2018

Is the Devil in the Second Year? Student Perceptions of Evidence-Based Medicine at Cooper Medical School of Rowan University

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Graduation Year: 2018

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Project Type: Research

Scholar's Domain: Evidence-based Medicine

Abstract

Background

Evidence-based medicine (EBM) is the use of scientific reasoning and current evidence to make clinical decisions. Today, most medical schools teach EBM as part of a preclinical block. However, schools have begun approaching EBM longitudinally. Cooper Medical School of Rowan University (CMSRU) utilizes a longitudinal course in EBM from the first through fourth years. This raises the question - does this novel, longitudinal curriculum promote a culture of clinical inquiry that is also positively perceived by students?

Objectives and Methods

Authors hypothesized that increased exposure to the EBM curriculum correlated with improved student perception of EBM value and effectiveness from first year (M1) through fourth year (M4). A cross-sectional survey design was used with the study population of M1, second (M2), third (M3), and M4 students. Participants were contacted to complete a brief online survey. Surveys were distributed between July - September 2017, with 65 respondents. Differences were measured between classes.

Results

Significant between-class differences were observed in perceived emphasis in EBM, confidence in developing questions, motivation to apply EBM, usage of skills, types of sources utilized, and most important research article sections. Although perceived EBM effectiveness increased over time, there was a prominent decrease in the M2 year.

Conclusions

Differences in EBM perception exist between classes. EBM effectiveness generally improved from preclinical to clinical years with a prominent dip in M2 year. These results may help shape the future CMSRU curriculum. Additional study with a larger population is required to draw definitive conclusions.

Introduction:

Evidence-based medicine (EBM) is a relatively recent concept which has been incorporated into medical education. Today, EBM is regarded as the "conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients."[1] However, EBM ultimately finds its origins to the concept of scientific reasoning, dating back to the 17th century. The early application of reasoning in science, the true definition of scientific reasoning dates back to the 1970s. Simon and Newell defined the nature of scientific reasoning as a "problem-solving process that involves critical thinking in relation to content, procedural, and epistemic knowledge."[2]

Recently, scientific reasoning has shifted from classical experimentation to emphasizing evidence evaluation.[3] EBM echoes this concept in day-to-day clinical practice. This skill has broad implications for developing a generation of physicians who can sort through the breadth of available information in order to provide the best care for their patients.

Medical schools have been teaching EBM for the last 20 years.[4] A systematic review revealed the heterogeneity of EBM teaching practices.[5] Methods included lectures, workshops, journal clubs, use of mobile devices in the curriculum, simulations, and online teaching.[5,6,7] Courses ranged from a few hours of elective instruction to several months of structured course time. However, many schools compartmentalize this skill into a few days, often in the third year of medical school.[8] Some schools have begun acknowledging the importance of developing skills over time through a longitudinal curriculum.[4]

Cooper Medical School of Rowan University (CMSRU), now in its fifth year, has developed a novel EBM curriculum spanning all four years of medical education in a course called Scholar's Workshop (SW). Part of this course is dedicated to teaching how to frame a question, determining the strengths and weaknesses of various sources of information, understanding the hierarchy of evidence, defining bias, error, and risk, and developing competence in applying these skills to clinical decision making.[9] Along with SW, students are required to see patients in the student-run clinic, the Cooper

Rowan Clinic (CRC). This opportunity immerses students in the world of clinical medicine starting in the first year of medical school, and can provide an early glimpse into the practical application of EBM.

The longitudinal curriculum rich in EBM raises the question - does this format of EBM exposure affect student perception of their skills? If so, it would be interesting to evaluate the evolution of these perceptions from the beginning of students' education in the first year to their perceptions of EBM as they practice clinical medicine in their fourth year clerkships. The importance of understanding this development of student-perceived skills may assist course directors at CMSRU in the development of the SW course in the future. Furthermore, the novel concepts of early exposure and immersion in clinical reasoning may help shape the development of future medical education courses in EBM.

Methods:

The purpose of this study was to assess the strengths and weakness of the longitudinal EBM exposure at CMSRU by distributing a survey asking students to reflect on two important curricular principles - value and effectiveness. Specific curricular elements sought in the survey included student perception of encouragement, motivation, confidence, self-reported use, knowledge, accessibility, and usefulness (Table 1). To assist with conceptualizing the framework of a successful curriculum, a post-hoc review of the survey divided the above curricular elements into the principles of value or effectiveness (Diagram 1).

The study was a descriptive, cross-sectional survey design with a target population of M1, M2, M3, and M4 medical students at CMSRU. Surveys included two background questions (on class year and previous graduate degrees), and 10 brief multiple-choice questions (on curricular elements, described above) delivered on the Qualtrics platform. This project was a pilot study obtaining baseline characteristics to compare differences between classes at one point in time. The survey was distributed via an email to all current students with consent to participate obtained when filling the survey. Participation in the survey was voluntary and no identifiable information was collected. Inclusion criteria consisted of

M1, M2, M3, and M4 students from CMSRU with current enrollment in the academic curriculum (n =341). Exclusion criteria included students not currently participating in the academic curriculum at CMSRU or alumni of CMSRU. The survey duration lasted from July 19 - September 6, 2017.

