

## A Strategic Plan for Increasing Scholarly Activity Among Medical Students, Residents, and Faculty

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**Background:** Scholarly activity among students, residents, and faculty provides the foundation for medical education. However, a decline in the number of physician-scientists has been acknowledged during the past few decades. As a result, institutions have attempted to increase research activity among students and residents through a variety of means. This study describes a replicative model for medical institutions to increase their research enterprises among medical students, residents, and faculty.

**Methods:** Des Moines University College of Podiatric Medicine and Surgery (DMU-CPMS) developed a Strategic Research Plan (SRP) to increase scholarly activity in the college. The SRP outlined an innovative model to increase research activity, including creating a Director of Research position, modifying the existing curriculum toward an evidence-based focus, increasing extracurricular research opportunities, and fostering collaborative research efforts among students, residents, and faculty.

**Results:** After SRP implementation, an increase in scholarly activity was observed. In the 6 years before implementing the SRP, DMU-CPMS published 11 manuscripts. In the 6 years after initiating the SRP, manuscript publications increased to 50. During this same period, podium presentations at scientific meetings increased from 6 to 40, and students listed as lead author increased from 0 to 16.

**Conclusions:** The SRP provides a replicative model for medical institutions seeking to increase their research enterprises through collaboration among students, residents, and faculty. To our knowledge, this is the first study to demonstrate a research plan aimed at increasing scholarly activity among a comprehensive scope of individuals in medical education. (*J Am Podiatr Med Assoc* 108(4): 292-303, 2018)

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Scholarly activity provides the foundation of medical education. Despite the critical role of research endeavors in supporting this pursuit, a decline in the number of physician-scientists has been widely acknowledged throughout the United States during the past several decades.<sup>1-7</sup> However, studies have shown that 10% to 13% of medical students are

interested in pursuing a research career.<sup>5,7,8</sup> Wickramasinghe et al<sup>9</sup> noted an exponential increase in the number of publications listing medical students as first or second author since 1980; however, the total number of medical student authors during that period remained static.<sup>9</sup>

A lack of consistent research productivity has similarly been noted across a variety of medical residency programs. A national survey of family medicine residencies found that 90.1% of programs had fewer than six residents submit publications, and 80.1% had fewer than six residents present at conferences.<sup>10</sup> In another study, only 19.9% and 16.3% of all physical medicine and rehabilitation residents had at least one publication when surveyed in 2007 and 2008, respectively.<sup>11</sup> Meanwhile, other specialties have demonstrated considerable

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research success. For example, radiation oncology programs averaged 5.5 publications per resident in 2010 alone.<sup>12</sup> Similarly, a survey of pediatric residency programs found that 56% of pediatric residents and 95.9% of residency directors were actively engaged in research.<sup>13</sup> Thus, inconsistencies in the quantity and quality of resident research remain, with barriers such as lack of interest, time, mentors, and funding all cited as contributing factors.<sup>13-17</sup>

Medical school and residency program faculty demonstrate similar research deficiencies. A survey of family medicine residency programs found that only 10.6% of faculty had research productivity as a requirement, 65.9% of programs had fewer than four faculty dedicated to mentoring resident research projects, and 74.2% of programs had fewer than six faculty publications in the previous 2 years.<sup>10</sup> Among psychiatry programs, the median number of publications completed by residency directors was one to three during a 5-year period.<sup>18</sup> A study of pediatric residency programs noted that 47.1% of directors were satisfied with the level of resident research activity at their institutions, with only 30.7% of directors satisfied with their program's ability to train residents in conducting research.<sup>13</sup>

Despite the variable role of research in medical training programs, the value of scholarly activity to the developing physician is undeniable. In a national survey of podiatric medicine residency directors, 52 stated that research publication was a requirement at their residency program, with each of these programs deeming student research involvement during medical school as an important criterion in the selection of future residents.<sup>19</sup> Likewise, internal medicine residents with research experience were twice as likely to obtain the fellowship of their choice compared with their peers.<sup>20</sup> Several other studies have demonstrated that students involved in research during medical school and residency are significantly more likely to continue research endeavors throughout their careers.<sup>21-27</sup> Beyond its benefit to students, research activity is further advantageous to the medical institution at which it is conducted, establishing the program as a leader in the medical profession. Goldstein et al<sup>28</sup> observed that institutional prestige regarding development of academic physicians and biomedical researchers is best measured through recognition of institutional scholarly activity. Cultivating this motivation behind students, residents, and institutions provides a key element in developing a research culture.

