

# Components of the Required Scholarly Project for U.S. Allopathic Medical Schools

**Sarah Wypiszynski**

The University of Arizona College of Medicine Phoenix

**Erin Hartnett**

UA College of Medicine Phoenix: The University of Arizona College of Medicine Phoenix

**Pareena Kaur**

The University of Arizona College of Medicine Phoenix

**Matthew McEchron** (✉ [mcechron@arizona.edu](mailto:mcechron@arizona.edu))

University of Arizona College of Medicine - Phoenix, Phoenix, AZ, USA <https://orcid.org/0000-0003-4692-4949>

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## Research article

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# Abstract

**Background:** The medical student scholarly project (SP) promotes self-directed independent learning and engenders critical thinking skills. The SP also allows medical students to understand scientific methods and promotes life-long learning practices. More medical schools have adopted aspects of the SP into their curricula, and notably the SP approaches have varied widely from one school to the next. Several studies have carefully documented the SP options for specific medical schools, but no study to date has compared the curricular components of the various medical schools with required SPs.

**Methods:** This study queried 156 allopathic medical schools based in the U. S. to identify the curricular components of the various SPs. Each SP was analyzed to determine: (1) if it was required or optional, (2) its duration and placement within the four-year curriculum, (3) the capstone requirement (e.g., thesis, manuscript, and/or poster), (4) if the research required a data-driven research question and hypothesis, (5) if there was a formal curriculum dedicated to the SP, and (6) a list of the program objectives.

**Results:** Our research shows that of the 156 medical schools examined, 108 schools (69%) have an SP included in their curricula, and 62 of the 156 (39.7%) require an SP for graduation. Only 24 (15.4%) of the 156 medical schools queried have a required SP that must have a data-driven research question. Of the 24, we found that six medical schools have a required SP spanning all four years of medical school, with a research question/hypothesis-driven project and completion of a final written thesis or journal article style manuscript.

**Conclusion:** Numerous studies have described successful models of the medical student SP. We summarize the curricular components of the six medical schools that have a required, spanning all four years of medical school with a research question/hypothesis driven project and completion of a final written thesis or journal article style manuscript. We also describe two additional schools with comparable SP requirements, however, one of these example schools does not require a final written product and the other school concentrates the SP in a five-month period toward the end of the medical school curriculum.

## Background

Most medical schools have implemented novel and dramatic changes to their curricula over the past 10 to 15 years. Many are now including some form of a scholarly project (SP) requirement in the curriculum. The SP promotes self-directed independent learning and engenders critical thinking skills. The SP also allows medical students to understand scientific methods and promotes life-long learning practices. There is evidence that the medical school SP also impacts residency placements (Arephanthu et al., 2015; Radville et al., 2019) and decisions to pursue a career in research (Segal et al., 1990; Wolfson et al., 2017).

A few medical schools have had SP options or requirements for decades (see Ebbert 1960), however, as more medical schools adopt this practice, the approaches for scholarly research vary widely from one

school to the next. Several studies have carefully documented the SP options for specific medical schools (e.g., Jacobs et al., 1995; Schor et al., 2005; Gotterer et al., 2010; Green et al., 2010; Boninger et al., 2010; Parsonnet et al., 2009; Sawarynski et al., 2019). These studies discuss various SP models in terms of the following: required vs. optional, duration and placement of the SP within the four-year curriculum, the overall learning objectives of the SP curricula, the capstone requirement for the finished SP product, the hypothesis-driven nature of the SP, and the curricular elements of the SP. Despite these in-depth analyses of the SP programs at specific institutions, no study to date has compared the curricular components of the various medical schools with required SPs. Thus, this study sought to identify U.S. allopathic medical schools with required SPs and determine the curricular components which define these programs. This study also describes several medical schools, including our own program at the University of Arizona College of Medicine – Phoenix (UA COM-P), with components that include a required, four-year longitudinal, hypothesis-driven SP culminating in a written manuscript or thesis.

