REVIEW

Leadership Training and Undergraduate Medical Education: a Scoping Review

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Abstract

The purpose of this scoping review is to fill the gap in understanding the current status of intervention-based studies regarding leadership training in undergraduate medical education. As of late, there is an increased focus on the role of physicians as leaders in their fields, and communities. In order to evaluate these studies, both the PubMed and ERIC databases were searched, and an ultimate total of 35 articles methodologies were evaluated for their general methodology, curricular content, specific teaching methods, and evaluation methodologies. There were a number of trends identified, as well as remaining gaps.

Keywords Leadership · Undergraduate medical education · Curriculum development · Leadership training · Leadership skills

Introduction

There has been increased attention on the role of physicians as leaders in both clinical healthcare and management settings in recent literature, in many different capacities [1]. "Leadership" is defined by Merriam-Webster as, "the office or position of a leader" "capacity to lead", and "the act or an instance of leading" [2]. Unfortunately, those definitions do little to define what it means to be a physician leader. Of course, in more recent times, specifically with the SARS-CoV-2 pandemic, physicians are needed to inform their communities and manage public health crises, making leadership training even more important than previously stated. In his summary on the status of leadership training in the USA, Dr. Stewart Gabel notes the need for leadership training not only those who fill formal leadership roles, but informal

roles as well, as all physicians will fill one of those positions at some point in their careers [1].

Fortunately, leadership development in undergraduate medical education is not starting from zero. In a semi structured interview investigation, graduates from the University of Missouri-Kansas City reported that the most impactful leadership developing components of their undergraduate medical education were longitudinal learning communities, peer to peer mentoring, supportive relationships with peers and faculty, and a clinically oriented but integrated curriculum [3]. Although there are differences between eastern and western culture for community service, researchers found that students in Singapore who were previously involved in community service reported gaining experience and knowledge about communication, team dynamics, and leadership styles as a result [4]. That finding underscores the impact of volunteer work on the budding leaders in medical school [4]. Similarly, a study from Ghana explored the importance of role modeling on the development of leadership skills, and how role models impact students' perception of vital leadership skills [5]. Finally, a survey of US medical school deans revealed various leadership development opportunities, including dual degree programs, workshops, lectures, seminars, and non-curricular options like committee work, student organizations, service projects, and volunteer and teaching opportunities [6]. Although these studies surveyed different groups and considered different methodologies,

undergraduate medical education already shows some success as it relates to leadership development.

Medical students, however, do not feel that they have reached a level of leadership skill needed to be effective leaders [7]. As a result, there has been an increased effort to tackle this deficiency through different leadership building and skills training at the undergraduate medical level [7]. A systematic review published in 2011 identified areas of essential medical leadership and management skills for undergraduate medical education, including quality improvement, managed care, use of resources and healthcare cost, "the role of the doctor", patient safety, and general leadership and management [8]. The review pointed out the concerns of medical students who want increased training but lack the time and show disinterest in certain areas [8]. One potential solution is to utilize a module-based system in which the learning is more self-paced throughout undergraduate medical education as implemented by the University of Newfoundland [9]. The same study concludes by calling for more research on the topic and more investigations into the best approaches to leadership development for medical students [8]. In another, more recent systematic review of 11 studies from 2018, the authors again concluded that there is limited evidence of effectiveness in the studies they examined ranging from the years 2000–2014 [10]. The same review also summarized a lack of objective and long-term outcomes, as well as a standard framework for evaluation [10].

There is a growing need for expanded areas of leadership development, in part because leadership needs are also changing. Acomparative analysis of medical school leadership job postings from 2000-2004 and 2010-2014 showed thatthere was a difference in the posting language with an increased focus oncollaboration, transparency, community centeredness, accountability, andteamwork, highlighting the changing skills needed in medical education [11]. Further, for women in leadership positions,tenured faculty cited individual skills and actions to facilitate development,including mentorship and institutional support for diversity and inclusion asthe key factors in becoming successful leaders [12]. So, not only have recent events thrust physician leadership to the forefront, but the broader field of medical education and academia have as well.

