conducted by a combination of professors in the medical school with former graduates of the SPP. Students were exposed to >20 h of presentations by academic support staff, simulation units, standardized patients, etc. Additionally, students were given the opportunity to participate in clinical activities at local facilities.

Survey Instruments

On the first day of the program, students were asked to complete an anonymous presurvey with questions that inquired about their fears and concerns regarding medical school, their prior study methods in their undergraduate work, and their plans for studying in medical school. The survey consisted of Likert-scale, multiple-choice, and open-ended questions and required ∼20 min to complete. On the last day of the course, students were given a postsurvey to analyze changes in their study plans over the course of the program.

Instructional Materials

Three different interventions were used during the SPP, with the goal of improving students’ study plans and skills.

**Intervention 1.** An open question-answer session called “What to Expect During Your First Year” was facilitated on the second day of the program. The speaker for this session was a medical student who was a recipient of the Thomas B. Calhoon Physiology Prize, a prestigious honor given to a student who demonstrates not only academic success but also leadership and a desire to help others learn human physiology. This session was guided via suggested questions that focused on study habits but was open to any student questions or concerns. Major themes that arose during this session included: the busy daily/weekly schedule of a medical student, the benefits of attending class versus listening to the lectures online, the importance of group study, the most highly used study materials (high use of notes and videos and low use of textbooks), and strategies for reducing stress and maintaining health.

**Intervention 2.** A lecture was given by C. J. Miller, in which 10 study tips based on educational research were provided to students (some select references used included Refs. 6, 11, 12, 16, 18, 27, and 32). These tips included methods to organize content, use group study, practice time management, establish proper sleep and exercise habits, focus on active retrieval techniques, approach multiple-choice exams, etc. The lecture included several opportunities for students to respond through a personal response clicker system (iClicker, Macmillan New Ventures, New York, NY) to tailor the presentation to student responses.

**Intervention 3.** Throughout the program’s physiology course, students were allowed to practice these study strategies through a technique called engaging lectures (20). Engaging lectures consisted of 10–15 min of lecture followed by an activity that required students to apply the content to which they had just been exposed while using appropriate study skills. These activities included problems or prompts that enabled students to brainstorm outcomes, compare contrast pathologies, complete case studies, solve mathematical equations, complete Venn diagrams, watch professor-designed video clips and complete worksheets, do “think-pair-share” activities, write 1-min papers, etc. The activities ranged in duration from 1 to 20 min. In the 15 contact hours of engaging physiology lectures, there were 47 active learning segments. All of the activities were developed exclusively by C. J. Miller using guidelines and suggestions from the large body of literature on active learning techniques (2, 4, 5, 26). In these activities, students were encouraged to work in small groups of two to four students, and each activity was followed by a class debriefing. The goal of the engaging lectures was to model appropriate study strategies for the students, to help establish the proper habits before beginning medical school.

**Data Analysis and Institutional Review Board Approval**

Statistical analyses were performed using Origin software (version 8.1, OriginLab, Northampton, MA), as shown in the figures, with statistical significance defined as $P < 0.05$. This study was determined to be Institutional Review Board exempt by the UofL (tracking no. 12.0463).

**RESULTS**

The at-risk SPP students reported a large number of study hours in their undergraduate careers (Figure 1), with students studying an average of 7.6 h per hour of lecture in their science courses ($n = 35$, 2 yr of the program). On the first day of the program, students indicated that they planned to increase their time on task in medical school to 9.1 h of studying per hour of lecture. There was also a very large range of student responses, from 2–20 h per hour of lecture, resulting in a large SD. By the end of the program, there was a statistically significant decrease in the students’ planned study hours, to a more feasible 4.3 h per hour of lecture in medical school ($n = 35$, 2 yr of the program, $P < 0.05$).

At the UofL School of Medicine, first-year medical students can be expected to up to 25 h of lecture in a week. Given that there are 168 h in a week, if students sleep 7 h per night and attend 25 h of lectures there would only be 94 h remaining in their week. If students studied 9.1 h per hour of lecture, as predicted by students at the beginning of the SPP program, their study time alone (227.5 h/week) would exceed the 168 h actually available in a given week (Fig. 2). At the conclusion

![Fig. 1. Comparison of study hours. Students reported a planned increase in study hours for medical school from their undergraduate study habits. After the Summer Prematriculation Program (SPP), there was a statistically significant decrease in the planned hours of study for medical school. Data are presented as means ± SD; $n = 35$ students (2 yr of the program), *$P < 0.05$ by one-way ANOVA with a Tukey post hoc test.](http://advan.physiology.org/12.0463)
of the program, students planned to study an average of 4.3 h per hour of lecture (107.5 h/wk), which is more feasible given the weekly time constraints of first-year medical school curricula.

Figure 3 shows the specific study methods reported by students in their undergraduate science classes compared with the postsurvey results in which students indicated the methods they planned to use after completing the program. Students proposed to reduce their use of textbooks while increasing their reliance on videos, diagrams, and peer teaching. It was also reported that they heavily relied on their notes and planned to continue this habit during their medical school studies.

