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Dual-Impact Outcomes of a Summer Medical Pathway Program: Learner Empowerment and Student Educator Development

Xinyi Luo

xluo6@tulane.edu

Tulane University Health Sciences Center: Tulane University School of Medicine
https://orcid.org/0009-0000-9359-5354

James Pai
Tulane University School of Medicine

Hiyori Roberts
Tulane University School of Medicine

Jonathan Allotey
The University of Texas Southwestern Medical Center

Joseph Ritondale
Baylor College of Medicine

Kalli Segel
Christiana Care Health Services: Christiana Care Health Services Inc

Vivien Okechukwu
Baylor College of Medicine

Korey Walter
Tulane University School of Medicine

Carolyn Cook
UNC-Chapel Hill: The University of North Carolina at Chapel Hill

Amanda Watters
Phoebe Putney Memorial Hospital

Allegra Ploeg
Lakeland Regional Health Medical Center: Lakeland Regional Medical Center Inc

Hanna Li
University of Washington Tacoma

Danielle Tatum
Tulane University School of Medicine

Jacquelyn Turner

Tulane University School of Medicine

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Abstract

Purpose

Premedical pathway programs may support students underrepresented in medicine by providing early exposure, mentorship, and preparation for medical school. Fewer programs explicitly pair undergraduate learner support with educator development for medical student mentors. This exploratory mixed-methods evaluation examined IMPRESS, a summer pathway program, as a dual-impact model supporting undergraduate learner empowerment and near-peer educator development.

Methods

Three cohorts of first- and second-year undergraduate students completed IMPRESS, a six-week immersive program integrating clinical immersion, simulation and procedural skills, research and scholarly development, medical school and MCAT preparation, and longitudinal mentorship/community. Quantitative outcomes included clinical exposure, medical knowledge, MCAT self-efficacy, research knowledge, laparoscopic confidence and task completion, mentorship outcomes, and satisfaction. Pre- and post-program outcomes were compared using paired analyses. Qualitative data were collected through semi-structured focus groups and written responses and analyzed using a hybrid deductive-inductive approach informed by Social Cognitive Theory. Fourth-year medical student mentors completed an anonymous post-elective survey assessing perceived growth in teaching, leadership, communication, curriculum-development interest, and academic-medicine identity.

Results

Thirty-five undergraduate students completed IMPRESS; 68.6% identified as Black or African American, 40.0% reported household income below $50,000, and 25.7% were first-generation college students. All post-program survey respondents reported significant clinical exposure, and 34 of 35 students reported an intention to pursue medicine. Medical knowledge scores increased from 55.5% ± 15.1 to 71.4% ± 12.4 ($p < 0.001$), MCAT self-efficacy increased from 62.2% ± 15.4 to 74.8% ± 13.5 ($p < 0.001$), and research knowledge increased from 47.3% to 60.1% ($p = 0.01$). Laparoscopic exposure and confidence increased by 162%, and 32 of 35 students completed both laparoscopic tasks within the program-defined benchmark. At one-year follow-up, 19 of 23 respondents remained in contact with at least one mentor. Qualitative themes included confidence, belonging, structured support, shared experience, professional development, and embodied mentorship. Among surveyed medical student educators ($n = 9$), all reported improved teaching, leadership, communication, and feedback skills. They also described the experience as an opportunity to “give back,” develop teaching and communication skills, build lasting connections with mentees, and engage in reciprocal learning, with one respondent noting that the program was “a two-way street in that we learned from our mentees as well.”

Conclusions

IMPRESS illustrates a feasible dual-impact pathway model combining undergraduate exposure to medicine with structured near-peer educator development. Exploratory findings suggest that integrated pathway programs may support learners' confidence, sense of belonging, preparation, and mentorship, while providing medical students with formative teaching and leadership experiences.

Introduction

The physician workforce in the United States does not reflect the racial, ethnic, or socioeconomic diversity of the population it serves[1,2]. Black, Hispanic, American Indian, and Alaskan native individuals remain substantially underrepresented among physicians, and students from lower-income families continue to face unequal access to the educational, financial, and social resources that support medical school entry [3–5]. These inequities are not only a workforce concern [6]. Physician diversity is associated with improved communication, trust, access, and responsiveness to the needs of historically underserved communities [2,7,8].

