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# The importance of undergraduate coursework in student success at South Carolina medical institutions

**Halford G. Warlick IV, Gabriel N. Desouza, Megan L. Wander and Vincent S. Gallicchio***

Department of Biological Sciences, College of Science, Clemson University, Clemson, South Carolina, USA.

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**The importance of undergraduate coursework in determining medical school student readiness reaches far beyond preparation to take the standardized Medical College Admissions Test (MCAT®). Since medical schools employ a rigorous and fast-paced learning system to instruct prospective medical students on (A) didactic information in the basic sciences and (B) the critical methodology of clinical practice, it is essential for applicants to be well-equipped for the challenge that this type of scholarship requires. A research study investigated current medical students enrolled at the four medical schools in the State of South Carolina: The Medical University of South Carolina (MUSC), University of South Carolina College of Medicine Columbia (USCSOM-Columbia), University of South Carolina College of Medicine Greenville (USCSOM-Greenville) and Edward Via College of Medicine Spartanburg (VCOM-Spartanburg). Questionnaires were distributed in the form of Google surveys to all medical institutions in order to distribute them to all students enrolled (M1-M4). The results were received, compiled, and analyzed. The data demonstrated striking similarities in the responses received from medical students representing all four professional schools regarding their evaluation how well they were prepared as undergraduates. The significance of these results is discussed.**

**Key words:** Medical education, medical school, South Carolina, MCAT, South Carolina.

## INTRODUCTION

Medical school admission committees have provided pre-medical students with prerequisite and recommended coursework that can be viewed on their institutional websites in order to increase applicant success. These suggestions are indexed by The Association of American Medical Colleges (AAMC) for M.D programs and The American Association of Colleges of Osteopathic Medicine (AACOMAS) for D.O programs.

According to both National Center for Biotechnological Information (NCBI) and Google Scholar, each reveals no specific case-study regarding the research question, *"What specific courses in an undergraduate curriculum would best prepare pre-medical students for this rigor of medical school?* "Similar studies have been performed in different contexts, including one by the University of Saskatchewan. The University's research showed how their current medical school students tended to lose knowledge of required coursework at the undergraduate level and how this inadvertently decreased their performance in medical school (Deon, 2006) studies like these show the need to perform research similar to that of this manuscript so that measurement of student

*Corresponding author. E-mail: vsgall@clemson.edu.