Students were asked on the postsurvey to respond to the following open-ended prompt: “Do you feel that the Prematriculation Program helped you to establish study skills for medical school?” All of the students responded that they felt that the program improved their study skills, including the following specific comments:

Absolutely. I experimented with some different methods and I think I have actually become more efficient, even in the past 4 wk. Time is very limited for studying and the tips provided to us helped me to cut out the extra things I was doing which were just a waste of time.

Yes. First, the program gave me confidence in the sense that I think I can handle the material. I have learned the importance of retrieving information and am much better at using my time.

[The course] prepares students to think critically about learning and course concepts; emphasis on ways to self-test and find errors in understanding and thinking.

I’ve learned a more realistic study approach centered around practice problems and group study.

[The learning activities] help to engage students in active learning while in the class. Improves retention and assists in critical thinking about material both within and without of class. I stayed engaged, mistakes were corrected early, and I felt more prepared.

In the 2012 cohort of SPP students, two students entered into the MEd program, which they successfully completed and entered into medical school with the 2013 cohort. Of those students directly entering medical school, 100% of the 2012 cohort of SPP students passed the Medical Physiology course, with 3 of the 14 students receiving honors in the course (Fig. 4). The average for the 2012 prematriculation students in the Medical Physiology course was 0.6% higher than the overall average for the course. From the 2013 cohort of SPP students, two students entered into the MEd program. From the students that directly entered medical school, 1 student achieved honors in the Medical Physiology course, 16 students passed, and 2 students remediated the course after a failure (Fig. 4). This remediation was completed via an online physiology course. Despite the two failures, the average performance of the 2013 SPP students was only 1.8% below the overall average for the Medical Physiology course.

Fig. 2. Comparison of compiled hours before and after the SPP. Initial student plans were infeasible given the time constraints of the first-year medical school curriculum. The black bar indicates the actual number of hours per week (168 h total). Sleep schedules are approximated at 7 h/night. After the SPP, students reduced their planned study hours per week. n = 35 students (2 yr of the program).

Fig. 3. Comparison of specific study methods. Likert-scale questions were used to assess the study methods that students used in their undergraduate coursework versus the methods that they planned to use in medical school after participating in the SPP. Likert-scale responses ranged from 1 to 5, with 1 = not at all, 3 = sometimes, and 5 = often. Data are presented as means ± SD; n = 35 students (2 yr of the program). *P < 0.05 by Mann-Whitney U-test for nonparametric Likert-scale data.
How We Teach

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<tr>
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<td>2013 SPP Cohort</td>
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<td>n=2 students entered 1 year M.Ed. Program prior to Medical School</td>
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Fig. 4. Performance of SPP students in the Medical Physiology course. To obtain honors in the course, students must achieve above a 90% average. Grades below a 70% average constitute a failure that may be remediated through an online course.

DISCUSSION

Many medical schools have established academic support services and prematriculation programs to improve the retention and success of at-risk students. One study indicated that 41 of the responding 83 U.S. medical schools offered prematriculation programs (25). It has been reported that 79–95% of medical schools provide some form of academic support for first-year students (22, 24). Despite these attempts, students from racial/ethnic groups underrepresented in medicine and from economically disadvantaged backgrounds are still associated with a higher rate of medical school withdrawal or dismissal as well as lower pass rates on the U.S. Medical Licensing Examination Step 1 test (1). It has been suggested that at-risk students may not benefit significantly from programs that focus solely on content, but additional gains may be achieved through programs that also teach study skills and strategies (10). It appears that at-risk students may be personally aware of their deficiencies in study strategies, as students in prematriculation programs at other medical schools have requested further instruction in study and test-taking skills (9).

A recent aim of the UofL SPP was to determine any weaknesses in student study plans and to ameliorate these deficiencies through exposure to appropriate study tactics. The results of this study indicated that at-risk students lacked proper study plans for their medical school careers. Students self-reported a large number of study hours in their undergraduate careers and planned to increase the number of hours per hour of lecture in medical school. This might be an intuitive study plan, and an increased time on task has been associated with higher performance indicators for >50 yr (8). However, entering medical students may be underestimating the strenuous didactic schedule expected of them. During the SPP, students were made aware of the realities of the first-year schedule through a question-and-answer session with a successful student who had completed the Medical Physiology course. This session helped to illustrate the impracticality of the plan to simply increase the number of hours spent studying.

Research has suggested that student performance can be improved by focusing on productive use of time and the development of appropriate study skills (31). Students in the SPP were exposed to a lecture containing 10 study tips that could help them to organize content, use group study, practice time management, establish proper sleep and exercise habits, focus on active retrieval techniques, approach multiple-choice exams, etc. The goal of these strategies was to accomplish mastery of material in a more concise amount of time.