The primary hypothesis of this study was if students are exposed to the increasing depth and breadth of the EBM curriculum over their four years, then student perception of curriculum value and effectiveness would increase from first through fourth year. Between-group differences were measured using Fisher's exact test for categorical variables (i.e. expected graduation year, prior education) Significant results were defined as a p-value less than or equal to an α of 0.05. Data was presented with number and percentage as all data collected was categorical.

Results:

Participant Characteristics

Sixty-five surveys were submitted out of the 341 survey invitations, reflecting an 19.06% return rate. Of the 65 surveys submitted, two surveys skipped one question. These surveys were included in the analysis to increase power. Between-group response rates varied, with second and third year students participating less frequently (Table 2). With a population size of 341, sample size of 65, and a confidence interval of 95%, the achieved margin of error was calculated to be 11%.

Ten individuals did obtain additional graduate degrees. Of the 10 respondents who reported additional graduate education, the types of degrees included: 1 PharmD, 1 post-baccalaureate degree, 2 Master's in Public Health, and 6 other Master's degrees (1 physiology & biophysics, 2 engineering, 1 communication, 1 education, 1 none specified). Groups did not significantly differ in the number of students with previous graduate education. The post-baccalaureate degree was counted as prior education despite it not being considered a traditional graduate degree, as it may have exposed students to additional experience in research and/or statistics.

Positive Learning Environment - Question 1,2,5

Student perception of the academic environment as a space supporting clinical inquiry was measured in questions 1 and 2. Question 1 asked, **“**Have you felt encouraged by faculty during your medical education to define a question and look up information?” Significant differences were found between the M3 (class of 2019) and M2 (class of 2020) students (p = 0.0428) as well as between the M1 and M3 students (p = 0.04572).

In an alternate representation of the data, Figure 2 displays the percentage of students reporting a negative environment (i.e. not encouraged to ask questions). M2 students responded with the highest feelings of dissatisfaction at 30.77% of respondents.

The second question addressed student motivation. It asked, **“**Have you felt motivated to independently define a question and look up more evidence to solve it?” Between-group differences were significant for the M4 students (class of 2018) and M2 students (p = 0.0146) as well as between M1 and M2 students (p = 0.0007). Second year students reported the lowest motivation rates with 61.5% reporting feeling motivated versus 100% M1 students reporting motivation (Figure 3).

Students were asked to describe their level of confidence in asking a clinical question. Question 5 asked, “On a 1-5 scale, with 5 being “very confident,” how comfortable are you with developing a clinical question?” Confidence levels varied from 1 (no confidence) to 5 (very confident). Significant differences were present between the M4 class and the preclinical classes, specifically, between the M4 and M2 classes (p = 0.0166) and between the M4 and M1 classes (p = 0.0370). Figure 8 displays these rankings. Noticeably, at least 50% of the M3 and M4 students reported “high confidence” (answering “sufficient confidence” or “very confident”) versus M2 and M1 students. Although not reaching statistical significance, M2 students had the smallest percentage of “high confidence” rankings than any other class (15.38%) and M1 students reported only slightly higher confidence in creating clinical questions (26.31%) (Figure 6).

Self-Initiated Use - Questions 3,4

Questions 3 and 4 addressed student application of EBM in daily practice. Question 3 asked, "In the last month, have you had the opportunity to apply the answer to your question in practice, either in clinic or during direct patient care?" Significant differences were found between the M4 and M2 students (p = 0.0033), M4 and M1 students (p = 0.0076), and M3 and M3 students (p = 0.03140) (Figure 4).

Students were also asked to rank their level of EBM application on a 5 point scale. Question 4 asked, "How often have you needed to look up more information with clinical decision making?" Answers ranged from 1 (never/rarely), 2 (2+ times per month), 3 (once weekly), 4 (3+ times per week), or 5 (daily). Between-group difference were found comparing preclinical students (M1 and M2) with clinical students (M3 and M4). Between-group differences were significant for M4 and M2 students (p = 0.0175), M4 and M1 students (p = 0.0133), M3 and M2 students (p = 0.0143), and M3 and M1 students (p = 0.0116) (Figure 5). Students reporting EBM application at least three times per week were 84.61% and 68.33% for M3 and M4 students, respectively. In contrast, 30.69% of M2 respondents and 52.63% of M1 respondents endorsed using EBM at least three times per week.