Pathway programs are one strategy for addressing these upstream barriers. Effective programs may combine early clinical exposure, near-peer and faculty mentorship, test-preparation resources, research experience, skills training, and a community that normalizes belonging in health care[9,10]. However, many program evaluations emphasize long-term matriculation outcomes while giving less attention to earlier motivators that may help students remain interested in and prepared for medical careers, such as self-efficacy, skill confidence, and professional identity formation [1,11,12].

Belonging is a particularly important but undermeasured mechanism. Students decide whether medicine is “for people like me” through repeated social experiences: whether they are welcomed into clinical spaces, whether mentors share relevant lived experiences, whether peers provide safety and accountability, and whether they are trusted with meaningful work[13]. Social Cognitive Theory proposes that self-efficacy is shaped through mastery experiences, social modeling, encouragement, and interpretation of emotional states [14]. Within a pathway program, these mechanisms can transform clinical exposure from passive observation into an emerging professional identity [11].

A second, related challenge is the development of future physician-educators. Medical students and residents frequently teach peers, junior learners, and patients, yet many enter residency with limited formal preparation in teaching, feedback, curriculum design, or mentorship [15,16]. Near-peer teaching models may offer benefits for both learner groups: undergraduate participants receive mentorship from trainees close enough to make the pathway feel attainable, while medical student mentors practice educator skills before assuming teaching responsibilities [17–19]. In surgery, where technical skills, feedback, coaching, and professional identity formation are central to training, structured opportunities for medical students to teach and mentor may be especially relevant to the future surgical education workforce [20,21].

The Introduction to the Medical Profession: a Rotation to Empower StudentS (IMPRESS) program is a fully funded summer immersive program for first- and second-year undergraduate students. The program is modeled after elements of a clinical clerkship and includes clinical observation, surgical skills simulation, research experience, didactics, MCAT and application preparation, and longitudinal mentorship. IMPRESS also includes a structured near-peer educator elective course for fourth-year medical students, who participate in faculty-guided preparation and then serve as mentors and instructors for undergraduate participants. This exploratory study examines the IMPRESS program as a dual-impact model: a summer pathway program that supports early undergraduate learners and an early educator development course for medical students.

Methods

Study design

This was a prospective, exploratory, mixed-methods program evaluation of early undergraduate students who completed a six-week summer immersive pathway program. The evaluation also included a descriptive assessment of fourth-year medical student educators who participated in a paired near-peer teaching elective and served as mentors and instructors for the undergraduate learners. The study was determined exempt by the Tulane University Institutional Review Board. Verbal consent was obtained before each focus group, including consent to record the discussion and to use de-identified quotations in analysis and reporting. Participation in the evaluation was voluntary and was not required to complete the program. Because participants applied to and were selected for the program, the evaluation should be interpreted in the context of a motivated and selected participant population.

IMPRESS Program Design and Setting

IMPRESS is a fully funded summer pathway program based at a single academic medical center in the southern United States. Twelve undergraduate freshmen and sophomores are enrolled annually through a holistic application and interview process that considers academic potential, demonstrated interest in medicine, personal experiences, and access to educational, clinical, and professional development opportunities. The program expanded from four weeks in its inaugural year to six weeks in subsequent cohorts. The primary catchment area is local; however, the program is open to other students nationally.

The curriculum integrates five domains: clinical immersion, simulation and procedural skills, research and scholarly development, medical school and MCAT preparation, and longitudinal mentorship/community. Students participate in specialty rotations; practice suturing, knot tying, laparoscopic tasks, robotic simulation, and ultrasound; develop a mentored research question and present a final project; complete workshops in CV development, personal statements, interviewing, financial planning, and test-taking strategy; and are paired with longitudinal mentors.

Medical Student Educator Elective

A paired fourth-year medical student educator elective was developed to structure the role of medical students as near-peer mentors and instructors within IMPRESS. Medical student mentors participated in weekly faculty-guided didactics aligned with their teaching responsibilities, including curriculum building, writing measurable objectives, mentoring strategies, assessment and feedback tools, inclusive teaching practices, managing adult learners, and clinical teaching frameworks such as the One-Minute Preceptor and SNAPPS. They then applied these concepts by serving as primary instructors for selected simulation and skills sessions and by helping design teaching modules for undergraduate participants.