Recognizing the valuable role of research in developing physicians and institutions, many medical schools have attempted to increase their research enterprises through innovative means.<sup>21,23,27,29-36</sup> One common example includes incorporating evidence-based medicine (EBM) into the curriculum to cultivate student interest and inquiry.<sup>37,38</sup> Another approach includes introducing summer research electives. A significant increase in clinical research abilities has been observed in medical students participating in mentored summer research electives.<sup>23</sup> Solomon et al<sup>27</sup> reported that 83% of students acknowledged that they were likely to pursue a career in basic or clinical research as a result of their summer mentored research program. Nevertheless, required research still remains the gold standard when attempting to increase research publications among medical students. Between 1976 and 2003, Mayo Medical School in Rochester, Minnesota, noted that 554 research reports and 258 abstracts were published by 998 graduates participating in the required experience.<sup>30</sup> Similarly, Smith et al<sup>29</sup> observed a dramatic increase in the number of students who submitted research publications, from 11% to 59%, after establishing a required research program. Yet, with only a handful of medical schools in the United States requiring research for graduation, the need for institutions to develop an innovative research approach remains imperative.<sup>31</sup>

Research activity guidelines as outlined by the American Council of Graduate Medical Education state that "residency research productivity is vital in the development of future physicians." However, no specific curriculum is established for accomplishing these research aims.<sup>39</sup> Numerous studies during the past decade have documented attempts made by residency programs to increase their research enterprises.<sup>24,26,40-48</sup> Initiatives such as monthly meetings, establishing research mentors, and presenting at national conferences have all been implemented with varying success.<sup>48-50</sup> Manring et al<sup>45</sup> demonstrated that through collaboration with residents and faculty, as well as hiring an experienced medical editor, resident coauthoring in research publications increased fivefold from 2009 to 2012. Likewise, the addition of a resident research director was shown to increase publications nearly three times and presentations nearly two times during a 5-year period.<sup>51</sup> Other programs have introduced elective research rotations designed to protect the residents' time, with an increase in research activity occurring as a result.<sup>20</sup>

Although many research initiatives have shown

success, guidelines for developing a research culture in students, residents, and faculty alike have not been established that would allow institutions to increase their research enterprise in a replicative manner. Acknowledging this, faculty at Des Moines University College of Podiatric Medicine and Surgery (DMU-CPMS) developed a set of strategic initiatives for increasing their own institutional research activity through student and faculty collaboration.

## Methods

### DMU and CPMS Background

Des Moines University consists of three separate colleges: the College of Osteopathic Medicine, the CPMS, and the College of Health Sciences, which represents multiple doctoral and masters programs, including physical therapy, physician assistant, public health, health-care administration, anatomy, and biomedical sciences.

The DMU-CPMS was established in 1981 and today enrolls 53 podiatric medical students per year. Currently, the college consists of six full-time clinical faculty members and one part-time clinical faculty member.

### Strategic Research Plan

In an effort to increase research activity, the Dean of Academic Affairs for DMU-CPMS collaborated with faculty and students to develop a 3-year Strategic Research Plan (SRP) for stimulating scholarly activity between 2009 and 2012. The main goals of this plan were to 1) enhance the podiatric medicine curriculum to advance student knowledge in design, methods, policies, and evaluation of research; 2) build on the research success of the CPMS to create a sustainable research program through the application of technologies, collaboration, and scientific presentation; and 3) promote and support opportunities for CPMS students to develop the skills to become researchers in the field of podiatric medicine.

### Implementation

Central to the implementation of the SRP was the recruitment of a Director of Research with extensive publication experience. The responsibilities for this newly appointed position included 1) overseeing the college research enterprise as a whole and 2)

coordinating research efforts between students and faculty members.

Under the guidance of the Director of Research, DMU-CPMS developed both required and elective research initiatives to foster student research activities. Specific steps taken to achieve this goal included 1) research lectures embedded into the current curriculum to increase student knowledge of research methods; 2) a required scientific poster presentation for third-year students, allowing them to demonstrate their acquired skills in forming a clinical question, developing methods, disseminating results, and applying these results to future patient care; 3) a required EBM presentation for third-year students to faculty and peers on a topic from the current literature; 4) faculty research forums held monthly to identify research opportunities available to students; 5) research elective courses for students to partake in research activities throughout the academic year; 6) research rotations available to fourth-year students; and 7) increased funding opportunities for students and faculty to both perform research and present at national scientific meetings.

Additional opportunities available to DMU students in any college included 1) a summer mentored research program between students' first and second years and 2) an annual DMU research symposium.