## Methods

### *Medical Schools*

This study queried 156 allopathic medical schools to identify the curricular components of the SP. Of these medical schools, 146 participated in the American Medical College Application Service (AMCAS; accessed March 25, 2019).

### *Data Collection*

Information about the SP curriculum was first gathered from each school's website. All gathered information was verified and/or augmented by subsequently contacting the director of the program or equivalent official by email. If there was no response, a phone call was made to the director of the program or equivalent position. A similar approach to gather information has been used in other studies (Green et al., 2010). If email and phone responses were not obtained from a medical school, website information alone was used for all analyses.

The following information was collected from each school on the list:

- Does your school have an SP in the curriculum?
- Is the SP required or optional?
- Please describe the time commitment required of the SP, including curricular elements and protected research time (e.g. scheduling, benchmarks, etc.).
- What is the capstone requirement of the program? For example, is there a written thesis requirement, a requirement to orally present the project, a requirement or desire to submit for peer-reviewed publication, or other?
- Is the SP centered on a hypothesis-driven research question, implementation project, or other (please describe)?

- Describe the curriculum time devoted to the SP (i.e. required course(s), optional course(s), integrated coursework, no coursework).
- Are there clearly stated objectives for the SP? If so, please list them here.

## Results

### *Scholarly Project Requirement*

A total of 156 medical schools were queried in this study. We could not obtain data from two of the medical schools. Our analysis revealed that 108 of the schools identified an SP in their curricula. Examination of the schools with identified SPs revealed that 62 of them were required and 46 were optional (see Table 1). For the 62 schools with required SPs, the information we obtained was confirmed by email or phone call for 40 schools, by website for 14, and eight were unconfirmed. For the 46 schools with optional SPs, the information we obtained was confirmed by email or phone call for 15 schools, by website for 24, and seven were unconfirmed. The remainder of the analyses in our study focus on the curricular components of the 62 medical schools with required SPs.

Table 1: SP required or optional.

<b>SP Program</b>	<b>Number of Medical Schools with an SP (N =108)</b>
Required	62
Optional	46
No SP Program	46
Could not determine	2
Total	156 medical schools queried

### *Duration of Scholarly Project*

The duration of the SPs at the 62 medical schools with a required SP varied from a six-week summer program to a longitudinal four-year curriculum. One school also offered a year of dedicated research in addition to the four-year medical school curriculum. The majority of the schools with summer research opportunities positioned these activities between the first and second year of a traditional four-year medical school curriculum, with the option of continuing the research throughout the remainder of medical school. Some schools also provided opportunities to third and fourth year medical students to take time to complete research. The duration of the SPs is found in Table 2. If a school did not provide information regarding the duration of the SP it is included in Table 2 as “unable to determine.”

Table 2: Duration of required SPs.

<b>Duration</b>	<b>Number of Schools with a Required SP (N = 62)</b>
<1 year	13
1-2 years	9
2-3 years	7
4 years	26
5 years	1
Unable to determine	6
<b>Total</b>	<b>62</b>

### *Capstone Requirement*

Most of the required SPs necessitate students to complete a final capstone product at the conclusion of the SP. The types of capstone requirements are listed in Table 3.

Table 3: Final capstone for required SPs

<b>Capstone Requirement</b>	<b>Schools with a Required SP</b>
Manuscript/Thesis	21
Poster Presentation	10
Manuscript/Thesis and Poster	19
Manuscript/Thesis or Poster	5
Unable to determine	7
<b>Total</b>	<b>62</b>

Note: A manuscript/thesis requirement may include a journal submission, written report, abstract, thesis, or other manuscript iterations.

### *Research Question*

Some schools required the SP to have a hypothesis-driven research question utilizing some form of data collection. Other schools allowed the SP to be a community or patient group implementation project without a specific research question or hypothesis. We found that 24 of the 62 schools with a required curricular SP also require the project to have a data-driven research question. Put another way, only 24 (15.4%) of the 156 medical schools queried have a required SP that includes a data-driven research question. These results are presented in Table 4.

