

Curiosity, Discovery and Application of Evidence Curriculum Reform Committee – June 2018

Committee Members:

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Purpose of Committee:

This committee was established as part of the curriculum reform process of the University of Colorado School of Medicine. The overall charge was to examine the current curriculum, review the existing relevant literature, review the current curricular elements within the scope of this committee, examine practices at other institutions and develop recommendations. Specifically, this committee was charged to examine curiosity, discovery, and the application of evidence. The committee distilled the following basic questions in each of these areas that needed examination to inform our recommendations:

- **Curiosity**
 - Do we already recruit people that have curiosity or is there a way to screen for it during the admissions process?
 - How do we create an environment that nurtures curiosity rather than suppresses it?
- **Discovery**
 - What are the elements needed to teach and promote research and scholarship?
 - Do students need protected time for research/scholarship?
 - Do we currently have excellent programs to support research and scholarship or are there better alternatives?
- **Application of Evidence**
 - **Biostatistics and Epidemiology**
 - What is the optimal way to teach students biostatistics and epidemiology
 - **Evidence Based Medicine**
 - What is the best way to integrate EBM in the curriculum
 - **Clinical reasoning**
 - How do we develop/teach clinical reasoning skills in our students

Review of Best Practice/Alternate Practices

The committee investigated the relevant curricular elements regarding curiosity, scholarly projects, biostatistics epidemiology and evidence based medicine curriculum of the following schools:

1. University of Michigan
2. University of California San Francisco
3. Vanderbilt
4. New York University
5. Oregon Health Sciences
6. Harvard
7. University of North Carolina
8. Hofstra University
9. Georgetown
10. University of Washington
11. Stanford
12. Johns Hopkins
13. Columbia University
14. University of Chicago

A. Curiosity

We did not find any schools in which a process to actively identify curious applicants exist. Two schools, Harvard and University of Chicago/Pritzker's School of Medicine explicitly state on their admissions websites that they value curiosity and curious students. These schools emphasize offering broad experiences and course work to allow students to explore their passions and interests. In the literature, curiosity has been shown to be repressed by stress, anxiety, and workload (lack of time to reflect, ask questions, and seek answers). Alternatively, curiosity is nurtured by providing space and time for students to think and ask questions. Several schools have structured the preclinical curriculum to provide more of their curriculum in a block format and limiting other activities running at the same time as major blocks. Some schools have inserted and utilized "spacer time" in between major blocks. Although this time is utilized in different ways by the different schools, it consistently provides a time when less dense and time-intensive curriculum or activities are delivered. UCSF, for example, uses week long spacers of time between major curricular blocks for assessments (e.g. formative competency assessments, summative clinical skills exams, comprehensive basic science exams), reflection, coaching (developing learning plans, meeting with coaches), and health (activities that promote resilience, time to access campus resources). Other schools utilize spacer time to consolidate delivery of elements of the curriculum that have been threaded at other schools. These spacers provide some decompression of the curriculum. Although not studied, interventions that decompress curriculum should provide more time for students to think, reflect, and ask questions—providing for time and space for students to display curiosity.

B. Discovery (Research and Scholarship)

The committee's review of scholarly project time at other medical schools showed that 12 of the 14 schools reviewed required a mentored scholarly project. Of those schools requiring scholarly projects, 11 had protected time for students to do project work. The median amount of protected time was 12 weeks (range 6-30 weeks).

C. Application of Evidence

In addition to our review of the medical school curriculum from the 14 schools listed above, Carolyn DiGuseppi (Evidence Based Medicine Thread Director) informed our committee of a separate review (as part of her Thread Director role) of 15-20 different programs/courses/tutorials/textbooks related to epidemiology/biostatistics from universities in the US, Canada and the UK (e.g., Tufts, Toronto, Dartmouth, U Mass, Virginia Medical College, Oxford, Duke). Several schools in the investigation had significantly more hours devoted to biostatistics and epidemiology as compared to our program. All schools had more small group time and some had additional online modules. Examples:

- Georgetown- involves 24 contact hours (including multiple small group sessions) in Year 1 plus several problem-solving assignments, and 8 contact hours in Year 2 plus several EBM projects. This totals 32 contact hours in addition to tests, multiple assignments, and projects over two years. A likely estimate is 50 hours of time in Years 1 and 2.
- University of Pittsburgh offers a 15 hour fundamentals of epidemiology/biostatistics course which combines lectures, multiple small group sessions and online modules over fall semester Year 1. There are also 17 sessions of applied biostatistics, epidemiology, and introduction to evidence based medicine over spring semester including mainly small group sessions, online modules and independent study. In the second year there are additional hours on epidemiology/population health in a fall semester class. A likely estimate is 50 hours of time in Years 1 and 2.