### Vision

After implementing the 2009-2012 SRP with favorable results, DMU-CPMS chose to engrain the ideals of scholarly activity into the 2013-2016 Strategic Plan (SP) of the college with a bold new vision for research. The Research Vision Statement included in the 2013-2016 SP was for DMU-CPMS to "be the leader in discovering new knowledge through collaborative faculty and student research initiatives that advance the profession." Specific goals set to reach this vision were as follows: 1) enhance the research curriculum to strengthen students' critical thinking, scientific knowledge, and understanding of research methods; 2) advance the CPMS research program by creating sustainable space and funding sources; 3) align the CPMS research program with the university's research focus areas; and 4) advance the CPMS clinical research program through collaboration with local podiatric medicine residency programs. Specific tactics to achieve these goals as well as measures to monitor their progression are outlined in Table 1.

**Table 1. DMU-CPMS Strategic Plan Goals, Strategy, and Measures Identified to Enhance the Institutional Research Enterprise**

Goal	Strategy	Measures
1. Enhance the research curriculum to strengthen students' critical thinking, scientific knowledge, and understanding of research methodology	1.1 Inventory all research-related content in the CPMS curriculum	1.1.a Completion of compilation of research inventory in CPMS curriculum
	1.2 Reallocate research content in the CPMS curriculum to optimize the student's ability to understand, implement, and evaluate the research process	1.2.a Complete research content restructure in the CPMS curriculum for the 2013-2014 academic year
	1.3 Enhance EBM activities during the clinical years	1.3.a During Foot and Ankle rotations, students participate in a weekly clinical group activity performed on the Learning Management System
	1.4 Focus research product on peer-review publications	1.4.a Increase the number of faculty/student peer review publications in line with faculty workload
2. Advance the CPMS research program by creating sustainable space and funding sources	2.1 Redesign the CPMS allocated research space for user friendliness and promote use to faculty and students	2.1.a Defragment the current space in the tower 3rd floor to a continuous space that allows for subject preparation, measurement and experimentation, and student/faculty meetings
		2.1.b Student/faculty accessibility to the space using DMU IDs
	2.2 Increase funding support for students to report research findings at local and national seminars	2.2.a Increase the number of travel stipends for students to report findings at national meetings to a minimum of at least 3 per meeting
		2.2.b Increase the student support for travel to report research to 75% sponsored/25% student cost share
	2.3 Identify and apply for external research funding sources that are available to CPMS	2.3.a Create a database of external funding sources for podiatric medical research
		2.3.b Increase the number of applications for external funding support to CPMS research to 1 application per faculty every 2 years
3. Align the CPMS research program with the university's research focus areas	3.1 Explore opportunities to increase research in movement science	3.1.a Enhance the support and leadership to the activities of DMU faculty and students interested in the movement science research focus area
	3.2 Explore opportunities to increase research in pedagogy in education	3.2.a Enhance the support and leadership to the activities of DMU faculty and students interested in the pedagogy in education research focus area
	3.3 Encourage broader participation in monthly research forums from across DMU with increased collaborative ventures	3.3.a Increase collaborations with the research office to expand the invitation to the CPMS monthly research forums to pertinent DMU faculty and students
		3.3.b Current departmental or program research interests reviewed and opportunities for collaborative activities identified
		3.3.c Increase trending in the number of podiatric medicine faculty and students working on collaborative research projects noted

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**Table 1. continued**

Goal	Strategy	Measures
4. Advance the CPMS clinical research program through collaboration with podiatric medicine local residency programs	4.1 Partner with the research office to increase/improve faculty training in research methodology	4.1.a Increase the on-campus educational activities available to the faculty at DMU 4.1.b CPMS faculty to attend $\geq 2$ research professional development activities per year
	4.2 Create a process for expediting data use agreements	4.2.a Formalize data use agreements to be completed with all local residency programs
	4.3 Establish a research collaborative with Iowa residency programs and central Iowa medical centers	4.3.a Identify research topics/projects with stakeholders 4.3.b Create a database to log current research projects/publications by residents, faculty, adjunct faculty, and students 4.3.c Review and revise as necessary benefits afforded to adjunct faculty related to library and technology resources

Abbreviations: CPMS, College of Podiatric Medicine and Surgery; DMU, Des Moines University; EBM, evidence-based medicine.

## Results

### Scholarly Activity

Des Moines University CPMS set out to create a newly founded research enterprise and to establish a culture of scholarly activity through the collaboration of faculty and students. After restructuring the curriculum to include evidence-based medicine initiatives, students began actively seeking evidence to support the various procedures they were learning in both clinical and academic settings. A renewed interest in scholarly activity was similarly reflected by an increased presence of DMU-CPMS at regional and national scientific meetings as well as an increase in research publications within peer-reviewed journals.