Student Knowledge - Questions 6,7

Questions 6 (Figures 7a, 7b, 7c, 7d) and 7 (Table 4) asked students specific questions regarding the types of sources used to search for answers to clinical questions, as well as what aspects of an article students perceived as most important. The most frequent sources used often varied by class. Only seven of the 11 choices for sources were found to have between-group differences which were statistically significant (Table 3). UpToDate use was most frequently used by the fourth year class, and significant between-group differences were found between the M1 and M2 students (p = 0.0009), as well as the M1 and M4 students (p = 0.0006). Textbook use was most frequently used by the M3 class, and were observed less in the M4 class (p = 0.0386). Journal article use was found to be significantly affected by previously obtaining a graduate degree. Accounting for this variable, however, revealed a nonsignificant difference between groups. In addition, M1 students responded with the highest percentage of using social media as a resource for clinical appraisal. A significant difference was found between the M1 and M4 students ($p = 0.0428$). Although M3 students also did not endorse social media use along with the M4 students, the number of respondents limited the ability to reach statistical significance when compared with the M1 students ($p = 0.0685$). WebMD use was highest in the M2 class, with statistical significance between the M2 and M4 classes ($p = 0.0340$).

Moreover, the M2 and M3 classes displayed the highest percentages of Google Scholar use, both with an average of 38% of respondents. Differences were significant between M4 students and M3 students ($p = 0.0499$) as well as between M4 and M2 students ($p = 0.0499$). Finally, students reporting "other" sources for finding clinical data were most common in the M2 class, with 31% of respondents searching with an alternative method. Differences were significant between the M4 and M2 classes ($p = 0.0235$) and M1 and M2 classes ($p = 0.0207$). "Other" responses included Dynamed, Clinical Key, BMJ Best Practice, and Scopus.

In question 7, students were asked to select the three most important elements of an article. Of the eight choices (Table 4), only three were found to have significant between-group differences - speed of obtaining an answer, whether the information will be on the exam, and finding a peer-reviewed article. M3 students had the largest percentage of students citing speed as an essential element. Between-group differences were present between M3 and M1 students ($p = 0.0453$). Furthermore, whether an article element would be tested on an exam also was found to be significant. This was most commonly reported by M2 students. Differences were significant between M2 and M1 classes ($p = 0.0198$), M2 and M4 classes ($p = 0.0018$), and M4 and M3 classes ($p = 0.0127$).

Value - Questions 8,9,10

Questions 8, 9, and 10 explored the topic of value in EBM. Question topics included reflection on whether EBM is considered "not necessary," whether looking up articles is "too tedious for daily practice," and whether looking up articles is "time worth spent." Notably, none of these three questions achieved statistical significance in response variation between classes, and consequently were not represented as graphs. The majority of participants affirmed that EBM is “necessary to me at this time.” Most respondents believed that looking up articles is “usually worth the effort” (⅘ on Likert scale), while none of the respondents reported that looking up articles “has never been worth the time” (⅕ on Likert scale). Regarding daily practice, most respondents perceived daily clinical searches as “occasionally tedious” (less than 40% of the time) or “sometimes tedious” (< 60% of the time).

Discussion:

Evaluating study goals

As a new school, it is important to create and deliver curricula that is both valuable and effective (Diagram 1). When assessing if CMSRU students perceive value in a longitudinal EBM curriculum, there were no significant differences between classes. Value was defined as a task that was considered useful and applicable (Diagram 1). Regardless of class year, students felt that using the skills of EBM were necessary, was time worth spent, and was not excessively tedious for daily practice (Questions 8,9,10). This is a positive finding, and demonstrates that students may appreciate the importance of such a skill.

Effectiveness of an EBM curriculum can be subdivided into elements supporting a positive learning environment, achieving improved student knowledge, and driving self-initiated use (Diagram 1). Survey results differed between classes in these three elements of effectiveness.

One of the goals when constructing a longitudinal course would be to ensure students maintain a high level of encouragement in applying concepts, therefore fostering independent learning. Findings did not support this expectation. Levels of encouragement generally declined from first to fourth year, with a significant spike of discouragement in the second year. Likewise, motivation levels also dipped in the second year. Motivation could be argued to be an intrinsic quality, however, it is most certainly at least partially impacted by extrinsic factors such as a supportive environment, thus echoing the previous results on levels of encouragement.

Moreover, confidence levels most significantly differed between preclinical and clinical students. It is possible that this variation is due to the repeated exposure to the curriculum over time. As EBM is a skill that directly can be applied to clinical practice, it is plausible that students were exposed to daily moments involving EBM, thus improving confidence with repeated practice. It is noteworthy that confidence significantly dipped in the second year compared with the first and fourth years, potentially indicating that increased experienced does not necessarily correlate with increased confidence.

Student knowledge varied between class years. This study asked students specifically about selecting valid sources for information gathering, and important elements of an article when appraising literature. Weak non-peer reviewed sources such as social media and WebMD were exclusively selected in preclinical students, with highest percentages in M1 students. Textbook use was common amongst M1 through M3 students, but declined in the M4 class. M4 students responded with the highest frequency of UpToDate use, a point of care clinical decision support resource. Students' reports of citing journal articles were consistent between M2, M3, and M4 classes, with significant differences compared to the M1 class. Furthermore, although not found to be statistically significant between groups, all classes used Google searches most commonly to search for clinical answers.