Participants

Participant flow and survey completion at each evaluation time point are summarized in Table 2. Across the program cycles, 82 students applied, 36 were accepted, and 35 matriculated. The first cohort included 11 students because one accepted student withdrew before the program's start date. One student did not participate in MCAT prep because they had already taken the official MCAT at the time of the program. Survey and focus-group participation varied by evaluation component. The participants who were not present at the focus group were given the opportunity to submit a written response to the question.

Across the same program period, 13 fourth-year medical students completed the paired IMPRESS medical student educator elective. Of these, 9 completed the anonymous post-elective mentor survey evaluating self-reported teaching, leadership, communication, curriculum-development interest, and academic-medicine identity formation.

Outcome measures

The primary qualitative outcomes were participants’ perceived impact of the program on undergraduate learners’ decisions to pursue medicine or health care careers and medical student educators’ perceived development as near-peer mentors, teachers, and future academic physicians. Secondary quantitative outcomes for undergraduate learners included pre/post change in general medical knowledge scores, MCAT self-efficacy, and adapted laparoscopic simulation performance. Secondary outcomes for medical student educators included post-elective self-reported changes in teaching confidence, leadership, communication, feedback skills, interest in curriculum development, understanding of barriers faced by underrepresented students, and interest in academic medicine. These outcomes were selected to assess the program’s short-term dual impact on learner empowerment and medical student educator development, rather than to directly measure medical-school admission, residency performance, teaching competence, retention, or workforce outcomes.

Quantitative Measures

Students completed a general medical knowledge test before the curriculum and again after the curriculum. The two administrations were approximately six weeks apart. Students were not provided answers to the pre-test, did not receive item-level feedback, and did not have access to the questions after completion. This approach does not eliminate test-retest bias, but a six-week interval, combined with withholding the questions and answers, was intended to reduce direct recall of specific items. Test-retest guidance emphasizes that intervals should be long enough to reduce memory effects but short enough to limit change unrelated to the construct [22].

MCAT self-efficacy was assessed before and after the program using an 11-item, five-point MCAT self-efficacy scale adapted and developed for undergraduate premedical students (Appendix 1) [23]. The scale measures perceived capability rather than objective MCAT readiness. Most participants had not yet taken the official MCAT at the time of this report; therefore, official MCAT score outcomes were not available and were not analyzed. Students also completed a half-length practice MCAT and a one-hour preparatory course from an independent commercial company.

Research-related knowledge was assessed using four items embedded in the pre- and post-program knowledge assessment. These items evaluated basic research concepts, including PICO question structure, the role of literature review after formulating a clinical question, identification of clinical research, and identification of translational research.

Laparoscopic simulation exposure included peg transfer and circle-cutting tasks adapted from Fundamentals of Laparoscopic Surgery. The tasks were used as early exposure and task-completion activities for undergraduate learners, not as a test of surgical trainee proficiency or operative competence. The FLS examination allows 300 seconds for each task; published trainee proficiency benchmarks are substantially more stringent and are intended for surgical training contexts [24]. For this program evaluation, the program-defined metric was completion of the adapted tasks within the session parameters after three practice rounds. Participants also rated their laparoscopic exposure and skills on a four-point self-assessment scale.

Mentor outcomes were assessed through an anonymous post-program survey distributed to a cohort of past fourth-year medical student mentors after the elective conclusion and grades were finalized. Likert-scale items assessed self-reported improvement in teaching skills, leadership development, communication and feedback ability, interest in academic medicine, interest in curriculum development, and understanding of challenges faced by students from groups underrepresented in medicine. These mentor data are reported descriptively as self-reported outcomes. Because the mentor survey was post-program only, used a small sample, and did not include objective teaching assessments or learner-rated evaluations of individual mentors, these findings should be interpreted as perceived professional development rather than demonstrated teaching competence.

Quantitative Statistical Analysis

Continuous variables are reported as mean ± standard deviation or median with range, depending on distribution and data availability. Categorical variables are reported as numbers and percentages. Pre- and post-program paired outcomes were compared using the paired Student's t-test. Because this was an exploratory program evaluation with multiple outcomes and a small sample size, p-values were interpreted descriptively rather than as definitive evidence of causality. Statistical significance was defined as $p < 0.05$. Quantitative and qualitative findings were integrated during interpretation to examine whether measured gains in knowledge, skills, and self-efficacy aligned with participants' descriptions of belonging, mentorship, and emerging physician identity. STATA 18 was used to perform the analysis.