Table 4: Number of required SPs requiring a data-driven research question.

<b>Type of Research Question</b>	<b>Schools with a Required SP</b>
Data/research question driven	24
Not data/research question driven	31
Unable to determine	7
Total	62

*Research Courses/Lesson Material*

We also sought to determine if medical schools offered or required students to complete curricular elements or course material that was dedicated to research methods or the SP. The results are outlined in Table 5.

Table 5: SP/Research curriculum.

<b>Dedicated Curriculum</b>	<b>Schools with a Required SP</b>
Required	43
Optional	3
None	6
Unable to determine	10
Total	62

*Milestones and Learning Objectives*

We queried the medical schools with a required SP to determine the goals, milestones, and objectives of their SP; our analysis revealed that these are overlapping for a number of schools and thus we have summarized the most common ones in Table 6. Each of the milestones, objectives, and goals included in this table were shared by at least 10 medical schools. The most common of these were as follows: use of scientific methods and/or forming a research question and hypothesis, working with a mentor, self-directed learning and/or critical thinking skills, analyzing existing scientific literature, research compliance and statistical methods, and generating written products such as abstracts, proposals and/or research papers.

Table 6: SP program learning objectives, goals, and milestones

<b>Most common objectives/goals/milestones</b>	<b>Number of Schools</b>
Appropriate use of scientific methods and/or forming a research question and hypothesis	26
Work with and/or create a relationship with a mentor	23
Critical thinking/problem solving and/or self-directed learning	22
Analyze existing literature	20
IRB compliance, human data acquisition, IACUC standards, statistical analysis, and/or presentation skills	21
Generate written products such as abstracts, proposals, and research reports	20
Communication skills and teamwork	11
Present work publicly through a conference, journal, or other modality.	11
Emphasize ethics in human research	10

Note: One school may identify multiple learning objectives/goals/milestones, and some schools included other less common goals that are not listed.

#### *Models of the Required Scholarly Project*

Medical school SP curricula were examined in this study using the following characteristics: whether the project is optional or required, the curricular duration of the project, the capstone requirement of the project, and whether the project required hypothesis-driven data collection. Examination of the 62 schools with required SPs revealed the data in Table 7. Moreover, we found a total of 15 schools with a required hypothesis/data-driven SP and a final capstone requirement with less than four years of curricular duration. In contrast to this, there were six schools with required hypothesis-driven SPs and a final capstone requirement with four or more years of curricular duration. Below we discuss the curricular design of the SP of these six schools.

Table 7: Models of the required scholarly project

<b>Duration of Curricular SP</b>	<b>Schools with a Required SP</b>	<b>Both Required: Hypothesis- Driven and Final Manuscript</b>
<4 years curricular duration	29	15
≥4 years curricular duration	27	6
Unable to determine	6	
Total	62	21

Note: The subset of schools in the right-hand column included a hypothesis and data-driven SP with a final capstone requirement.

## Discussion

One of the goals of this research study was to determine the characteristics of the required SP curricula for U.S. allopathic medical schools. Our research shows that of the 156 U.S. medical schools examined, 108 schools (69%) have an SP included in their curricula, and 62 of the 156 (39.7%) require an SP for graduation. This number aligns very well with the data supplied by the Association of American Medical Colleges which reported 65 of 147 (44.2%) medical schools had a required SP in 2017-2018. It is interesting that only 24 (15.4%) of the 156 medical schools queried in our study have a required SP that must have a data-driven research question, while some other medical schools allow students to pursue implementation projects or development of educational materials to suffice for the scholarly project.