- Harvard has a month long block in Year 1 focused on social and population sciences including: clinical epidemiology and population health (clinical epidemiology/biostatistics, critical appraisal and population health). Formats include lectures, large groups (with 30-40 students), and small group problem solving sessions. This represents about 80 hours of instruction.
- UMDNJ-New Jersey offers 50 hours of biostatistics and epidemiology taught at the end of the second year. Each session is part lecture and part workshop/interactive session.
- LSU requires 40 hours for Foundations of Population Medicine and Health Systems – lectures, independent study, team based learning. Two of its five course objectives relate to Epi/biostats and to EBM, but it also includes health care financing, community health and healthcare quality.

We identified only 2 schools with explicit clinical reasoning curriculum. The University of Michigan has a first year course called “Chief Concern” that is focused on clinical reasoning. Groups of 15-20 students receive a case and some starting information. They then must ask questions to receive more information. The goal is to formulate a differential diagnosis, and ultimately arrive at a diagnosis through the process. UCSF has a 6 week block focused on data and clinical reasoning. Clinical reasoning topics include a framework for how doctors think, pretest probability, generating a prioritized differential, and diagnostic errors (including biases, heuristics). Students begin by focusing on how clinicians move from a patient's history and exam to a prioritized differential diagnosis, then move toward utilizing data science tools to move from diagnosis to management.

Aspects of Current Curriculum that Should be Maintained

The committee supports retaining the current research/scholarly project requirement and the option to complete this requirement through the current 3 routes: MSTP program, Research Track, or the MSA. Of note, the MSA program has recently been improved with increased student satisfaction. Although maintaining these programs is recommended, the committee feels that the current mandate of completing a scholarly project with little to no protected time to do this is counterproductive in terms of adding to “invisible” compression of the curriculum and student stress. This may also hinder the development of curiosity related to their scholarly topic. Further, it is felt that lack of protected time to complete projects sends a message that the SOM does not feel this is important enough to provide protected time. Hence, the recommendations below, will reflect this and recommend rectifying it.

The committee also supports retaining PBL, as its format is consistent with the principles that nurture curiosity and it allows students to assess their own learning needs and seek answers to the questions that they formulate. Whether or not PBL is retained as a stand-alone unit or the PBL format is integrated into other curricular elements, it is an educationally sound format that should be retained. PBL is evaluated highly by students in the current curriculum and the committee favors expansion of PBL, if possible, in the new curriculum.

Recommendations

Curiosity Recommendations:

1. The curriculum should be decompressed, with schedules clearly depicting unscheduled time
 - a. Goal of 3 half days per week of unscheduled (required) time in Phases I and II.
 - b. Consider “spacer blocks” of 1-2 weeks between major blocks.
 - i. This would be an opportunity to deliver a less dense curriculum (i.e. Thread and personal development or leadership content)
 - ii. Would allow students some time to reflect on their path and explore their questions
 - iii. Would contribute to overall student wellness
2. Block and Clerkship Directors/Facilitators/Preceptor training/Faculty should include training in fostering curiosity in students, faculty modeling of curiosity, encouraging curiosity, helping students formulate good questions
3. The modes of delivery of the curriculum should be modified to increase PBL/TBL time, decrease lectures, and to incorporate other active learning models that encourage curiosity and questioning (examples: pro/con debates, writing reflection of a case –what is the most important question and why).
4. Questions from students should be encouraged and valued in the clinical environment.

Discovery Recommendations

1. A required mentored scholarly project should be retained in the new curriculum.
 - a. Our current system of allowing students to choose the way they meet that requirement should be retained (MSA, MSTP, or Research Track)
2. Students in the MSA and Research Track should have protected time for scholarly project work (students in MSTP program have protected time in the graduate school).
 - a. A minimum of 12 weeks of protected time for research/scholarly project work is recommended in the new curriculum.
 - b. We recommend this time be structured in a flexible nature to conform to the differing requirements for the structure of this time based on the nature of the project.
 - i. Students could choose to do some of their research time the summer between 1st and 2nd year, in a month experience in the clerkship phase (achievable by inserting a one month selective block), or in phase IV.
 - c. Additional Research electives should be allowed.
3. Consider development of a 1 month integrated block, “Research, Inquiry, and the Application of Evidence”, that would integrate foundational knowledge in research, study design, biostatistics, epidemiology, and evidence based medicine). Time during this block would also be allocated to meeting with potential mentors for MSA projects.
 - a. The committee recommends considering placing this block early in the second semester of the 1st year. This would be optimal in that the foundational knowledge would be helpful in their scholarly project planning.