Qualitative Data Collection and Analysis

Qualitative follow-up was conducted through semi-structured focus groups supplemented by secure email written responses from students who could not attend. Social Cognitive Theory guided the development of focus-group questions and the analytic framework [14]. Specifically, questions were designed to elicit experiences related to self-efficacy, social modeling, verbal encouragement, emotional responses, sense of belonging, and outcome expectations [25]. A hybrid deductive-inductive coding approach was used.

Focus groups were facilitated by a physician educator familiar with the program but not responsible for student grading or selection for future opportunities. Participants were reminded that their comments would not affect mentorship, future opportunities, or program standing. Because the facilitator and some coders were connected to the program, the qualitative findings should be interpreted as participant-reported perceptions collected in a setting where social desirability and gratitude bias were possible.

Focus groups were audio-recorded with verbal consent and transcribed for analysis. Written email responses were imported into the qualitative dataset as additional participant reflections. Two coding teams reviewed the transcripts and written responses. Half of the coders were independent of the program and half served as program mentors. This mixed coder composition was selected to balance contextual understanding with independent review. Coders documented potential positionality and reflexivity concerns before analysis, including the possibility that mentor-coders might interpret comments more favorably and independent coders might miss program-specific context.

Qualitative analysis followed a mixed deductive and inductive thematic analysis approach [26]. The initial codebook was developed using Social Cognitive Theory constructs as sensitizing concepts, including confidence/self-efficacy, outcome expectations, barriers, supports, observational learning, and belonging [13,14,25]. Coders were also encouraged to identify new codes that emerged from the transcripts and written responses rather than limiting analysis to the initial theory-based framework. Coders first read the transcripts and written responses for familiarization, then independently coded the data in NVivo. The coding team met iteratively to compare codes, refine code definitions, combine overlapping concepts, and add emergent codes to the codebook.

At least 20% of each transcript was double-coded, and inter-rater reliability was assessed using percent agreement, with greater than 80% agreement across at least 95% of codes used as the threshold for acceptable reliability [27]. Disagreements were resolved through discussion and, when needed, review with the research lead. Attention was given to negative cases and quotations that did not fit the initial thematic structure. This approach was used to balance theory-informed analysis with openness to participant-generated themes and to mitigate single-investigator bias through reflexivity, consensus discussion, and investigator triangulation [26,28,29]. These procedures reduce but do not eliminate the possibility that program-affiliated coders interpreted participant comments favorably.

Given the focused research question, the specificity of the participant group, the use of both focus group and written-response data, and the exploratory goal of identifying perceived mechanisms rather than generating a formal theory, we judged the dataset using information power rather than claiming definitive saturation [30]. Representative quotations were mapped to the final themes to support transparency of interpretation.

Results

Participant Characteristics

The previously analyzed inaugural cohort included 11 students, of whom 8 (72.7%) were sophomores and 3 (27.3%) were freshmen. Six students identified as women, two as men, one as transgender, and one as other. Most students identified as Black (n = 9, 81.8%); 5 (45.5%) reported Pell Grant receipt, and 7 (63.6%) reported no immediate family member in the medical field (Table 3).

Results by Program Domain

Clinical Immersion

Students reported high perceived value from the clinical immersion component. Among program evaluation respondents, 32 of 32 (100%) students agreed or strongly agreed that they gained significant clinical exposure, and 29 of 32 (91%) agreed or strongly agreed that the clinical team included them in clinical care discussions. The median number of patients seen was 30 (range 8–73). After program completion, 34 of 35 (97%) students reported an intention to pursue medicine.

Simulation and Procedural Skills

Simulation-based outcomes demonstrated improvement in both self-reported confidence and timed technical performance. All program evaluation respondents agreed or strongly agreed that the simulation experience was well organized and that they learned basic operative skills. Among the 35 students with paired pre- and post-program self-assessment data, mean laparoscopic exposure and confidence increased from 1.17 to 3.06 on a 4-point scale, corresponding to a 162% relative increase, and 32 of 35 students improved their self-ratings of familiarity with laparoscopic equipment.