In the 6 academic years before implementation of the SRP, DMU-CPMS published 11 articles in peer-reviewed journals. Of these publications, three listed a medical student as a coauthor, and nine residents were listed as coauthors. In the 6 academic years since implementing the SRP, DMU-CPMS published 50 manuscripts. These publications reflected the work of 44 students, 21 residents, and 63 faculty members over a 5-year period. Of the 50 manuscripts, 16 listed a medical student as the primary investigator (Figs. 1 and 2).

Also, DMU-CPMS achieved an increased presence at regional and national scientific meetings after implementing the SRP. During the 2008-2009 academic year, DMU-CPMS students completed five podium presentations. After instituting the SRP, however, podium presentations increased to eight

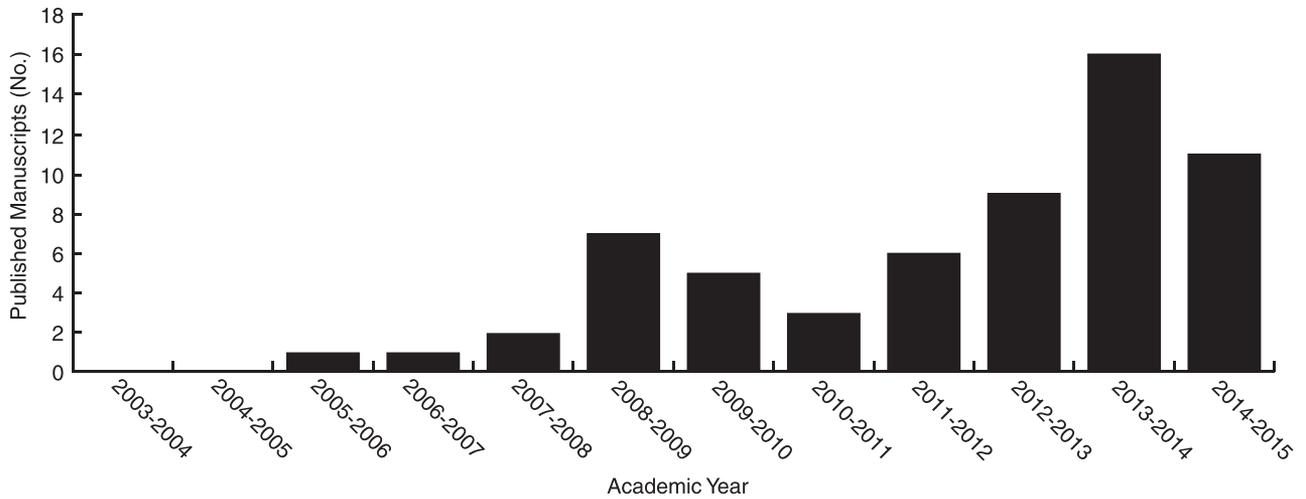
during the 2013-2014 academic year. Poster presentations at local, regional, and national meetings, however, decreased with the SRP, from 52 during the 2008-2009 academic year to 19 in the 2013-2014 academic year (Table 2).

### Research Funding

Funding for research projects within DMU-CPMS also increased after introducing the SRP. Before the implementation of this program, resources for faculty research were scarce, with no research space or initial project funds available. However, since implementation of the research initiatives, institutional support was given in the form of intramural seed money and supportive services. The renewed vigor for scholarly activity also increased student and faculty efforts to submit research grant proposals for extramural funds. As of 2012, research project grant funds totaling \$60,211 were attained, demonstrating a 58% success rate among proposals.

### Discussion

The DMU-CPMS SRP and SP focused on developing a culture where faculty and students would collaborate to advance medical knowledge through research initiatives. The DMU-CPMS made major strides in developing a research enterprise through creating a framework for students and faculty to inquire, hypothesize, and develop clinically relevant research questions. Through development of the SRP, students and faculty identified the shortcom-