When comparing selection of article elements, it is not surprising to note that answer speed and likelihood of information being presented on an exam were statistically significant in the M3 and M2 classes, respectively. It is plausible to suggest that M3 students, who are still in the process of balancing clinical inquiry with direct patient care, would be interested in finding efficient search results. Similarly, M2 students are under pressure to perform well on medical school and licensing exams such as the USMLE, taken at the end of the second year. Therefore, searches for articles correlating with exam material may be of particular interest in this cohort.

Finally, the third component of assessing effectiveness of the EBM course included determining the degree of self-initiated clinical inquiry. As authors had hypothesized, M4 students reported the highest percentage of clinical inquiries in the previous month. M4 students had the most exposure to EBMas part of the formal curriculum. In addition to the highest involvement in direct patient care. M3 and M4 students reported similar frequencies of daily searches at 46.15% and 42.11%, respectively. Likewise, M2 and M1 students reported less frequent searches, with 23% and 21.05% of respondents endorsing daily searches. M2 student frequencies were similar to M1 frequencies despite an entire year of additional exposure to the EBM curriculum.

Emerging Patterns

This study supports several patterns in survey responses, including patterns within the M2 class and differences between clinical and preclinical students. Certainly, an instrumental part of educating undergraduate medical students is to foster a sense of professional development. However, it is reported that empathy significantly drops within the third year of medical education.[10] Could the M2 student reports echo a similar facet of the "hidden curriculum?" From the survey data collected, it appears that "the devil is in the second year." Second year students, despite answering similarly when questioned about the value of EBM, consistently reported lower satisfaction with the learning environment (Fig 2,3,6), searches driven by finding evidence that was most likely tested on exams (Table 4), and reported less frequent independent searches (Fig 4,5) compared to the third and fourth year cohort.

As residency applications become more competitive, there is more incentive to screen applicants using cut-off scores for the USMLE examinations, which have unintended consequences on student perception of important concepts in medical school.[8] With increasing pressures to build a competitive application with high board scores, it is plausible that second year students would be less engaged and more dissatisfied with a course that was not directly applicable to "the test." This is especially true as EBM has not been historically tested in length on the USMLE examinations.[11]

More recently, the USMLE Step 1 examination has increased the proportion of questions relating to EBM. The biostatistics and epidemiology "systems" account for part of the 15-20% distribution of questions, and the competency of practice-based learning and improvement accounts of 4-8% of the Step 1 examination.[11] This may encourage students to more actively engage with the EBM curriculum in their second year. However, it is important to recognize that continuing to place such emphasis on board examinations will not change M2 student behavior with regards to learning material outside the scope of the exam.

The best method of mitigating this practice would be to shift the current culture toward a holistic evaluation of skills necessary in residency and clinical practice, including applicant confidence, knowledge, and initiative to engage in evidence-based practices. This shift would require an alteration of the residency application process, which has numerous hurdles.

Limitations

This study had several limitations. One of the largest limitations was the number of respondents. Definitive conclusions are difficult to obtain from the current sample size. M1 and M4 students had the highest participation rates. Future work on increasing respondent size will be important, specifically as achievement of a 5% margin of error would require a sample size of 181.

Furthermore, timing of the survey may have affected respondent results. The M3 and M4 classes began approximately 1 month prior to M2 and M1 classes (1st week of July versus 2nd week of August). Despite a difference of a few weeks, it is possible that the additional clinical rotations gave M3 and M4 students more exposure to EBM, the timing of which may have immediately coincided or preceded survey distribution.

Moreover, question wording may have impacted responses. This is especially true for the value-based questions 8,9, and 10. This could have led to respondent bias, causing participants to acquiescence to the response that seemed "correct." Similarly, there may have been an element of question-order bias, with clustering of similar questions resulting in respondents primed for specific answers.

Other limitations of this study exist. During analysis of data, there is susceptibility to confirmation bias, especially with only one set of data points. Additionally, there may be confounding elements based on demographic data such as respondent age, gender, and degree of undergraduate exposure to research which may have impacted results. Finally, year-to-year changes in coursework could have impacted the variation between classes, as the M3 or M2 students may have had a different series of formal lectures and assignments directed towards EBM than M4 students. If so, effects due to improved course changes would have only decreased between-group differences compared to the M4 class, although negatively perceived changes are possible.

Conclusions:

This study is the first to assess a novel curriculum in EBM by understanding student perceptions at CMSRU. The purpose of this study was to determine some of the strengths and weaknesses of this longitudinal curriculum by exploring student-reported value and effectiveness of evidence-based practices. Generally, all four classes of students perceived value in learning and utilizing EBM.

Regarding course effectiveness, differences between classes existed in perception of the learning environment, self-initiated searches, and specific search elements sought by students. Generally, students were more motivated and confident in their ability to perform searches in their clinical years compared with their preclinical years. Additionally, students in their clinical years reported stronger sources for clinical searches compared with preclinical students. Significant declines in the positive perceptions and application of EBM in the second year were seen across several questions. These findings may be a result of the differing priorities of M2 students.