Laparoscopic terminology knowledge increased from 1.17 to 3.03, corresponding to a 159% relative increase, with all 35 students demonstrating improvement. Among students with timed skills data, all 35 completed peg transfer within 300 seconds, and 32 of 35 (91%) completed circle cutting within 300 seconds.

Research and Scholarly Development

The research component led to strong participation in scholarly work and increased knowledge of the basics of research. All students reported completing a final research project with a research mentor. Among program evaluation respondents, 27 of 32 (84%) agreed or strongly agreed that they learned basic medical research terminology, 27 of 32 (84%) agreed or strongly agreed that their research mentor provided meaningful feedback and guidance, and 26 of 32 (81%) agreed or strongly agreed that they enjoyed working with their research team. Research-related knowledge increased after program completion among participants with paired pre- and post-program data. The mean research knowledge score increased from 47.3% to 60.1% correct responses, corresponding to a relative increase of 23% ($p = 0.01$).

Medical School and MCAT Preparation

Medical school preparation outcomes demonstrated improvement in both knowledge and MCAT-related confidence. Among participants with paired medical knowledge data, 31 of 35 (89%) participants significantly improved their medical knowledge score. Mean scores increased from 55.5% ± 15.1 to 71.4% ± 12.4 ($p < 0.001$).

MCAT self-efficacy increased across all 11 measured domains. Mean MCAT self-efficacy scores increased from 62.2% ± 15.4 to 74.8% ± 13.5 ($p < 0.001$), corresponding to a 20.3% relative increase. The largest gains were observed in confidence to perform well on the MCAT (or practice MCAT) exam (40.1% increase), confidence in working through difficult or challenging MCAT-style problems (32.5% increase), and confidence in applying test-taking skills to successfully answer Chemical and Physical Sciences MCAT-style questions (31.5% increase). Thirty-two of 34 respondents completed their first mock MCAT examination during the program with a median score of 487 [473, 500].

Program evaluation responses also supported the value of the preparatory curriculum: 30 of 32 (94%) students agreed or strongly agreed that the medical school preparation lecture was useful, 29 of 32 (91%) found the CV-building lecture useful, 27 of 32 (84%) found the MCAT tips lecture useful, and 26 of 32 (81%) found the interviewing lecture useful. All participants reported that they would recommend IMPRESS to others.

Longitudinal Mentorship and Community

Mentorship and community were consistently represented across survey and focus group data. All students were paired with at least one career and one research mentor and had at least 1 meeting with each. Most respondents reported knowing how to maintain contact with their mentors after the program:

30 of 32 (94%) for research mentors, 31 of 32 (97%) for career mentors, and 32 of 32 (100%) for resident or student mentors. Among annual follow-up respondents, 19 of 23 (83%) reported being in touch with at least one mentor one year after the program.

Among all students who are in their Senior year of university or graduated at the time of this study, 13 of 17 (76%) elected to take at least one gap year before applying to medical school or matriculating. Three IMPRESS participants had applied to medical school, and all three were accepted. One was lost to follow-up.

Qualitative Outcomes

Two focus-group questions were analyzed to evaluate how IMPRESS influenced participants' confidence, communication, career development, and sense of belonging.

Focus Group Question 1: Confidence and Communication in Healthcare Spaces

For the question, "How has your participation in the program contributed to your confidence and communication skills in a healthcare space?", nine themes were identified. The most frequent themes were Confidence (10 references), Sense of Belonging (7 references), and Awareness of Assistance (4 references). These findings suggest that clinical exposure, visible representation, and access to mentors helped students feel more comfortable speaking, asking questions, and imagining themselves in healthcare roles (Table 4).

Focus Group Question 2: IMPRESS Community and Career Path in Medicine

For the question, "How has your IMPRESS community impacted your career path in medicine?", five themes were identified: Structured Support, Shared Experience, Confidence/Empowerment, Professional Development, and Embodied Mentorship. Inter-rater agreement averaged 88%. The most frequent themes were Structured Support (21 references) and Shared Experience (13 references). Frequency counts for the remaining three themes were not available in the current coding output.