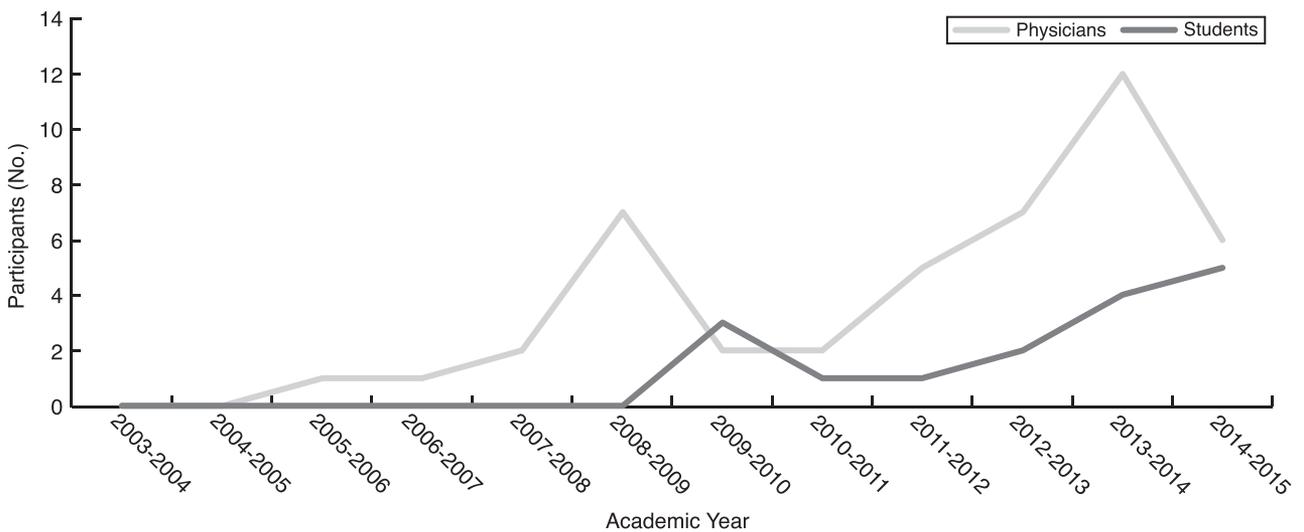
**Figure 1.** Number of research manuscript publications by Des Moines University College of Podiatric Medicine and Surgery between the 2003-2004 and 2014-2015 academic years.

ings of previous research initiatives and made adjustments throughout the college and curriculum accordingly.

Other institutions have attempted to increase research among medical schools and residency programs through various means. The orthopedic departments at the University of Texas and The Ohio State University found that residents were significantly more likely to publish manuscripts after establishing resident research programs.<sup>40,45</sup> Medical schools have noted similar trends through establishing research mentorship programs and formal research requirements.<sup>23,29,30</sup> The DMU-CPMS results echo those found by other programs.

Since implementation of the SRP, student, resi-

dent, and faculty engagement in scholarly activity has increased fivefold within the college. Medical students began publishing as primary authors, and research commitments among students, residents, faculty, and residency program directors flourished. In the 2005-2006 academic year, only one research publication was produced by DMU-CPMS. In 2008-2009, seven research manuscripts were published, listing only two medical students as coauthors. After the SRP was initiated, eight faculty members, one resident, and five students published research articles. Since the beginning of the 2013-2014 academic year, 27 manuscripts have been published, including nine manuscripts listing a student as the primary author. However, note that there was



**Figure 2.** Comparison of faculty and students as primary investigators on research manuscript publications between the 2003-2004 and 2014-2015 academic years.

**Table 2. Number of Scientific Poster and Podium Presentations by Medical Students Between the 2007-2008 and 2013-2014 Academic Years**

	2007-2008 Before SRP	2008-2009	2009-2010	2010-2011	2011-2012 After SRP	2012-2013	2013-2014
Poster presentations							
National conferences	12	15	21	14	5	5	11
Regional conferences	10	11	7	0	0	6	2
Local conferences	20	26	12	15	6	10	6
Subtotal	42	52	40	29	11	21	19
Podium presentations							
National conferences	1	1	0	2	2	0	5
Regional conferences	0	0	0	9	1	0	0
Local conferences	0	4	4	8	4	2	3
Subtotal	1	5	4	19	7	2	8

Abbreviation: SRP, Strategic Research Plan.

a decrease in manuscript publication during the 2009-2010, 2010-2011, and 2014-2015 academic years. During the 2009-2011 academic years, the SRP had been implemented for only 2 years, and incorporation into the curriculum was still developing. The first class of students who received the full incorporation of the SRP in the curriculum matriculated in the 2009-2010 academic year, and as these students progressed throughout their medical education, a substantial increase in manuscript publication was observed throughout their academic careers. The decline in manuscript publication during the 2014-2015 academic year was due to the timing of the manuscript submission, revision, acceptance, and publication as it coincided with the academic year. The success of the DMU-CPMS SRP points to a cultural change within the college and provides a model for other institutions seeking to bolster their own research environments.

A limitation of this initiative is that it is difficult to prove that the increase in institutional scholarly activity is directly related to the SRP, and other factors may have resulted in the reported increase in research activity. However, the results demonstrate that creating an awareness and culture that supports scholarly activity, whatever the catalyst, increases production.

The following subsections identify the aspects of the SRP that were most vital to the success of this program.