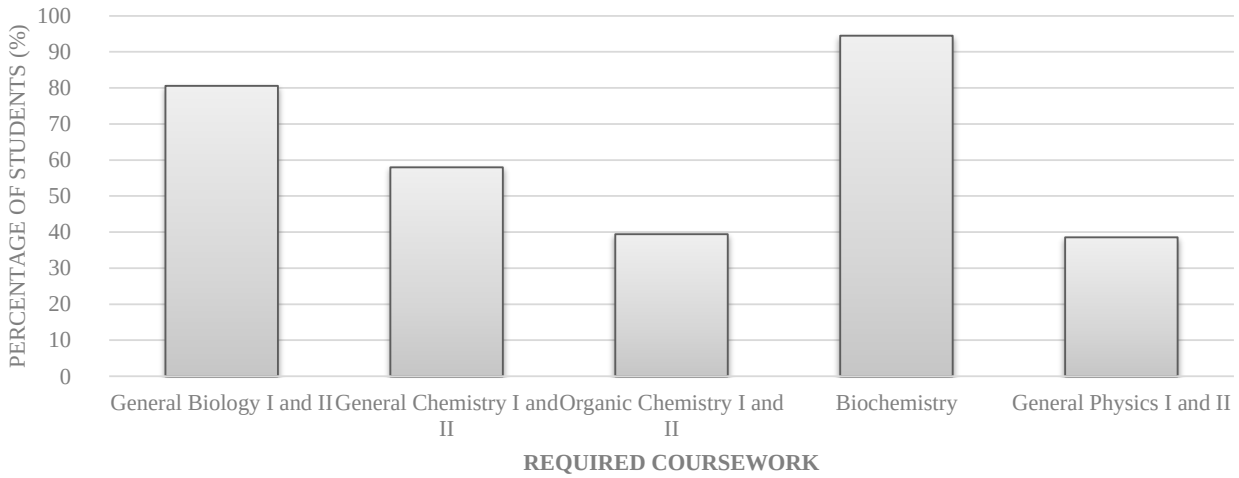


**Figure 1.** Quantitative analysis of students who found required courses effective in medical education.

success in medical school can be attributed to specific emphasis on coursework at undergraduate institutions.

The objective of this study is to investigate medical school student opinions of undergraduate coursework preparation for curriculum at The Medical University of South Carolina (MUSC), University of South Carolina College of Medicine Columbia (USCSOM-Columbia), University of South Carolina College of Medicine Greenville (USCSOM-Greenville) and Edward Via College of Medicine Spartanburg (VCOM-Spartanburg).

Data from each of these institutional websites show differing information regarding matriculant requirements in regard to both degree preference, coursework, letters of recommendation and MCAT cutoff scores. For this manuscript, however, we focus on required coursework. According to MUSC, applicants are required to take ninety-semester hours, but are not required to take any courses for admission. USCSOM- Greenville and USC SOM-Columbia, as well as VCOM in Spartanburg all require two semesters each of General Biology, General Chemistry, Organic Chemistry, Physics, as well as one semester of biochemistry, along with baccalaureate degrees. However, even though there is a difference between MUSC admission's requirements and USC/ VCOM, the data obtained reveal commonalities in coursework, specifically biochemistry, in enhancement of medical education at these institutions.

By performing an analysis on information received in a comprehensive survey, the question between the rigors of undergraduate curriculum and medical school preparedness will provide insight on what specific coursework helps students succeed while attending medical school. It is hoped that a valid correlation can be established between these two entities so that premedical students can best select courses that will prepare them for medical school. Furthermore, another aim of this study is to disseminate this information to other colleges, universities, and medical schools outside of South Carolina so that they can be informed about undergraduate preparedness for medical education.

## MATERIALS AND METHODS

The study was conducted in a way where questionnaires were sent out to all four South Carolina medical schools over a two-month time period from August 2018 to October 2018. Admissions offices for all these institutions were contacted and received proposal copies and agreed to allow for the questionnaires to be distributed to students. The questionnaires were distributed through Google Forms, which consisted of both required fields and optional fields. Personal identifying information was not included in the questionnaire to protect participant identity. Required information on the forms included year in medical school, undergraduate institution and major, current medical school, and mandatory undergraduate coursework. The mandatory undergraduate coursework section required participants to select yes or no to questions regarding typical mandatory prerequisites for medical school entrance. The required courses for participant selection were: General Biology, General Chemistry, Organic Chemistry, Biochemistry, and General Physics and are displayed in Figure 1. After completing this section of the questionnaire, there was one optional section where students could suggest other courses they found helpful in medical education that are typically not require as shown in Figure 2.

Three hundred and forty-five responses were received from a total of 2,206 students, yielding a total response rate of 15.6%. The response count was further analyzed in order to compare responses from students enrolled in allopathic programs and osteopathic programs for all questions, as shown by the following data.

## RESULTS AND DISCUSSION

This review presents striking variability in student responses for coursework suggestions provided by MSAR. Therefore, other factors may influence matriculant success in medical school, including undergraduate research and other coursework not specified by MSAR. For example, Gilmore et al. (2015) conducted a study that showed participation in undergraduate research