Additionally, we found that six medical schools have a required SP spanning all four years of medical school with a data-driven research question and completion of a final written thesis or journal article style manuscript. Here we outline the curricular components and objectives of these six schools. These medical schools include the Feinberg School of Medicine at Northwestern University, Texas Christian University and University of North Texas Health Science Center School of Medicine, the University of Arizona College of Medicine- Phoenix, the University of Pittsburgh School of Medicine; the Virginia Tech Carilion School of Medicine, and Yale University School of Medicine. Numerous studies have described varying and successful models of the SP (e.g., Jacobs et al., 1995; Schor et al., 2005; Gotterer et al., 2010; Green et al., 2010; Boninger et al., 2010; Parsonnet et al., 2009; Sawarynski et al., 2019). Thus, we also describe two additional schools with very similar models to these six schools. The Oakland University William Beaumont School of Medicine also has a required four-year SP with a data-driven research question, however the final manuscript or thesis is optional. Likewise, Emory University School of Medicine has a required SP with a data-driven research question and completion of a final manuscript, but without a dedicated four-year SP curriculum.

### *Feinberg School of Medicine at Northwestern University*

The Feinberg School of Medicine at Northwestern University includes an Area of Scholarly Concentration (AOSC) in their professional development curriculum. All students are required to take part unless they are completing a dual degree program. The program has eight small group leaders to help guide the students over the four years of AOSC. Through the AOSC, students compete a hypothesis-driven investigation of a research question related to medicine, Global Health, or other topics relevant to the intersection of Society and Medicine more broadly. In year one, students attend lectures and small group learning sessions. These sessions focus on such topics as how to choose a mentor, scientific methods used in research, the role of the Institutional Review Board (IRB), research integrity and ethics, as well as authorship. During the summer of year one, four weeks of required on-campus research is conducted, with an additional four weeks available for optional research time with a stipend. Support for statistical consultation and

analysis is available, and students work with a statistician directly for their projects, if required. In the second year, students present their work at a formal poster session, where faculty judges engage with students about their projects and complete formal assessments of their work. Thereafter, students participate in small group oral presentations to demonstrate their progress in their area of chosen investigation, and practice presenting to their peers and small group faculty leaders. In the clerkship years, students do not have dedicated time for their AOSC work per se but may take elective credits (generally two to six weeks in duration) to complete their work. Travel support is available for presentation of their work at scientific meetings. They are required to complete assignments and achieve milestones by given deadlines to progress in the curriculum. A senior thesis or submitted manuscript is required for all students not pursuing a dual degree, as a capstone assignment in year four prior to graduation.

By the end of the four-year medical school curriculum, the students will have gained knowledge of the scientific process of hypothesis-driven research, implementation of an IRB approved project, and presentation skills for communication of data to faculty and peers alike.

*Texas Christian University and University of North Texas Health Science Center School of Medicine (TCU and UNTHSC School of Medicine)*

The TCU and UNTHSC School of Medicine required Scholarly Pursuit and Thesis (SPT) curriculum encompasses all four years of student learning. In the 1<sup>st</sup> year, students re-ignite their curiosity, engage in questioning exercises, use active learning to gain evidence-based research skills, chose a research mentor, generate their hypothesis-focused research prospectus, and start their research project. Students continue to work with their faculty mentor through the remaining years refining their project while collecting and analyzing their data. SPT culminates in the 4<sup>th</sup> year with a thesis based on their project and a research symposium where students present their research posters to the medical school community and the public. The overall objective of SPT is to develop curious, life-long learners capable of critical inquiry and medical information literacy who will be comfortable in understanding and possibly participating in research during their future in medicine. The objectives/milestones for the longitudinal SPT are as follows:

1. Create questions in contrasted areas of basic, clinical, and translational/societal research.
2. Critically appraise medical literature.
3. Reason deductively to assess methodological problems based on scientific methods and accepted practices.
4. Develop and defend a general hypothesis-driven and testable research question.
5. Analyze types of data and identify the appropriate statistical test(s) to use for evaluation.
6. Generate a testable project hypothesis in collaboration with a mentor.
7. Apply evidence-based medicine skills in multiple scenarios.

8. Present prospectus to a diverse audience potentially including faculty, peers, mentors, community members and other audiences.
9. Analyze and evaluate initial results and address any issues of compliance, ethics, and/or failures discovered in the research project.
10. Demonstrate advancement in the research project with focus on data collection progress.
11. Critically evaluate and apply research results to diverse populations and communities.
12. Write thesis according to specified requirements.
13. Present findings in a public poster session to a diverse audience potentially including faculty, peers, mentors, community members and other audiences.