Medical student educator and mentor outcomes

Among surveyed past mentors (n = 9), all respondents agreed or strongly agreed that participation improved their teaching skills, helped them develop as leaders, and improved their communication and feedback skills. Most respondents also reported increased desire to pursue academic medicine 8 of 9 (89%), increased interest in curriculum development 7 of 9 (78%), and a deepened understanding of challenges faced by underrepresented students 8 of 9 (89%). All respondents reported that they would recommend the program to others (Fig. 1).

In free-text responses, medical student educators described motivations for participation, anticipated goals, suggested improvements, and reasons they would recommend the experience. One respondent

wrote, “Having had help myself I want to give back and help others.” When asked what they hoped to gain, respondents described teaching experience, leadership experience, mentorship experience, communication skills, and the opportunity to “pay it forward.” One respondent wrote, “I wanted to gain some teaching experience,” and another wrote, “I hoped that I would gain more experience as a leader and form lasting connections with students going into medicine.”

When asked why they would recommend the experience, respondents described staying in touch with mentees, working on communication skills, teaching and learning from mentees, and finding the experience “meaningful.” One respondent wrote, “This program was a great way to start learning how to be an effective mentor,” and another wrote, “It is very rewarding to be able to both teach and learn so much from a mentee.”

Discussion

This exploratory mixed-methods evaluation describes IMPRESS as a dual-impact model that supports early undergraduate learners while creating an educator-development role for medical student mentors. Undergraduate participants described the program as increasing their confidence, helping them feel that they belonged in medicine, and making the path to a health care career feel more visible and attainable. These qualitative findings were reinforced across five program domains, including clinical immersion, simulation and procedural skills, research and scholarly development, medical school/MCAT preparation, and longitudinal mentorship. Overall, IMPRESS appeared to provide a broad early medical experience in which exposure, skill-building, mentorship, and community were closely linked.

A distinguishing feature of IMPRESS is its dual educational design. The program pairs early undergraduate exposure to medicine with a structured teaching role for senior medical students, creating a shared learning environment for undergraduates exploring health care careers and medical students preparing for the educator responsibilities of residency. Medical student mentors reported growth in teaching, leadership, communication, interest in curriculum development, and understanding of the barriers faced by underrepresented learners. Although these outcomes are self-reported, they suggest that embedding a students-as-educators model within pathway programming may strengthen the experience for both learner groups.

The qualitative findings suggest that IMPRESS helped students move beyond abstract interest in medicine toward a more concrete understanding of what a medical career could look like. Prior studies of early clinical exposure have similarly reported that early contact with clinical environments can strengthen professional attitudes, communication, confidence, and career clarity [9,10,31]. Broader work on professional identity formation emphasizes that clinical experiences, role models, expectations, and learning environments shape how trainees come to see themselves within medicine[32,33].

This may be especially important for early undergraduates who are still assessing whether medicine is academically, financially, and socially feasible. By combining clinical immersion, hands-on simulation, structured advising, near-peer and faculty mentorship, and visible representation in medicine, IMPRESS

may help students better understand the culture and structure of medical training before applying. Such early familiarity may reduce uncertainty around the “hidden curriculum” of medicine and support more informed persistence, although the present analysis does not establish whether these short-term perceptions translate into application, matriculation, retention, or career satisfaction [34].

This pattern is consistent with Social Cognitive Theory, which emphasizes that behavior and career persistence are shaped by interactions among personal factors, observed models, and the learning environment [14]. In IMPRESS, students encountered physicians, residents, medical students, and peers in clinical and educational settings, allowing them to observe possible professional roles, receive encouragement and feedback, and practice skills in a supported environment. These experiences may strengthen self-efficacy by helping students see that medical tasks and career steps are learnable, while also shaping outcome expectations by making the path to medicine more visible and concrete [25]. The qualitative themes of confidence, belonging, mentorship, and community, therefore, align with core Social Cognitive Theory constructs, particularly observational learning, self-efficacy, social support, and perceived feasibility of future goals.

The observed improvement in medical knowledge scores suggests that even a brief, structured summer curriculum may support measurable short-term learning. This is consistent with other medical education interventions showing that focused short courses can improve learner knowledge and skills over relatively limited time frames. For example, a short evidence-based medicine course for undergraduate medical students was associated with significant pre/post knowledge gains, and intensive clinical education models have similarly reported improvements in knowledge, clinical skills, and confidence [35,36]. Although the repeated-assessment design limits causal interpretation, students did not receive item-level feedback or access to pre-test answers, and the score changes suggest that immersive pathway programs may provide meaningful early academic exposure when paired with clinical context, didactics, and structured preparation.