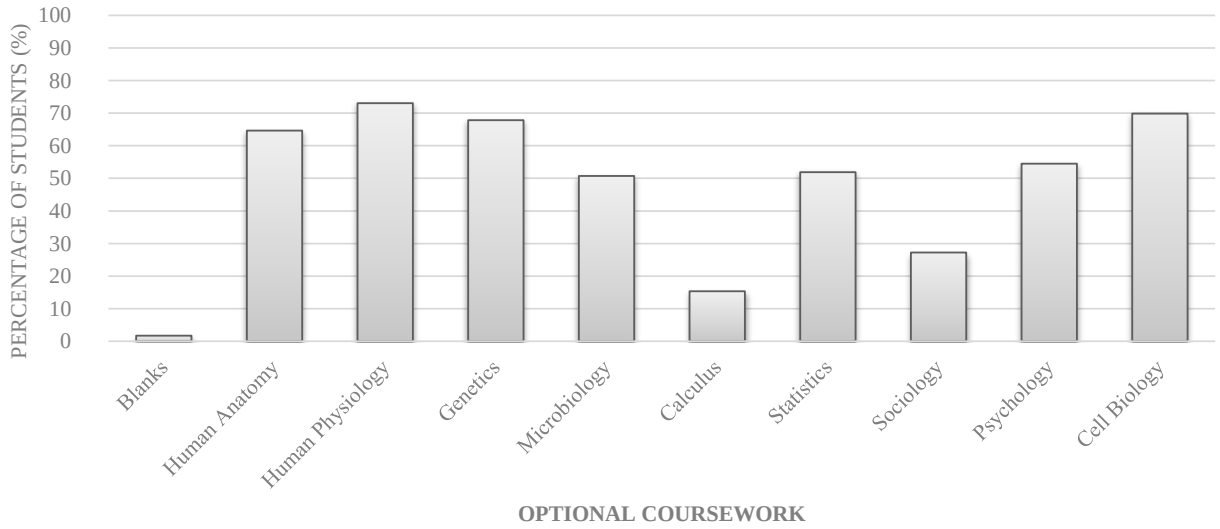


**Figure 2.** Quantitative Analysis of students who found optional courses effective in medical education.

increased disciplinary knowledge, problem-solving skills, and ability to interpret data analysis in medical school. Similarly, Robertson et al. (2019) found that students who took anatomy in undergraduate studies reported lower amounts of stress in medical school due to prior exposure to the content and terminology. Survey results from this study show comparable trends in student responses between required and recommended courses. This implies that specific undergraduate classes such as biochemistry, physiology, and cell biology may be influential in student performance at South Carolina medical institutions.

Even though VCOM Spartanburg only contributed 20% to the total responses of the study (Table 1), questionnaire submissions by these students were valuable in assessing coursework preparation because of the different approaches between osteopathic and allopathic institutions. In regard to approach differences, there are distinctions between allopathic medical colleges and osteopathic medical colleges.

Allopathic medical schools focus on treating symptoms of diseases with medication, radiation, and surgery. Students are instructed on how to use these techniques in treating patients on a daily basis, e.g., from a minor cut wound to a specific pathology, such as needing a liver transplant. On the other hand, a newer, distinctive approach to medicine exists known as osteopathic medicine. This perspective of medical education focuses on the body as a holistic entity and how nutrition, exercise, and injury prevention contribute to overall patient health. Even though there are fewer osteopathic medical colleges in the United States than allopathic medical colleges, physicians from both are fully licensed practitioners that have the same rights and responsibilities (Tolen, 2017).

Tables 2 to 3 display questionnaire responses by student year in medical school (Table 2) and by medical institution attended (Table 3). In a typical medical school, the first two years of instruction focus on different aspects of didactic medical education, including human anatomy, physiology, pathology, and biochemistry. However, the last two years of instruction focus on direct patient/clinical interaction, clinical rotations, and preparation for residency after completion of the USMLE exam. A potential reason for the unequal response rates between M1's and M4's could include the latter's' commitment to clinical work, residency preparation, and board exams during their final year, whereas M1's were halfway through their first semester of schooling when the questionnaire was distributed.