*University of Arizona College of Medicine - Phoenix (UACOM-P)*

UA COM-P has a required four-year longitudinal SP. The SP must include a hypothesis-driven investigation of a medically related research question and involve some form of data collection. Each SP culminates in a final thesis and poster in year four. All research projects are completed under the guidance of a mentor. Students must complete their own unique project, as group projects do not satisfy the requirement.

During year one, students work with their mentor to identify a research question based on gaps in the primary literature and complete a written prospectus. Students deliver an oral presentation of their progress and must achieve half of their data collection during year two. The final thesis and poster are due at the end of year four. Strategies for overcoming barriers and obstacles are developed on a one-on-one basis with either the mentor or the SP director.

Curriculum dedicated to scholarly pursuit is integrated into each year of the broader medical school curriculum and is required of all students. This content includes lectures and workshops about evidence-based medicine, statistics, research study design, and how to evaluate research evidence. Students must complete several assignments to help structure their SP and incorporate the feedback from these assignments into their final project. These assignments include a literature review, an exercise in reference organization, research compliance training, construction of a prospectus, and an oral presentation to faculty about progress and barriers. In order to satisfy the SP requirement in the curriculum, students must meet ten specific learning objectives. These objectives are listed here:

1. Demonstrate in-depth mastery of a specific area of medical knowledge.
2. In collaboration with a qualified mentor identify a research question through critical appraisal of the medical literature.
3. Establish a network of collaborative resources for resolving questions and completing the SP.
4. Demonstrate teamwork and effective communication with the SP director, mentor, and other collaborators during the construction and implementation of an effective research plan designed to acquire new medical information.

5. Use critical thinking skills to develop and execute an approved methodology to resolve a medical question.
6. Demonstrate effective verbal and written communication through the construction of a research prospectus, final thesis, and oral presentation.
7. Implement ethical and professional research practices by adhering to research compliance standards and sound scientific methods.
8. Evaluate results of the SP through critical appraisal of the medical literature.

### *University of Pittsburgh School of Medicine*

Each student at the University of Pittsburgh School of Medicine is required to complete a Longitudinal Research Project (LRP). The LRP is a longitudinal experience throughout the four years of the medical school curriculum in which students engage in a research project under the mentorship of a faculty member. The LRP must include a research question and data. Each student is assigned an LRP Director that will follow their progress throughout the entire longitudinal experience. who also share a responsibility of establishing and executing policies/procedures of the LRP.

The goals of the LRP are to:

- 1) Foster analytical thinking skills and the development of tools for rational decision making for our students;

### *Virginia Tech Carilion School of Medicine*

The SP curriculum at the Virginia Tech Carilion School of Medicine includes over 1200 curricular hours dedicated to research throughout the four-year curriculum. Students have protected time to work on their projects during each academic year, as the school aims to produce “scientist physicians.” As such, students must engage in original, hypothesis-driven research throughout their time in medical school and are allotted \$1000 per year in years 2-4 for research supplies. Additionally, students are required to submit an abstract for presentation at a conference/meeting with travel funds available.

During the first year, students are allotted three weeks for dedicated full-time research. The year one curriculum also includes classroom-based instruction in biomedical research fundamentals, biostatistics, epidemiology, and ethics. To help students identify potential mentors and projects, students attend brief presentations from faculty members throughout the academic year, known as “Research Live!”. By the spring of the first year, students identify a mentor and submit a project proposal (oral and written). During the second year, students spend a minimum of 4.5 hrs/week in each six-week block working on their projects; additional time is available after each exam week. Students spend a minimum of eight weeks conducting research full-time in the spring of year two. Milestones for year two include submitting research reports at the end of each block and giving an oral presentation in the spring. During the third and fourth years, students are required to spend four weeks and two weeks, respectively, doing full-time research on their projects, with optional time available for a research elective. Milestones for year three

include submitting a report at the end of rotations, as well as a manuscript draft and final oral presentation by June. In the spring of year four, students submit a final manuscript and give a poster presentation at a school-wide research symposium.