### Director of Research

Appointing a Director of Research proved to be of utmost importance to the success of the SRP. By creating a research director position, students and faculty had a single source for managing research

project inquiries. Selecting an individual with extensive research experience in manuscript publications provided an essential knowledge base for managing these projects effectively. The research director also served as a spokesperson to promote the importance of research early in the medical student's career, as other studies have demonstrated vital to the success of the student's future research endeavors.<sup>21-27</sup> The value of the research director position was supported by the extensive number of research publications that this individual was involved in. Since the introduction of the SRP, the DMU-CPMS Director of Research was listed as a coauthor on 14 publications and provided guidance and support for countless others.

### EBM Curriculum

Once a Director of Research was established, DMU-CPMS formed a committee comprising administrators, faculty, and students tasked with the goal of outlining a research-oriented curriculum. This allowed for the identification of strengths within the current curriculum as well as new opportunities to reinforce the ideals of EBM and research skills. Several studies have implemented similar EBM curricular strategies, noting increases in scholarly activity as a result.<sup>48-50</sup> Several new elements were integrated into the existing DMU-CPMS curriculum to reinforce an EBM focus.

**EBM and Research Fundamentals Lectures.** The DMU-CPMS created an inquisitive culture among students and faculty through integrating EBM and research fundamental lectures into its core curriculum. Beginning in the fall semester of the medical student's first year, EBM and clinical research design lectures were taught in an intro-

ductory podiatric medicine course. During these lectures, students were taught the fundamentals of developing a research study design, conducting a literature review, and determining levels of evidence. Students also reviewed basic statistical analysis and methods of presenting data. Furthermore, topics such as appropriate research conduct and the ethics of biomedical research were highlighted. These fundamental research skills were built on throughout the students' education as they continued to use evidence-based medicine to critically evaluate clinical topics.

**Scientific Poster Presentation for Third-Year Students.** A required scientific poster presentation allowed third-year students the opportunity to showcase their EBM and research skills. Students demonstrated their abilities to review current literature, determine appropriate research methods, present the results using appropriate statistical analysis, and formulate a discussion. This scientific poster could be completed in conjunction with a current research project or as a literature review or case study from a topic of interest encountered during the clinical third year.

**Scientific Podium Presentation for Third-Year Students.** Building on the skills of the poster presentation, third-year students were then required to present a research study from a podium format. The presentations allowed students to formulate clinically relevant research questions and to develop conclusions based on critical evaluation of the literature. This requirement challenged the students' understanding of research methods, statistical analysis, and dissemination of results. Overall, the podium presentation not only heightened the students' abilities in presenting scientific information but also helped them develop the skills of a future clinician in critically evaluating the validity of new treatment options.

**Monthly Research Forum.** The monthly research forum provided a venue to expose students to research opportunities within the college. Students and faculty regularly presented findings from current research projects to create an awareness of ongoing opportunities. The Director of Research also identified new research opportunities as well as deadlines for abstract and presentation submissions to local, regional, and scientific meetings. These gatherings not only facilitated collaboration between faculty and student researchers but also generated a continued excitement and support for the pursuit of research projects within the college.

By implementing EBM curricular modifications under the SRP, an increase in student understanding

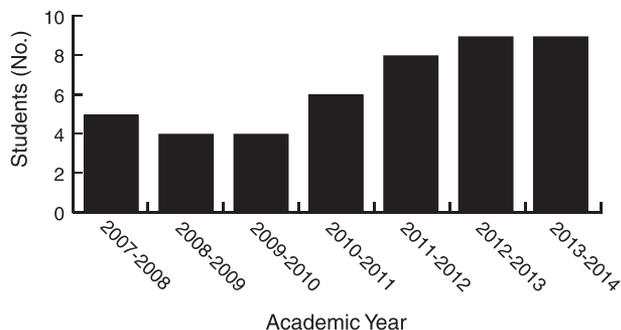
and involvement in the research process was demonstrated campuswide. Students were equipped to discuss clinical decisions from an evidence-based approach, paving the way for dynamic discussions between faculty and staff. Faculty members were similarly encouraged to develop a research focus as they became more accountable for demonstrating the evidence-based efficacy for treatments and procedures taught in the classroom and used in clinical rotations. Together, these efforts developed a culture of scholarly collaboration across campus.

### Extracurricular Research Opportunities

With a new curriculum in place that emphasized research-oriented learning and integrated the development of student research skills, the natural step in the progression of the DMU-CPMS research initiative was to provide outlets for students to further augment their research abilities. Numerous studies have demonstrated the success of protected research time away from the academic environment in producing increased research activity.<sup>41-44</sup> At DMU-CPMS, this was achieved through the creation of the following extracurricular opportunities:

**Mentored Student Research Program.** The SRP expanded the existing Summer Mentored Student Research Program. Throughout the academic year, students are often overwhelmed by adjusting to the rigorous demands of medical education. Students who may be interested in pursuing research are perhaps hesitant to commit due to rigorous study and time constraints. Providing a summer elective when no coursework is required is advantageous for students who desire to pursue research interests. The SRP enhanced the previously existing intense Summer Mentored Student Research Program by expanding its duration over the following academic year and by increasing participation of faculty mentors. Doing so not only provided more opportunities for students to get involved but also offered a greater diversity of research projects available. Since initiating the SRP, participation in the Mentored Student Research Program doubled. A total of 36 students completed summer research projects after its expansion, and many of these projects went on to publication (Fig. 3).