Regarding coursework preparedness, Figures 1 to 2 illustrate student responses to both required and optional coursework, respectively. Examining Figure 1, the course that most applicants denoted as important for medical school entrance was biochemistry, at approximately 94.49%. Reasons for this response could be that undergraduate biochemistry best assisted students in preparation for medical school biochemistry and the fact that this subject is heavily focused with respect to the Medical College Admission Test (MCAT). Furthermore, Baynes and Domiczak (2009) mention that since biochemistry is an integral component of human physiology and normal body function, this course can also enhance understanding of patient illness.

Figure 1 also displays that both semesters of general biology and general chemistry have high influence on medical education, at values of 80.58 and 57.95%, respectively. A potential reason for this ties back into biochemistry in that biochemistry requires a solid foundation of both general biology and general chemistry. In Figure 2, 73.04% of M1-M4 students mentioned human physiology as the most beneficial recommended

**Table 1.** Response Breakdown by M.D and D.O programs.

| M.D[1]/D.O[2] | Response count | Total Enrollment of medical schools surveyed | Response rate (Response count/ Total enrollment) (%) |
|---|---|---|---|
| D.O Responses[1] | 67 | 640 | 10.5 |
| M.D Responses[2] | 278 | 1566 | 17.8 |
| Total responses | 345 | 2206 | 15.6 |

[1]DO responses obtained were from Edward Via College of Osteopathic Medicine, Carolinas Campus.
[2]MD responses obtained were from MUSC, USCCM- Greenville and USCCM- Columbia.

**Table 2.** Response breakdown by medical school year (M1-M4).

| Year in medical school[3] | Response count | Response count/ Total responses (%) |
|---|---|---|
| M1 | 115 | 33.3 |
| M2 | 73 | 21.2 |
| M3 | 86 | 24.9 |
| M4 | 71 | 20.6 |

[3]1-4 represent first-fourth years, respectively.

**Table 3.** Response breakdown by medical institution.

| Medical school | Response count | Total enrollment | Response rate (Response count/ Total enrollment) (%) | Response count/ Total responses (%) |
|---|---|---|---|---|
| USCSOM- Columbia | 19 | 400 | 4.8 | 5.5 |
| USCSOM- Greenville | 129 | 415 | 31.1 | 37.4 |
| MUSC[4] | 130 | 751 | 17.3 | 37.7 |
| VCOM-Carolinas Campus | 67 | 640 | 10.5 | 19.4 |

[4]MUSC does not have any required coursework prior to matriculant entrance, but does provide recommendations on their website.

course for performing well in medical school. Human physiology is the study of how the body functions which is considered the basic foundation for matriculating medical students' career. On the other hand, M1-M4 students responding to the optional coursework component on the survey indicated that calculus was least needed in preparation for medical education at a value of only 15.36%.

According to Figure 3, 94.60 and 94.03% of allopathic and osteopathic students responded that biochemistry is the best prerequisite course for their success in medical school. A possible reason for this is because biochemistry employs testing used testing to interpret disease pathology. By understanding illness etiology, physicians can use this to develop effective treatment plans for patients. In Figure 2 and Table 4, the prerequisite coursework that was least important between M.D and D.O programs was general physics I and II, with response rates between 26.87 and 40.02% respectively and p-value of 0.029 (below the 0.05 significance level). Figure 2 and Table 5 show that 71.94 and 77.61% of M.D and D.O students mentioned human physiology as the best recommended optional course for medical school. The chairperson of the Department of Physiology at the University of Mississippi Medical Center, Dr. John E. Hall (2013) once said, "Each year the American Association of Medical Colleges (AAMC) asks graduating medical students about how well the basic sciences have prepared them for clinical training, and physiology is at the top and also stated, "Therefore, graduating medical students believe that physiology is highly relevant and important to their clinical training" (Adi and Alturkmani, 2013). Following human physiology as the best recommended course, cell biology was also emphasized by both M.D and D.O students at values of 69.42 and 71.64%, respectively. A crucial understanding of cell biology is essential for any prospective medical student because the course is taught in medical school and is vital in understanding human physiology and pathology (Lemberger, 2019).