Future endeavors

Despite the limited amount of data collected, interesting patterns emerged in analysis which can have an impact on the success of the EBM course in the future. First, it would be essential to assess internal validity and reliability. Although the discrete data points cannot be altered, repeated delivery of the survey over the course of the academic year will give a more robust understanding of differences between classes and the degree of change in answer choices over time. Re-evaluation of the survey content will be necessary to determine if respondent and question-order bias can be eliminated. Moreover, assessment of additional demographic variables will aid in detecting confounding factors.

Developing a deeper understanding of EBM course value and effectiveness can be improved with longitudinal surveys beyond the fourth year into residency, where a "truer" sense of utilizing EBM as a skillset can be assessed. Ideally, objective data from performance scores on examinations such as the USMLE exam and clerkship summative assessments would also aid in improving internal validity. Additionally, validated tools to assess EBM competence such as the Fresno test may be used.[12,13] Recently, the USMLE Step 1 score report delivers a breakdown of topics related to EBM. It may be helpful to compare deviations in school performance with national performance in this domain. In addition, creating a framework of questions on Liaison Committee on Medical Education (LCME) core competencies, rather than a discretionary collection of curricular elements, would assist faculty to more precisely direct efforts.[9]

Other methods of improving the students' perspective on specific courses would be a qualitative assessment via student interview. Constructive student feedback should be considered a key element of course development. Future studies should also explore specific elements of the EBM curriculum, such as strengths and weaknesses of statistics, critical appraisal, and application to patient care in order to more specifically aim efforts to adjust the course as necessary.

Tables and Figures

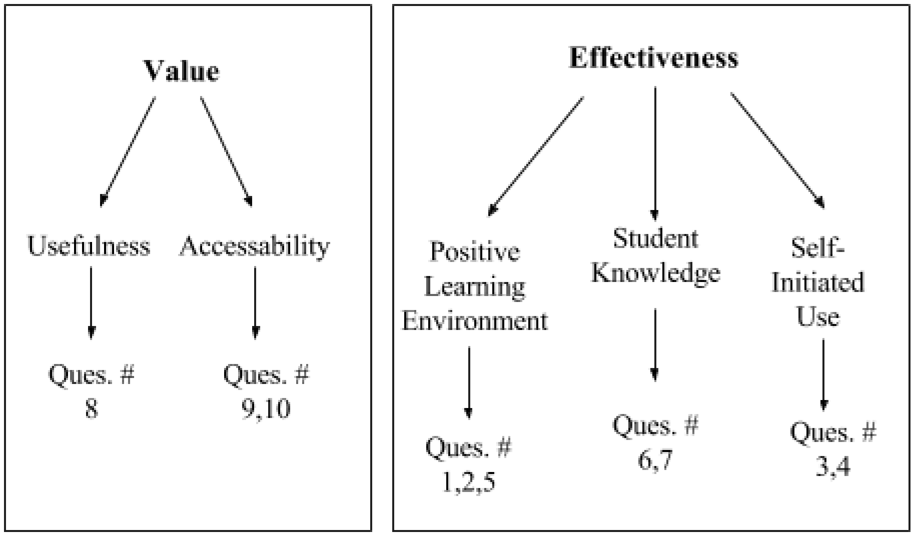


Diagram 1. Schematic of assessing the EBM curriculum, organized by question number.

Question Number	Question	Response Type
1*	Have you felt encouraged by faculty during your medical education to define a question and look up more evidence to solve it?	Dichotomous
2*	Have you felt motivated to independently define a question and look up more evidence to solve it?	Dichotomous
3*	In the last month, have you had the opportunity to apply the answer to your question in practice, either in clinic or during direct patient care?	Dichotomous
4*	How often have you needed to look up more information with clinical decision making?	Ordinal
5*	On a 1-5 scale, with 5 being “very confident,” how comfortable are you with developing a clinical question?	Ordinal
6*	What sources would you use to find the answer?	Nominal
7*	The top three pieces most important to me when searching for an article are:	Nominal
8	Evidence-based medicine is not necessary to me at this point in time.	Dichotomous
9	Looking up articles and data to a clinical question is too tedious for daily practice.	Dichotomous
10	Looking up articles and data on clinical questions is time worth spent.	Dichotomous

Table 1. Survey questions and response types. * = questions with answers yielding a power of <0.05.

	First Year (2021)	Second Year (2020)	Third Year (2019)	Fourth Year (2018)
Num. of Current Students	98	87	81	75
Num. of Responses (Response Rate Percentage)	20 (20%)	13 (15%)	13 (16%)	19 (25%)
Num. Reporting Previous Education (Response Percentage)	3 (15%)	2 (15%)	3 (23%)	2 (11%)

Table 2. Survey response data and prior achievement of graduate degree(s), by class.