Application of Evidence Recommendations (includes Biostatistics/Epidemiology/EBM and Clinical Reasoning)

1. The topics of biostatistics and epidemiology need significantly more contact hours in the new curriculum.
2. Due to limited faculty with expertise in biostatistics/epidemiology, some schools have gone to one faculty person serving as a facilitator for several small groups that are running in a room simultaneously. This format is likely to be needed in the new curriculum for biostatistics epidemiology and for other curricular elements if we expand small group time. Thought should be given to ensure rooms of adequate size would be available for this format.
3. Create a 1 month stand-alone foundational block “Research, Inquiry, and Application of Evidence” to provide students foundational knowledge in research, biostatistics, epidemiology, and evidence based medicine (see Recommendation 3 in Discovery section for more detail).
4. Reinforcement of basic biostatistics, epidemiology and EBM should be integrated into the clerkships as it relates to research, clinical, and public health questions.
5. There should be increased emphasis on the development of regular required experiences requiring students to develop differential diagnoses of common symptoms/signs and prioritization of those diagnoses based on likelihood. These experiences are foundational for developing clinical reasoning skills and should begin in the preclinical years to prepare for success in the clerkships. Teaching of clinical reasoning skills should be enhanced in the preclinical curriculum, including some sessions on pretest probability, types of diagnostic errors (including cognitive processing and biases) and strategies to recognize and mitigate them.

Justification of Recommendations:

A review of the literature shows that curiosity is nurtured by allowing time and space for students to think, reflect, develop questions, and seek answers. Therefore, the recommendations recommend structuring the curriculum such that students have 3 half days per week without required curricular hours to study, reflect and formulate their questions. Spacer blocks will also serve to decompress the curriculum, while potentially addressing other curricular problems (i.e. providing a home for dedicated time for threads or professional development). Encouraging inquiry, acknowledging and permitting openness about uncertainty, and participating in activities where students work together with their peers has also been shown to allow curiosity to flourish. After reviewing the literature, the committee did not recommend screening for curiosity during the interview process. There is evidence that most medical school admissions processes likely already screen for this trait, as the curiosity trait is positively correlated with academic achievement. The more important thing is to nurture curiosity throughout medical school and mitigate its suppression.

Recommendations regarding research/scholarly projects include retaining the current structure of fulfilling the research/scholarly project requirement. Twelve of the 14 schools we reviewed had required scholarly projects for students. However, requiring a scholarly project without provision of protected time to accomplish the goals sends the wrong message and contributes to “invisible” curriculum compression (not seen on the student schedule, but felt in terms of the time they must spend on this). Of the 12 schools that required scholarly projects in our review, 11 provided protected time for the project. The median protected time provided for scholarly project work was 12 weeks (range 6-30 weeks). Our committee believes 12 weeks of protected time (with the option for additional Research Electives if needed) would be reasonable.

Additionally, it is recommended that a 1 month experience (example title: Research, Inquiry, and Application of Evidence) be developed and delivered in the first year’s curriculum. The committee envisions a 1 month

integrated experience combining elements that could be delivered together encompassing the topics of research, formulating research/scholarly questions, study design, biostatistics, epidemiology, and evidence based medicine. This would provide foundational information for research/scholarship project planning and would provide protected time and additional curricular hours for biostatistics and epidemiology. This is an area of concern, as our recent LCME survey, identified biostatistics and epidemiology as needing ongoing monitoring. The committee notes that several revisions of the biostatistics and epidemiology curriculum have been done over the last several years without significant success with student satisfaction. The committee feels the major barriers to improving student satisfaction and better delivery of content are 1) the small amount of curricular time currently allocated for these topics, and 2) the placement of these elements within another block. As found in our survey of other schools' curricula, many medical schools dedicate 3-5 times our number of curricular hours on these topics. Some have housed these in a protected block structure, which we are proposing. By creating this new block/course, students will be able to focus exclusively on this content. Note, an alternate plan could be to create two 2-week elements (instead of a month block) where this curriculum could be delivered unopposed—there are pros and cons to both approaches. However, if done in two 2 week elements, both should be delivered before the end of the first year. The committee felt an optimal placement for a 1 month experience would be in January of the first year. Students would have had some experience in a clinical setting (clinic preceptor experience by then) and likely would not have yet solidified their scholarly project. *Some of the activities in this block would include preparation for their scholarly project which many student start during the summer between first and second year.* Therefore, this seems to be an optimal time to deliver this information.