There are also significant impacts for medical students as to their acquisition of leadership skills or lack thereof. In a commentary on the type of leadership development emergency medicine residency directors are looking for specifically, a number of different leadership development tools were discussed as an essential component of a hopeful emergency medicine resident [13]. Different methods like serving on medical school committees, student interest group involvement, involvement in organized medicine, and wo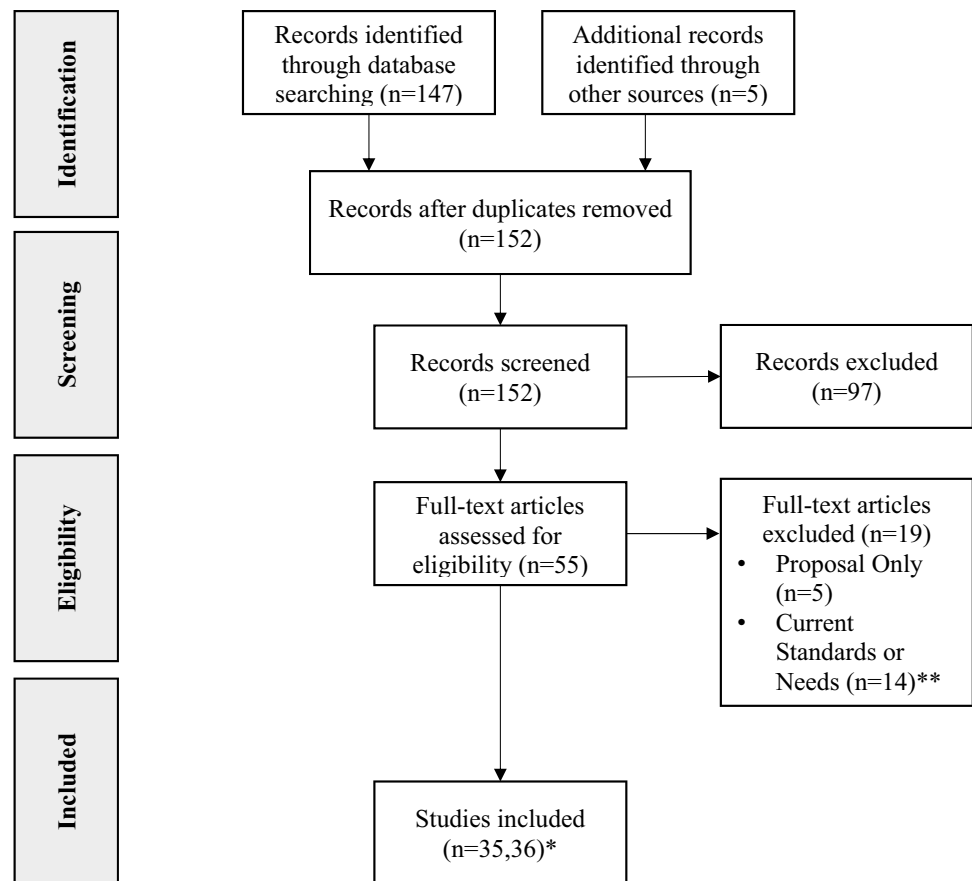rking on, and completing, projects were some of the examples listed as beneficial for leadership growth [13]. Yet, those gaps still persist into residency. In a survey of internal medicine residents at Massachusetts General Hospital, resident physicians reported needing more experience in "leading a team", "confronting problem employees", and "resolving interpersonal conflict" [14]. The most frequent ways they hoped to gain those skills were through interactive methods like case discussion, small group discussion, simulation, and lectures [14].

The aim of our scoping review is to identify, examine, and synthesize the most recent literature published on leadership training in undergraduate medical education and to consider classifications and characteristics of leadership interventions and outcome measures and to determine the possibility of conducting an updated systematic review. Our hope is that this scoping review may be used to help develop medical students' leadership skills and explore the gaps outlined by previous systematic reviews and whether they have been filled in the most recent literature [8, 10]. In order to do so, we used a leadership domain framework previously outlined in the literature, which we hope may be used to aid in the future development of uniform leadership competencies for US medical education, as well as to enhance additional comparison of leadership training interventions. Finally, we aim to help steer future leadership development programs by highlighting areas where current literature is lacking in order to reinforcing the core skills needed to become effective clinical and managerial leaders as resident physicians. Some of those skills include collaboration, understanding the fluidity of leadership, and to synthesize various information to produce a final decision according to one focus group study of clinicians [15]. Additionally, in another leadership program for internal medicine residents at The Ohio State University, some hallmark curricular topics included "leadership in medicine", "leadership versus management", "professionalism", "leadership styles", "conflict management", "team decision-making and bias", and "communication in multidisciplinary teams" [16].