However, simple exposure to new learning techniques may not be enough to change at-risk student behavior. It has been suggested that students must be shown how to effectively implement new learning strategies (23). During the SPP, students were given the opportunity to practice new study skills through the process of engaging lectures. After each 10- to 15-min section of content lecture, students completed activities that helped to reinforce the content through drawing concept diagrams, teaching the material to peers, solving case studies, hypothesizing outcomes, etc. As previously described by our group (20), the use of engaging lectures in physiology courses led to a statistically significant higher average on unit exams compared with traditional didactic lectures (8.6% higher, P < 0.05). Furthermore, students demonstrated an improved long-term retention of information via higher scores on the comprehensive final exam (22.9% higher in engaging lecture sections, P < 0.05). Many qualitative improvements were also indicated via student surveys and evaluations, including an increased perceived effectiveness of lectures, decrease in distractions during lecture, and increased confidence with the material (20).

In the SPP, by modeling new study strategies during the engaging lectures that focused on organization of content and retrieval of information, students were able to experience a hands-on implementation and practice the skills with professor guidance.

After the SPP, students reported plans to increase their use of these modeled strategies, such as drawing diagrams, studying in groups, and teaching the content to others. These methods focus on active retrieval of information rather than passive strategies, such as reading notes or listening to lectures. A study by Dobson (11) found that retrieval practice resulted in 41% greater retention of knowledge. The plans of SPP students to increase their use of collaborative study, through group study and teaching the content to others, may also be important for student success. Collaborative learning has been shown to increase exam performance for low-performing students, and a feeling of inclusiveness may be important for the success of at-risk students (15).

SPP students planned to reduce their use of the textbook and maintain a high level of time spent reading notes. It should be noted that the notes were custom designed by C. J. Miller and printed free of charge for all students. In the engaging lecture sections, many of the prompts and activities were included in the text of the notes, with spaces left for students to complete them. There were no required textbooks for the SPP. Thus, the students’ indication that they planned to extensively use notes and decrease their use of textbooks may have been biased by these factors. Given the exponential increases in medical knowledge that are occurring in modern society, information in textbooks may quickly become outdated. Conversely, the professors’ notes are updated each year using the most relevant physiological information. Thus, students’ plans to rely on notes rather than textbooks may indicate a preference for the most recent content available.

Interestingly, students also reported plans to increase their use of videos in medical school. Students in the SPP were given access to a website of videos created by C. J. Miller, which has been shown to increase student performance in physiology courses (19). The students currently enrolled in medical school are typically of the “millennial” generation and have been exposed to technology from an early age (21).
Medical students who participated in an online modular review of material in a clinical setting have been shown to have increased interest in the topic being presented (14). Furthermore, online prematriculation programs have been reported to produce improvements in student performance (28, 33). However, some research suggests that while students prefer e-learning, the educational gains may not be significantly different from traditional methods (13). Furthermore, a larger reliance on multimedia outlets for learning could potentially detract from the important social interactions and networking opportunities that occur in the SPP. Thus, it may be beneficial in the future to examine the usefulness of online learning for at-risk students.

Providing an online SPP program could help to increase the number of participating students. One weakness of the SPP at the UoFL is that participation is voluntary, and not all at-risk students may elect to complete the program. However, it is difficult to make such programs mandatory, as students may not have free schedules in the summer before beginning medical school. Thus, it may be necessary to include all at-risk students in programs throughout the first year of medical school. Furthermore, while it was not examined in this particular study, there may be general benefits to providing study skills programs to all medical students, regardless of their backgrounds. While entering medical students are selected from a well-qualified pool of applicants, they may still lack the appropriate study strategies to succeed in a rigorous, fast-paced program. On the other hand, a study by Winston et al. (34) showed that large-group workshops were ineffective at improving the performance of at-risk students.

Participation in the SPP with small class sizes appeared to have increased student awareness of their inappropriate study plans while simultaneously giving them the skills necessary to succeed. Students reported high levels of satisfaction with their improvement in study skills during the SPP via comments on the postsurvey. Furthermore, the majority of students completing the SPP with a study skills emphasis performed well in the Medical Physiology course, with 4 students honoring in the Medical Physiology course, indicating the usefulness of the program. On the other hand, a study by Winston et al. (34) showed that large-group workshops were ineffective at improving the performance of at-risk students.

The present study focused primarily on the development of student study skills and the concise attainment of material in an efficient and long-lasting manner. In this study, it was determined that students could benefit from a SPP that exposed students not only to course content but also to study skill lectures and active modeling of appropriate study habits. Through engaging lectures in the SPP physiology course, students were able to practice effective study strategies in a low-stakes and interactive environment. Furthermore, the majority of students completing the SPP had high success rates in their Medical Physiology course, indicating the usefulness of the strategies. While creation and implementation of an effective SPP program is a time-consuming process, the results obtained in the present study suggest that the investment is important for the success of at-risk students.

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DISCLOSURES

No conflicts of interest, financial or otherwise, are declared by the author(s).

AUTHOR CONTRIBUTIONS

Author contributions: C.J.M. conception and design of research; C.J.M. performed experiments; C.J.M. analyzed data; C.J.M. interpreted results of experiments; C.J.M. prepared figures; C.J.M. drafted manuscript; C.J.M. edited and revised manuscript; C.J.M. approved final version of manuscript.

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