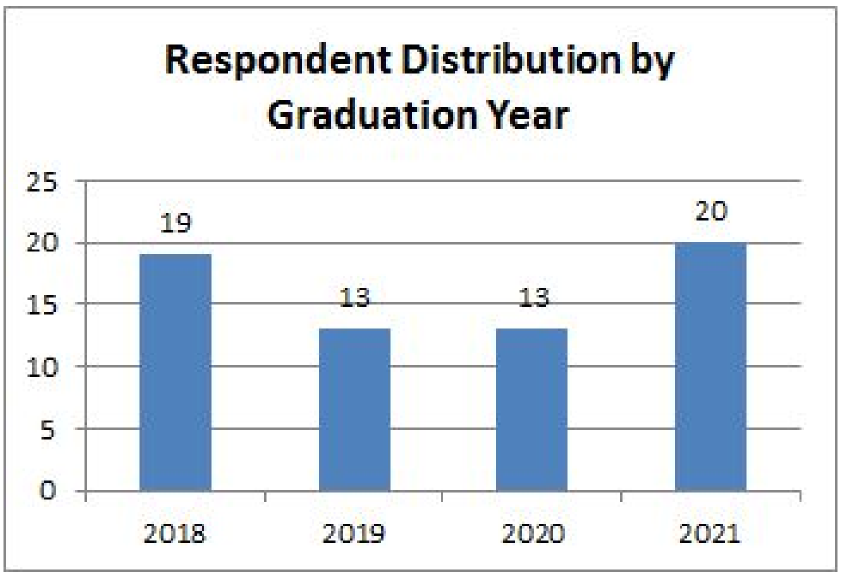


Figure 1. Distribution of survey respondents (number) by class year. No significant differences were found between number of student in each class participating, however M4 (2018) and M1(2021) students participated most frequently.

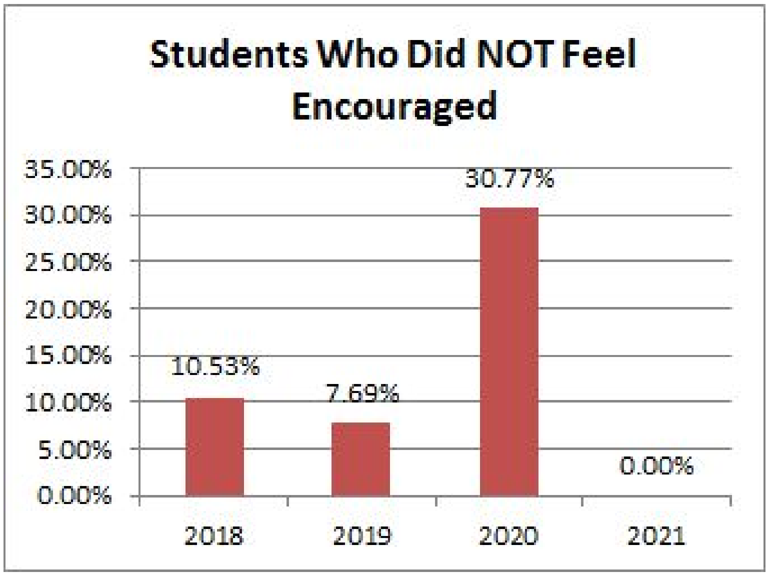


Figure 2. Question 1. Percentage by class of respondents reporting not feeling encouraged to formulate clinical questions. The second-year students displayed the highest level of discouragement.

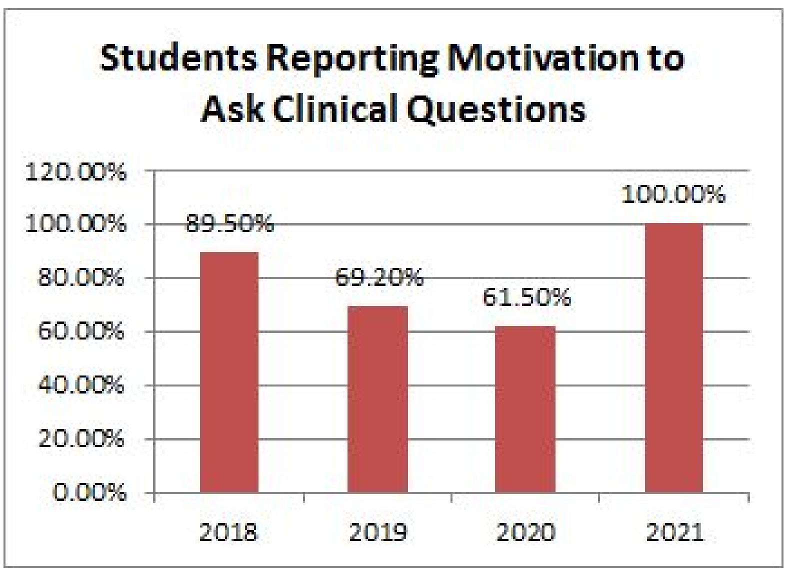


Figure 3. Question 2. Breakdown of motivation (percentage of class responses) to perform independent searches, by class year. Note the M4 class had the highest motivation, and the M2 class displayed the lowest motivation.