Method

We comprehensively searched both the PubMed and the Education Resources Information Center (ERIC) databases. We included articles if they described a leadership intervention in medical education published from 2015 to 2020, were written in English, and available in full text. We used search terms including medical school, undergraduate medical education, medical students, leadership development, leadership skills, leadership identity, leadership training, and leadership program. Of the 152 articles we retrieved, 55 were identified as potential candidates for full-text screening, and

Fig. 1 Article selection process [17]. *One Study had a repeated methodology, but separate publications with different outcome measurements. That intervention was only included once except for the consideration of evaluation measures which varied between the two publications. **Although the "current standards and needs" articles were not included in the analysis, they were used as background information and many were cited in the introduction

| Identification | Records identified through database searching (n=147) | Additional records identified through other sources (n=5) |

Records after duplicates removed (n=152)

Records screened (n=152) → Records excluded (n=97)

Full-text articles assessed for eligibility (n=55) → Full-text articles excluded (n=19)
• Proposal Only (n=5)
• Current Standards or Needs (n=14)**

Studies included (n=35,36)*

36 articles were ultimately selected for review, with one repeated intervention program, leaving 35 articles for full review, except for the different outcome assessment measures in the repeated intervention papers; a summary of this selection process can be found in Fig. 1.

We created a data charting spreadsheet to extract data on the country of individual studies, intervention target population, type of intervention, leadership domain coverage, delivery method, and outcome assessment; a truncated version of the spreadsheet can be found in Online Resource 1. We used a curricular content classification as a conceptual framework to identify common curricular themes and also attempted to standardize the type of program, method of teaching, and outcome measurement for more uniform analysis and comparison. We chose to utilize the classification by Mangrulkar et al. which defined six primary curricular content domains: leadership, change agency, teamwork, interprofessionalism, evidence-based medicine and practice, and professionalism and ethics [18]. Sub points in each category were also examined to drive the curricular content classifications and were compared with the Medical Leadership Competency Framework outlined by the National Health System in the UK in order to further validate the content coverage model we chose to use [19].

Results

The selected studies showed a wide range of representation from different countries. The USA represented 68.57% ($n = 24$) of the interventions studied, followed by the UK 8.57% ($n = 3$). Other countries of studies included Australia, Belgium, Brazil, Canada, Iran, and India. Studies were included from multiple nations in order to be as inclusive as possible with understanding leadership in medicine. Although there may be differences in the medical education systems and process for providing care, some of the leadership traits and skills gained abroad may be a beneficial addition to the health care system of the USA.

The targeted population for intervention was classified into several different groups based upon the descriptions provided in the literature. Preclinical ($n = 14$, 40.00%) included interventions taking place during the first and/or second years of medical school, while clinical ($n = 6$, 17.14%) included third and/or fourth years. Longitudinal programs ($n = 10$, 28.57%) were defined as including three or more years of undergraduate education. Some of the interventions did not fit into this model and were either focused on attending physicians ($n = 3$, 8.57%) or a combination of resident physicians and medical students ($n = 2$, 5.71%). Those which focused on attending

or resident physicians were primarily focused on their own development as mentors to then transfer such skills to medical students, and thus were also included in the analysis.

Type of Leadership Intervention

Reviewed studies employed different type of intervention that we categorized as:

- Workshops—a single occurrence, lasting less than 3 days total
- Stand-alone non-curricular course—a course which would not be reflected on a student transcript or be counted as credit for graduation
- Stand-alone curricular course—a course would be reported on the students' transcripts and be counted as credit for graduation

Out of the 35 primary studies, the most frequent delivery method was a stand-alone curricular course ($n=9$, 25.71%), closely followed by workshops ($n=7$, 20.00%), student organizations ($n=6$, 17.14%), and stand-alone non-curricular courses ($n=5$, 14.29%). Less frequent program types included full curriculum integration ($n=3$, 8.57%), activities and curricular tracks (not required by all students), both ($n=2$, 5.71%), and one module ($n=1$, 2.86%).