Overall, the committee believes training in the application of evidence is adequate to good based on a review of recent Graduate Questionnaire, Program Director Surveys, and the Intern Survey. We see no recognized deficiency reported in this area. In fact for the 2017 Graduate Questionnaire, 93.9% of our graduates strongly agreed or agreed with the statement, "I have basic skills in clinical decision making and the application of evidence based information to medical practice", compared to 94% of students nationally. However, we feel that generation and prioritization of a differential diagnosis to common problems encountered in medicine is so fundamental to the practice of medicine and to clinical reasoning, that it could be strengthened, particularly in the preclinical years.

Specifically, in terms of clinical reasoning, a national survey of internal medicine clerkship directors was published in 2017 (J. Rencic et al) describing clinical reasoning curriculum at U.S. medical schools. Seventy five percent of internal medicine clerkship directors thought clinical reasoning should be taught in all phases of medical school, yet 57% of schools lacked any formal sessions on this topic. Eighty four percent of respondents rated student knowledge of clinical reasoning as poor to fair when they enter the internal medicine clerkship. Respondents thought the most important topics to deliver included cognitive bias and diagnostic errors (e.g. premature closure). Supporting this study, few schools we investigated had clinical reasoning curriculum. Although our current curriculum has clinical reasoning embedded in Foundations of Doctoring and the discussion of pretest probability discussed in the Evidence Based Medicine Thread, we know of no sessions that formally address diagnostic errors (particularly related to cognitive processing and biases). We feel the addition of these would strengthen our curriculum.

Suggested Outcomes/Evaluation

Curiosity

1. We recommend the addition of a few questions to the end of year student evaluations to evaluate the ongoing “climate” for nurturing curiosity. Examples of questions that could be developed include (agree/strongly agree format): I am able to formulate questions, find appropriate resources, and seek my own answers. I have enough time to seek answers to my questions. The faculty are open to and encourage student questions.

Discovery

1. The committee feels that the currently employed evaluation of student research and scholarship is sufficient. In addition to process and faculty evaluation, we track self-reports from students on the numbers (%) of students that have submitted manuscripts, published manuscripts, or given a presentation at a local, regional, or national meeting.

Evaluation of Evidence

1. Student satisfaction with biostatistics and epidemiology instruction should continue to be tracked. We have a long record of this being a poorly scoring curricular element despite several interventions. This will provide a baseline for future enhancements, hopefully with an increase in curricular hours.
2. The LCME graduate questionnaire also provides the following questions on student satisfaction with biostatistics/epidemiology and application of evidence based medicine which should be tracked:
 - i. How will did your study of biostatistics and epidemiology prepare you for clinical clerkships and electives.”
 - ii. I have basic skills in clinical decision making and the application of evidence based information to medical practice. (Agree/Strongly Agree
3. Student ability to formulate a differential diagnosis is currently assessed via formative and summative clinical skills assessments (CAPE) and this should continue.
4. Incorporate the student’s ability to generate a differential diagnosis in the Foundations Preceptor’s Evaluation of a Student at least twice prior to entering into the clinical clerkships

Application of evidence based medicine could be assessed in a CAPE encounter in a clinical scenario that required students to search online for an appropriate evidence based guideline and use it in formulating the care plan.

Pilot ideas and Next Steps

- 1. In summer 2018, we will begin a pilot offering rising second year students the opportunity to choose to take the 2nd year Fall MSA course in either the summer (new pilot) or during the traditional offering in fall of second year.**
 - a. This pilot was conceived due to financial aid guidelines requiring students to be enrolled in a medical school course that counts for required credits toward graduation in order to receive financial aid over the summer. We decided to offer the fall MSA course in the summer to allow students who wanted to pursue education over the summer to do so with financial aid support. We see this as a first step in thinking about how the MSA course and research time could be structured to be somewhat flexible, since different types of projects may require very different distributions of time over 4 years (i.e. “bolus” summer time to collect all data vs. participation in a clinical trial that could extend over 1-3 years).

2. **The suggested “curiosity environment” questions could be incorporated in end of year surveys now to establish a baseline and inform us of the current climate.**
3. **Addition of the elements of clinical reasoning recommended could be added to the curriculum now. This would require identifying additional curricular hours, and if done in small group format it would require faculty support and faculty development.**

Likewise, the biostatistics epidemiology contact hours could be expanded earlier than curriculum reform. This would require decisions on what current curriculum should be eliminated to allow for expansion. Small group time would mandate faculty needs.

References: The committee reviewed numerous references in preparation for discussions. The following articles are the most pertinent:

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