**Elective Research Courses.** For students interested in research during the academic year, a research elective course was developed. This afforded the opportunity to CPMS students not selected to participate in the Mentored Student Research Program to engage in research with



**Figure 3.** Student participation in the Mentored Student Research Program between the 2007-2008 and 2013-2014 academic years.

faculty mentors throughout the 4-year academic curriculum. Participation was encouraged by awarding a 1.0 semester hour credit to the course, which equated to approximately 60 hours of dedicated research time. This elective allowed for a maximum of 3.0 semester hour credits, warranted continuity in the research process, and provided an incentive for students to accept the extra initiative and responsibility of pursuing research.

#### **Research Rotation for Fourth-Year Students.**

For fourth-year students, a dedicated research rotation was also developed. Students interested in this opportunity were afforded protected time in their schedules to solely focus on manuscript completion. This elective was often used during the spring semester of the student's fourth year, providing a chance for the student to bring to completion any outlying research projects before graduation.

**DMU Research Symposium.** The culmination of these extracurricular research initiatives was presenting the work at scholarly conferences. At DMU, an annual research symposium was established that allowed students to present their findings in a low-stress environment, a method used by other institutions to increase research involvement.<sup>29</sup> For some students, this symposium was the first time they presented their research findings publicly. Doing so in a familiar environment allowed students to build confidence in presenting scholarly findings and served as an opportunity to recognize and celebrate student research involvement. Furthermore, the symposium generated excitement and awareness for research opportunities available on campus and helped generate research interest among on-looking peers.

#### **National and Regional Scientific Meetings.**

The SRP also sparked an increased presence at national and regional scientific research meetings.

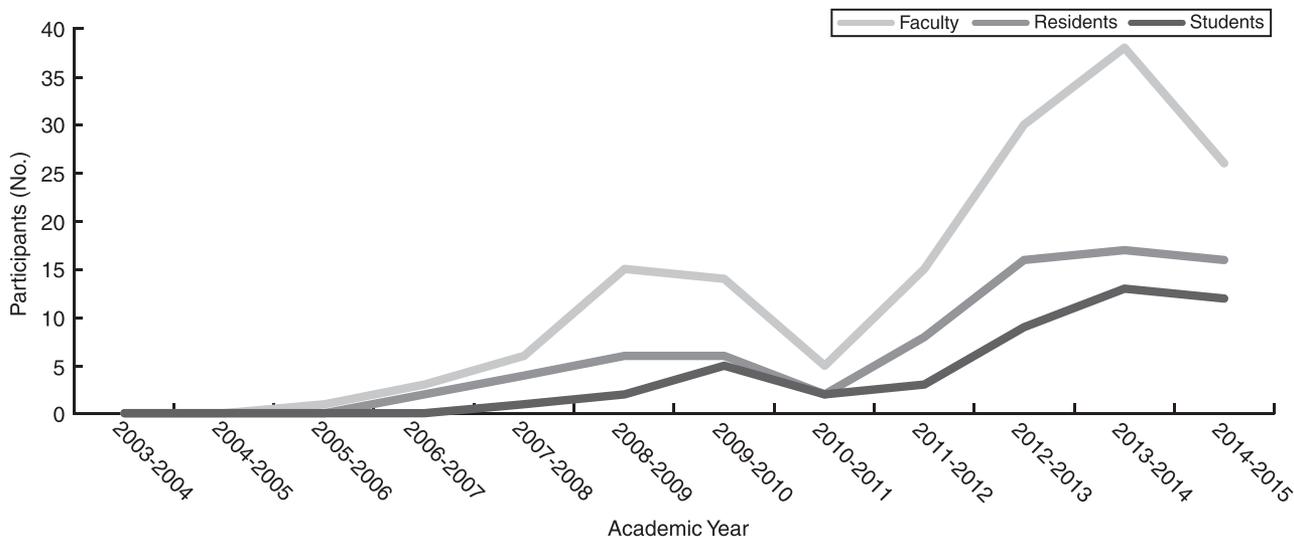
These efforts were supported by an increase in travel stipends attributed under the SRP. During the 2008-2009 academic year, DMU-CPMS students completed five podium presentations, one of which occurred at a national scientific meeting. After instituting the SRP, however, podium presentations increased to eight during the 2013-2014 academic year, with five of them delivered at national scientific meetings. Presenting at regional and national scientific meetings allowed students to disseminate their results beyond the DMU community and to gain confidence in presenting their work publicly. One interesting observation was that poster presentations at local, regional, and national meetings gradually decreased after initiating the SRP, from 52 in the 2008-2009 academic year to 19 during the 2013-2014 academic year. We suspect that this decline was correlated with the increase in manuscript publications and increase in podium presentations, as perhaps students felt more confident in disseminating their research findings (Fig. 4). In addition, the increase in the dissemination of research in the form of manuscripts is consistent with the 2013-2016 SP of the college.