The increase in MCAT self-efficacy is also notable because confidence in one’s ability to prepare for and perform on academic tasks is closely linked to motivation, engagement, and academic performance. Prior work has identified self-efficacy as an important belief in medical student learning and skill development, and broader educational research has shown positive associations between academic self-efficacy, learning engagement, and academic achievement [37]. For premedical students, especially those preparing for high-stakes standardized examinations, improved confidence in test-taking, persistence through difficult questions, and preparation strategies may represent an important early step toward MCAT readiness [38]. Official MCAT outcomes were not yet available for most participants, so future longitudinal follow-up will be important to determine whether these self-reported gains are associated with practice or official MCAT performance.

The simulation and procedural-skills component positioned laparoscopic tasks as early exposure rather than competency assessment. This framing is important because early, hands-on experiences can make surgery feel more visible, concrete, and accessible for learners who may have had limited prior exposure

to procedural fields [39–41]. Prior studies of surgical skills courses and robotic surgery exposure have found that early procedural experiences can increase student confidence, preparedness, and interest in surgery as a career, suggesting that even brief simulation-based encounters may help demystify surgical work. More broadly, career-development literature suggests that early exposure to unfamiliar fields can shape career awareness and interest by helping students understand the work environment, expectations, and pathways into a profession [42,43]. In IMPRESS, undergraduate participants were not expected to demonstrate surgical-trainee proficiency; rather, the simulation curriculum was designed to introduce procedural skills, reduce unfamiliarity with the operating room environment, and allow students to imagine surgery and other procedural specialties as possible future paths.

The same simulation activities also created a practical teaching environment for medical student mentors. By teaching suturing, laparoscopic task completion, feedback, and psychomotor skills, mentors were required to translate procedural knowledge into learner-centered instruction. This aligns with literature on medical students-as-teachers and peer-assisted learning, which suggests that teaching roles can benefit both learners and student-teachers by supporting communication, leadership, teaching skills, and professional development [44–46]. Although the mentor outcomes in this study were self-reported, the IMPRESS model offers a feasible structure for supervised practice in teaching, feedback, inclusive mentorship, and curriculum design before residency.

Limitations

This evaluation has several limitations. The study was conducted at a single institution with a small, selected cohort of students who applied to and were accepted into the program, and the absence of a comparison group limits causal interpretation. Future evaluations could include comparison groups such as eligible nonparticipants or wait-listed students.

The duplicated medical knowledge assessment may have introduced practice or recall effects, and the instrument requires additional validity evidence, including reliability testing, item-difficulty analysis, and alignment with curricular objectives. Future evaluations could develop and validate a larger medical knowledge question bank, allowing investigators to use equivalent but nonidentical pre- and post-program test forms and reduce the likelihood of recall or practice effects.

Several outcomes were self-reported, which were appropriate for assessing perceived confidence, belonging, motivation, and educator identity, but may be influenced by response or social desirability bias. Future evaluations should pair these measures with objective outcomes, such as MCAT scores, independently rated simulation performance, learner evaluations, faculty teaching assessments, and longitudinal follow-up into medical school matriculation and residency teaching roles.

Qualitative findings should also be interpreted in context. Although the coding team used reflexive discussion, consensus coding, double coding, and attention to negative cases, some facilitators, coders, and mentors were connected to the program, creating potential for social desirability, gratitude, or favorable-interpretation bias.

Finally, the program's design requires substantial institutional and departmental investment. Departmental funding reduced direct student costs and supported housing, meals, coordination, and access to clinical and simulation experiences, but this reliance on institutional resources, clinical capacity, faculty and trainee time, and sustained volunteer engagement may limit replicability in less-resourced settings.

Conclusion

IMPRESS illustrates a feasible dual-impact pathway model that pairs early undergraduate exposure to medicine with structured educator development for medical student mentors. Through clinical immersion, simulation, research, application preparation, and longitudinal mentorship, undergraduate learners reported greater confidence, belonging, and clarity about the path to medicine, alongside short-term gains in knowledge, self-efficacy, and procedural familiarity. Medical student mentors also described perceived growth as teachers, leaders, and near-peer role models. These exploratory findings suggest that integrated pathway programs may support both learner empowerment and early physician-educator development.