The SP objectives for Virginia Tech Carillion are as follows:

1. Graduates will demonstrate ability to identify, understand and apply the scientific method in both basic and clinical science settings.
2. Graduates will demonstrate ability to frame questions using the tools and language of the scientist physician.
3. Graduates will demonstrate ability to describe the research continuum that translates scientific discoveries into clinical applications.
4. Graduates will demonstrate ability to identify the ethical foundations of human research and apply the associated regulatory principles and procedures.
5. Graduates will demonstrate ability to identify the ethical foundations of animal research and apply the associated regulatory principles and procedures.
6. Graduates will demonstrate ability to identify, define, and apply the basic tools of biostatistical analysis.
7. Graduates will demonstrate ability to identify, define, and apply the basic tools of epidemiologic design.
8. Graduates will demonstrate ability to understand and apply the components of collaborative research.
9. Graduates will have advanced competencies in literature search, citation, report type and sources.
10. Graduates will demonstrate ability to interpret and apply legal principles to medical research in clinical and basic science domains.

### *Yale University School of Medicine*

Yale University School of Medicine has had a required SP in its curriculum since 1839. The required SP is a four-year longitudinal, hypothesis-driven project with integrated research curriculum culminating in a final written thesis. Additionally, most students present posters on their thesis at the Student Research Day. Students who enter medical school with a Ph.D. degree in the biomedical sciences are exempt from this requirement.

Students must devote at least nine months working on an individual research project and are encouraged to complete a tuition-free fifth year of medical school dedicated to research. These nine months are typically distributed as follows: three months during the summer between years one and two, and an additional six months thereafter. Additional three-month blocks are available in the last half of the third and fourth years. As the clinical clerkship curriculum runs from January of the second year to January of the third year, a full year is available for research and other pursuits (sub-internships, interviewing, etc.).

There are specific formatting requirements for the hard bound and digital copy of the thesis itself, which must include a “minimum of 30 pages of text excluding figures, legends, and references” and final approval is obtained via a thorough review process done by appointed thesis committees.

There are many successful models of the required SP around the United States. We have outlined two additional schools with very similar models to these six schools, including Oakland University William Beaumont School of Medicine and Emory University School of Medicine. Oakland University William Beaumont School of Medicine has a required four-year data-driven research question SP, but the final manuscript or thesis is optional. Emory University School of Medicine also has a required data-driven research question SP with completion of a final manuscript, but their SP does not encompass four years of dedicated SP curriculum.

### *Oakland University William Beaumont School of Medicine*

Embark is the required SP at Oakland University William Beaumont School of Medicine. It is a four-year, longitudinal program that includes 10 courses and an individual research project that is developed in collaboration with a faculty mentor (Sawarynski et al. 2019). The research question-driven SP must be health outcomes-based. The year 1 curriculum involves training in finding a mentor, composing a research question and developing a research proposal in a regulatory compliant manner. Presentation of scholarly works and communication of research are the focus of year 2. Year 3 continues with a dedicated research clerkship and monthly protected time, as well as, an optional mini-manuscript scholarship competition. Year 4 culminates with a final abstract and poster submission that is presented at a research colloquium. Throughout the four-year program, students report their progress of their individualized research plan as measured by their self-developed benchmarks. In addition to traditional research training course objectives, the overall program objectives are practice-based in skill sets that are transferable to residency and future careers. These include:

1. Demonstrate the ability to work and communicate with a team.
2. Demonstrate the ability to develop a research plan.
3. Demonstrate the ability to operationalize the plan.
4. Demonstrate the ability of time management in the conduct of a longitudinal research project.