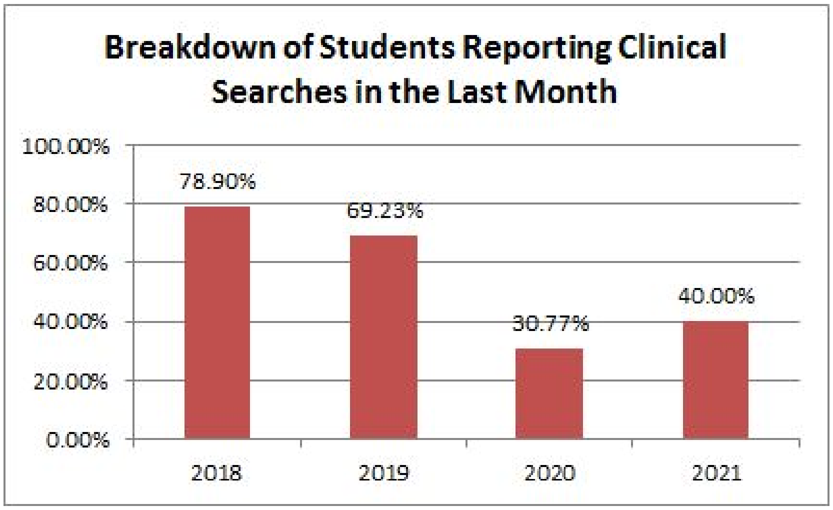


Figure 4. Question 3. Student-reported searches. The largest percentage of students reporting clinical searches in the last month were in fourth-year students, followed by third year students. Second year students had the lowest percentage reporting recent searches.

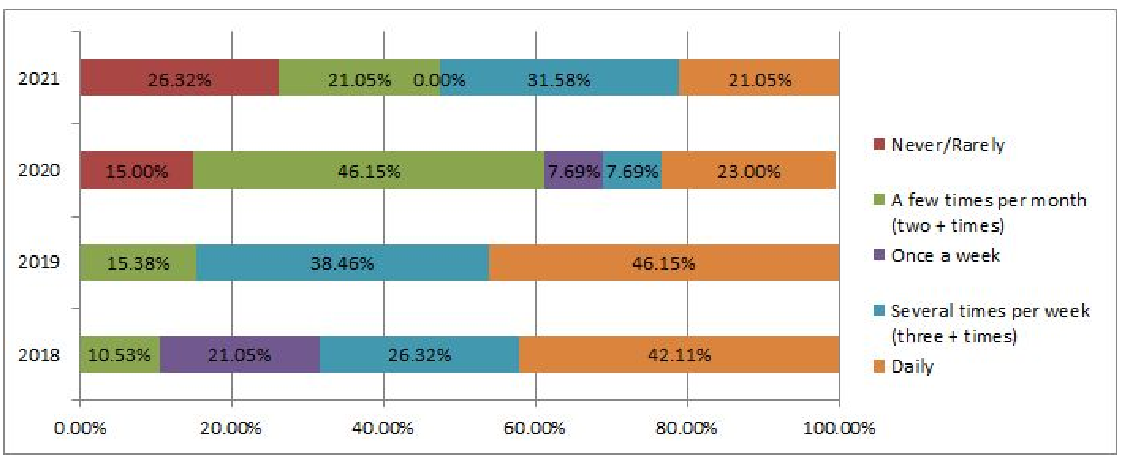


Figure 5. Question 4. Overall response to frequency of searches in clinical decision making (percentage of responses per class). Note the class of 2021 data was calculated based on 19 responses, as one of the 20 responses was not complete.