#### **Collaboration**

Collaborative efforts among students, faculty, and surrounding medical institutions provided a valuable impetus to move the SRP forward. These relationships created a culture of scholarly activity and generated a renewed interest and excitement in research pursuits. Furthermore, these collaborative efforts created accountability within the research projects and capitalized on the respective strengths of each member to move the projects forward.

Newfound research initiatives instituted under the SRP created more opportunities for faculty and students to collaborate on research projects. For example, the monthly research forums hosted by DMU-CPMS faculty alerted students to research opportunities within the college and allowed for the natural formation of student-faculty research teams. Furthermore, the opportunities to participate in the Mentored Student Research Program and the elective research course held during the academic year provided a formal mechanism to develop these budding research relationships.

In each of the research teams, the faculty member served a mentorship role by determining a research question and outlining basic measures and outcomes to complete this goal. From there, the student had a framework within which he or she was able to develop the project further. This format



**Figure 4.** Collaboration on research projects among faculty, residents, and students between the 2003-2004 and 2014-2015 academic years.

allowed the student to take ownership of his or her project while gaining valuable insights from the faculty mentor. Such a model of student-driven research has been shown to increase research project engagement, completion, and success.<sup>42</sup> The Director of Research was also a valuable member of the team, providing guidance as needed throughout the project and the publication process itself. The success of this collaborative model is highlighted by the number of DMU-CPMS publications listing students as coauthors since initiation of the SRP. Between the 2005-2006 and 2008-2009 academic years, only three students were listed as coauthors on research publications. Since the creation of the SRP, however, 44 students have been included as coauthors on research publications (Fig. 4).

A similar collaborative relationship was strengthened among DMU-CPMS faculty members. By serving as a centralized representative to facilitate research initiatives, the Director of Research united faculty research efforts as a whole. Furthermore, the Director of Research's expertise in the publication process was essential in bringing these projects to completion. Since the creation of the Director of Research position, he or she has served as a coauthor on 24% of faculty research projects and provided guidance and assistance for numerous others. Peer collaboration among faculty members was also observed. Between the 2005-2006 and 2008-2009 academic years, only three publications included more than one DMU-CPMS clinical faculty member as a coauthor. Since the SRP initiation,

however, 26 publications have listed more than one faculty member as a coauthor. These coordinated efforts were vital to increasing the DMU-CPMS research enterprise as a whole.

In the college's 2013-2016 SP, DMU-CPMS broadened its vision of institutional research to include the development of research relationships with podiatric medical residency programs in the greater community. Decreased publications among residents are often attributed to intense time constraints, lack of mentorship, and funding, although residents agree that scholarly activity is vital to future fellowship and career advancement.<sup>20,42</sup> Likewise, students interested in pursuing a particular field of medicine understand the value of contributing research activity within that given field. Thus, the interest in scholarly pursuit is mutually shared, yet the relationships between medical students and residents remain underused. The DMU-CPMS developed a collaborative relationship with two nonaffiliated residency programs. Student-resident interaction was encouraged through participation at resident-led journal clubs, grand rounds, and mortality and morbidity lectures. These opportunities provided a bridge between DMU-CPMS and the residency programs and allowed them to expand their research enterprises in a mutually beneficial manner. As a result of these relationships, 21 residents were listed as coauthors on DMU-CPMS publications after implementing the SRP. To our knowledge, the SRP is the first to demonstrate success in increasing scholarly activity among both medical

students and residents through cultivating nonaffiliated program relationships.

The DMU-CPMS sought to expand its research enterprise by developing an intentional, systematic research plan. The SRP centered on hiring of the Director of Research, expanding research opportunities for both students and faculty, and creating a culture of scholarly collaboration. The result of these initiatives was a substantially more robust research enterprise within a few years. Implementing the SRP has created a shared research culture among DMU-CPMS students and faculty and provides a model for other institutions seeking to bolster their own research environments.

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**Conflict of Interest:** None reported.

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