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Tables

Tables are available in the Supplementary Files section.

Figures

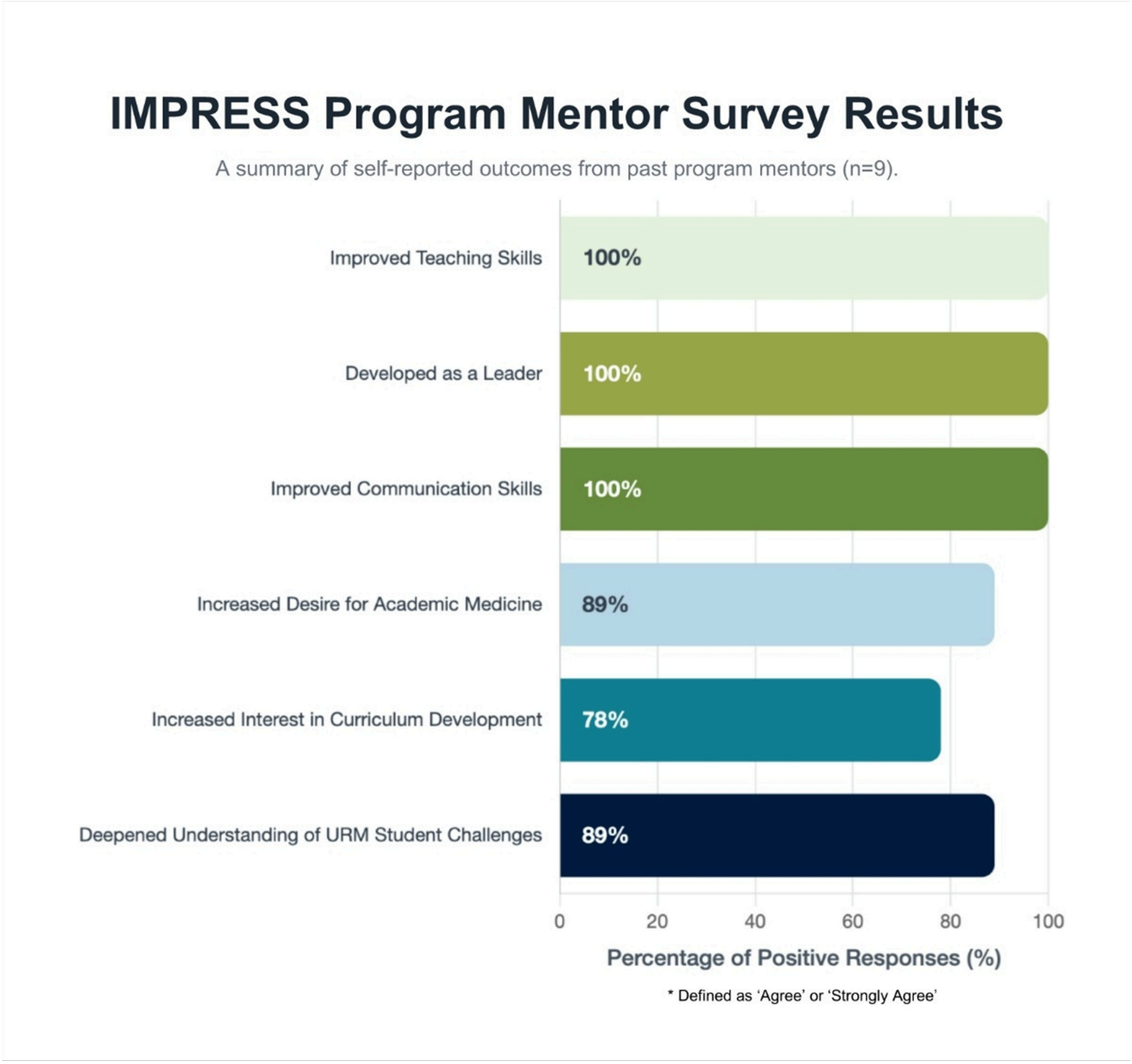


Figure 1

Self-reported data from IMPRESS medical student educators.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Table1.docx
- Table2.docx

- Table3.docx
- Table4.docx
- Table5.docx
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