**Table 4.** Comparative analysis of required coursework between M.D and D.O students.

| Required coursework | Percentage of MD students who consider the course helpful (%) | Percentage of DO students who consider the course helpful (%) | p-value[5] |
|---|---|---|---|
| General Biology I and II | 81.65 | 76.12 | 0.30302 |
| General Chemistry I and II | 58.63 | 55.22 | 0.61006 |
| Organic Chemistry I and II | 40.65 | 34.33 | 0.34212 |
| Biochemistry | 94.60 | 94.03 | 0.8493 |
| General Physics I and II[6] | 5.40 | 26.87 | 0.02852 |

[5]P-values were calculated using a 0.05 significance level and a two-tailed t-test.
[6]Only physics was found to have a statistical difference between M.D and D.O programs.

**Table 5.** Comparative analysis of optional coursework between M.D and D.O students.

| Optional coursework | Percentage of MD students who consider the course helpful (%) | Percentage of DO students who consider the course helpful (%) | p-value[7] |
|---|---|---|---|
| Human anatomy | 67.16 | 64.03 | 0.63122 |
| Human physiology | 77.61 | 71.94 | 0.34722 |
| Genetics | 67.16 | 67.99 | 0.89656 |
| Microbiology[8] | 62.69 | 47.84 | 0.02926 |
| Calculus | 13.43 | 15.83 | 0.62414 |
| Statistics | 50.75 | 52.16 | 0.83366 |
| Sociology | 25.37 | 27.70 | 0.70394 |
| Psychology | 59.70 | 53.24 | 0.34212 |
| Cell biology | 71.64 | 69.42 | 0.71884 |

[7]P-values were calculated using a two-tailed t-test at a 0.05 significance level.
[8]Only Microbiology was found to have a statistical difference between M.D and D.O programs.

Courses least suggested by students are shown in Figure 2 and Table 5 and include sociology, with a value of 27.7% and calculus at a value of 13.43%. Sociology is defined as the study of society, social institutions, and social relationships.

An explanation for the low suggestion rate for this course is not because it is irrelevant to medicine, but it has no bearing on understanding medical school curriculum. For the same reason, calculus was also poorly suggested by students since mathematics is typically only taught in pharmacology during the M2 year (Tolen, 2017).

## Conclusion

By conducting this research, we were able to determine what undergraduate courses were important in matriculant success for all South Carolina Medical Schools. This project should remain as ongoing research endeavor in order to detect and document any noted changes or trends biennially or quinquennially. This collective information can then be used as a reliable source for in-state and/or out-of-state prospective students interested in obtaining more information on recent courses that have demonstrated to be the most beneficial in a medical student's curriculum. This fact was mentioned from prospective medical students attending either of the four accredited medical schools in South Carolina.

A recognized limitation to this report was the fact that only South Carolina medical schools were contacted; thus, there is the possibility that the results could have been different if additional medical students were enrolled in the study. We did attempt to canvass out-of-state medical schools; however, it ended up being unsuccessful due to the fact that only a few out-of-state medical schools responding to participate in this questionnaire.

As previously mentioned, our initiative should continue as an on-going project as another effort in the near future to re-contact out-of-state medical schools in the hopes of increasing participation. The additional surveys could lend important information in order to add or detract from the results reported in this study. With the reported success of conducting an in-state medical school survey of medical students, this project could be used to extend further analysis for medical students when determining what specific undergraduate courses, if any, would best serve as a foundation when preparing for the United States Medical Licensing Examination (USMLE) or

Comprehensive Osteopathic Medical Licensing Examination of the United States (COMLEX -USA). These are necessary for prospective or incoming medical students to eventually gain clinical practice.

Lastly, an overall approach undertaken in this effort assessing medical students can also be used to target undergraduate coursework significance for other accredited health professional programs, such as dental medicine, physical therapy, and veterinarian programs.

## CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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