### *Emory University School of Medicine*

Emory University School of Medicine has a required SP with a data-driven research question and completion of a final manuscript, however, this does not encompass four years of dedicated SP curriculum. The Discovery Phase is a required five-month full-time experience which follows the 18 months of Foundations in Medical Science, and the Applications year of clinical clerkships. This Discovery Phase of the medical curriculum provides Emory medical students with the opportunity to conduct a hypothesis-driven research project while working closely with a faculty mentor. Each student's schedule is unique during their Discovery period to allow for individual interests and goals, however, all

Discovery work must be completed by the end of the year preceding graduation. During Discovery, medical students will work full-time on their projects with no other commitments except for seminars and/or workshops relevant to their research. Students may spend one half-day per week of non-research related time in the clinic or operating room to maintain and develop their clinical skills.

At the completion of the Discovery project, students will, with the guidance of their mentor, write a final Discovery Research Paper in the format of a medical/scientific manuscript, which is due mid-January the year of graduation. All graduating medical students will showcase their research in the form of either an oral presentation or poster at the Medical Student Research Day, which is held in the month of April prior to graduation.

## Conclusions

Our research revealed that there are many different curricular models and approaches for the required and optional SPs. Many of these models are driven by the resources at each institution and the overall mission and priorities of the school. Our analysis does not intend to determine if any single model is superior, but only to highlight various models of the required SP. Future studies examining outcomes may be able to compare the various models and curricular components highlighted in this article.

The majority of allopathic medical schools (69.2%; 108/156) are including some form of required or optional scholarly research in their curricula. A wide variety of topics and objectives were described across the various medical school SP programs. Many of these topic areas and objectives highlight the standards described by the Liaison Committee on Medical Education (LCME), the accrediting body for allopathic medical schools in the United States and Canada. For example, a number of the SP programs described goals of increasing student knowledge of the scientific method, improving communication skills, providing opportunities for interdisciplinary education, and enhancing critical thinking skills.

Student research projects help to prepare medical students to enter the field of medicine as it becomes increasingly data-driven, patient-centered, and population-focused. We expect to see an increase in the number of medical schools offering or requiring a structured SP within their curricula over the coming years, both as a way of addressing the latest LCME standards and also providing students with an opportunity to be more competitive for residency applications.

There were some limitations to this study. We were able to confirm our SP findings by email or phone call correspondence with 51% (55/108) of the medical schools queried with required and optional SPs. The remainder of the data were confirmed via websites or other means, which may have been outdated. Furthermore, this data was collected over the course of the previous 1.5 years and some schools may have changed their SP curricula and requirements during this period of time.

## List Of Abbreviations

AMCAS: American Medical College Application Service

AOSC: Area of Scholarly Concentration

LCME: Liaison Committee on Medical Education

LRP: Longitudinal Research Project

SP: Scholarly Project

SPT: Scholarly Pursuit and Thesis

TCU and UNTHSC School of Medicine: Texas Christian University and University of North Texas Health Science Center School of Medicine

UACOM-P: University of Arizona College of Medicine – Phoenix

U.S.: The United States

## **Declarations**

### **Ethics approval and consent to participate**

Not applicable.

### **Consent for publication**

Not applicable.

### **Availability of data and materials**

All data generated or analyzed during this study are included in this published article.

### **Competing interests**

The authors declare that they have no competing interests.

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### **Authors' contributions**

SW, EH, and PK collected and analyzed all the data included in the manuscript. MM reviewed the data and contributed to the final data analysis. MM and SW were the major contributors to the manuscript. EH and PK additionally contributed to the manuscript most notably with the inclusion of the in-depth Scholarly Project descriptions including in the Discussion section. EH, PK, and MM read and approved the final manuscript.

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## Authors' information

SW: Family Medicine Physician (MD), The University of Arizona College of Medicine - Phoenix, Class of 2017

EH: 4<sup>th</sup> Year Medical Student (MSIV), The University of Arizona College of Medicine - Phoenix, Class of 2021

PK: 4<sup>th</sup> Year Medical Student (MSIV), The University of Arizona College of Medicine - Phoenix, Class of 2021

MM: Professor and Director of Scholarly Projects (PhD), The University of Arizona College of Medicine - Phoenix

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