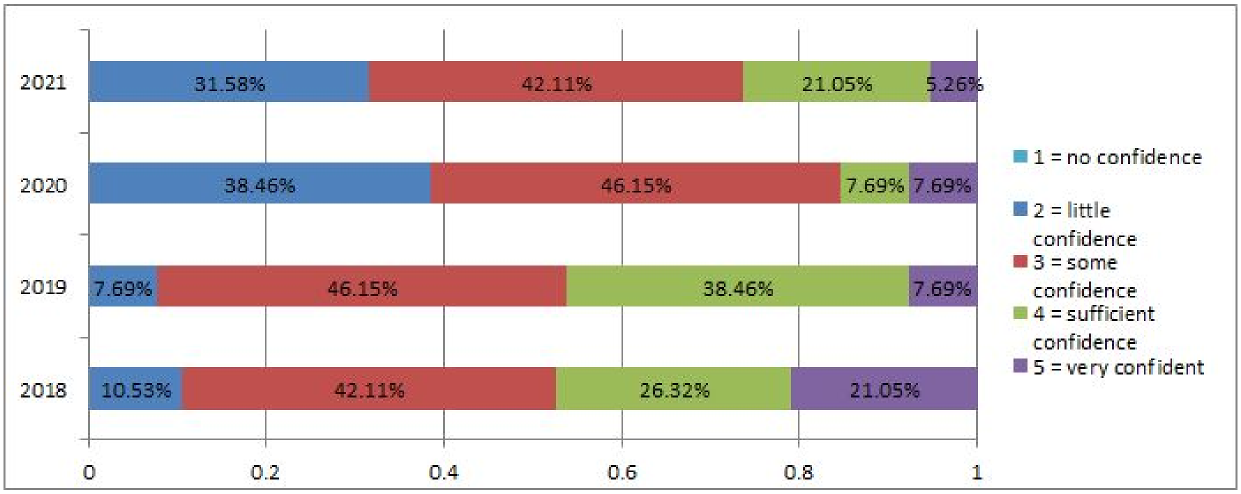
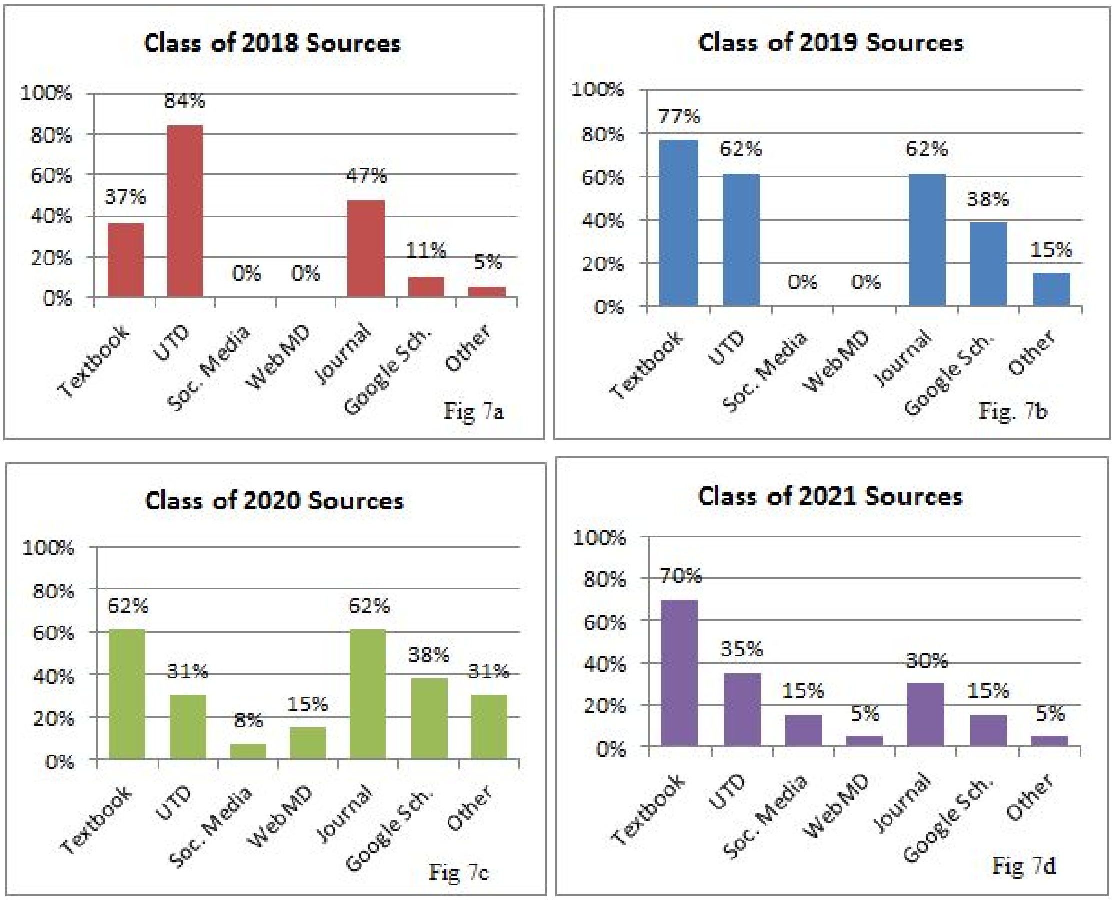


Figure 6. Question 5. Overall responses (based on five-point Likert scale) to confidence in developing a clinical question. Note the class of 2021 data was calculated based on 19 responses, as one of the 20 responses was not complete.

Textbook (online or hardcover)*	Google search
UpToDate*	PubMed / Ovid
Social media (Facebook links, Twitter, etc)*	Cochrane Library
WebMD*	Medscape
Journal article*	
Google Scholar*	
Other *	

Table 3. Question 6. Available choices for most important elements of critical appraisal. * = Sources with statistically significant between-group differences in frequency of use.



Figures 7a, 7b, 7c, and 7d. Question 6. Reported frequency of appraisal sources, by class. UTD = UpToDate, Soc. Media = Social Media, Google Sch. = Google Scholar. Only sources with significant between-class differences were graphed. “Other” sources listed in text.

Can I get to the answer I am looking for as fast as possible?*	Is this information from a validated study?
Will this be on the exam?*	Will I be able to apply this to my clinical practice?
Is the article peer-reviewed?*	Are the findings the most current evidence available?
	Can I access this information easily?
	Is this information follow traditional practices?

Table 4. Question 7. Available choices for important article elements. * = Sources with statistically significant between-group differences selection.

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