Leadership Content Coverage

We examined all of the studies for their content coverage based on the leadership domains described in the Methodology section by Mangrulkar et al. [18]. The summary of these six domains is found in Fig. 2. Notably, the three domains with the greatest representation in these studies were leadership ($n=27$, 77.14%), change agency ($n=23$, 65.71%), and teamwork ($n=29$, 82.86%), while the lowest by far was professionalism and ethics ($n=11$, 31.43%). Modestly, evidence-based medicine and practice and interprofessionalism fell between those two groups, both with $n=20$, 57.14%.

Delivery Method

Many different delivery methods of intervention were identified and fell into several categories: community engagement, extracurricular activity, clinical experience, assessments and projects, medical students as educators, mentoring, interactive sessions, and didactics/lectures. We defined several major categories by including constituent items which were related, which included didactics/lectures/modules (lectures $n=22$, modules $n=2$), interactive sessions (role play/case scenarios $n=8$, problem solving/team based learning $n=12$, group discussion $n=17$, group activities $n=7$, and skills sessions $n=9$), mentoring (physician mentoring $n=13$, peer mentoring $n=3$), assessments, and projects (written assignments $n=5$, projects $n=15$, presentations $n=5$, and self/group assessment, $n=12$). There were an additional four categories which did not fit a specific modality and were left alone, including medical students as educators, community engagement, extracurricular activities, and clinical exposure. A frequency plot of the major categories we defined is found in Fig. 3.

The most frequent methods of instructional delivery were interactive sessions ($n=53$) and assessments and projects ($n=37$) by far, with a moderate level of didactics ($n=24$) and mentoring ($n=16$), with limited representation of the other categories comparatively. There were several curricula which involved multiple types of interactive sessions, explaining the high frequency of the interactive category. Many interventions also utilized more than one method of teaching, and we listed all of the methods utilized.

Fig. 2 Leadership domain coverage summary
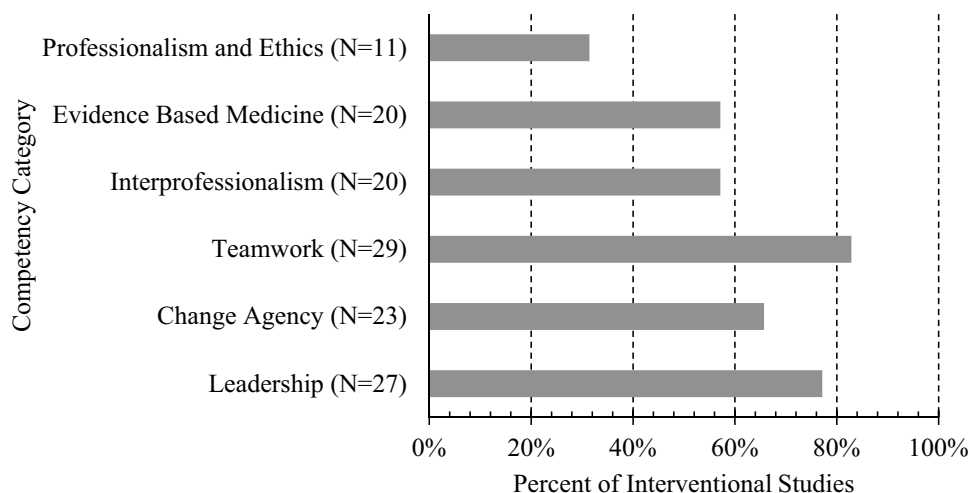
Fig. 3 Teaching methodologies
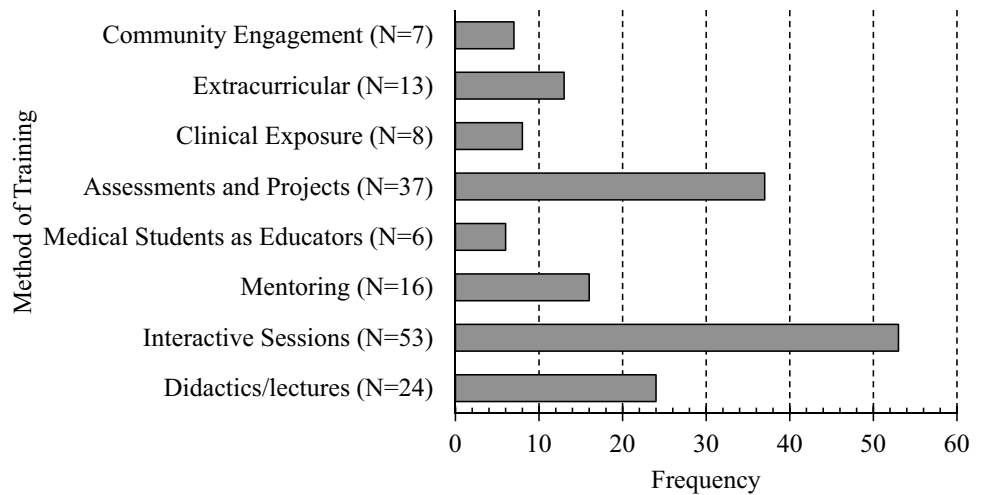
Outcome Assessment Methods

The assessment methods were widely varied among the different types of leadership interventions. By far the most popular assessment method was an in-house survey ($n=18$) [20–38]. But, a number of existing or validated tools ($n=11$) were used, including the Ottawa Crisis Resource Management Global Ranking Scale [39], FourCe-PITO Framework Assessment [40], Jefferson Teamwork Observation Guide [41], Kornives LID [42], the Medical Leadership Competency Framework (MLCF) [43], Kirtpatrick's Four Levels of Evaluation [21, 43], and the Kane-Blates Leadership Survey [44]. Further, we classified verbal evaluation ($n=4$) to include interviews and focus groups, formal evaluations ($n=4$) to include quizzes, a course grade, or faculty evaluation, and those which were considered "other" ($n=3$) included course evaluations, other quantitative data, or an intervention which did not have results to report at the time of publication. There were two other categories without different consistent groupings: individual reflections ($n=5$) and projects or project proposals ($n=8$).

A complete summary of the studies reviewed, including their leadership content coverage and outcome assessment methodologies is available in Online Resource 1 [52–60].

Discussion

There is a variation in content coverage in the interventions studied. In part, this may be due to the integration of the later curricular domains, interprofessionalism, evidence-based medicine and practice, and professionalism and ethics into other components of medical education. As noted in the introduction, many leadership components are best learned through practice and integration into the curriculum. Because of that, some of these domains may be better covered through the rest of the undergraduate medical education curriculum and would not necessarily be reflected in interventional studies relating to leadership, and instead be found as interventions in their more specific content areas. However, it does still highlight an absence in the holistic development of leadership skills in medical students and a focus for new intervention development that synthesizes leadership and its relationship to those domains. This concept is further supported by the focus on management skills in three different leadership training proposal articles, focusing on the managerial demands of physicians and the need to train physicians in those areas, albeit through different means, but still under the domain of evidence-based medicine and practice [45–47].

The constant difficulty in undergraduate medical education is the compromise between adding more content into an already content dense education [8]. However, based on the discrepancies found in our assessment of the existing literature, there appears to be a gap in training as it relates to required management and leadership skills. As many of the studies suggested, it is important for all students to have leadership and management skills because all physicians will have to lead at some point in their careers. Despite this axiom, most of the intervention-based learning experiences were not mandatory and often optional either by means of involvement in a specific student organization, workshop, elective course, or a specific track of medical education as expanded on in the "Type of Intervention" in the "Results" section. In one notable example from the University of Michigan, it was found that there was limited success in an experimental, required curriculum for all students, which may signal that integrated efforts may not produce the most robust response to the training, despite students wanting to receive this education on the whole [48]. Thus, while a goal of mandatory basic education should continue to be held in regard, further study needs to be done on the best curricular

and operational methodology to affect students' leadership development.

The most striking differences in the intervention-based data are that the significant level interactive methodologies are used in leadership training, with a frequency of 53 varying interactive methods out of 35 total studies considered, because many studies utilized more than one interactive method. Hands-on leadership training was referenced as a preference of students, as seen in the survey of Massachusetts General residents, as well as the qualitative responses from student facilitators in one of the interventions reviewed [14, 49]. The use of such interactive experiences also enhanced the ability to practice specific skills in teamwork as a function of leadership. For example, the study by Earis et al. utilized a military style training exercise to increase teamwork, and students described increasing their abilities in listening and communicating effectively, valuing of command tasks, and gaining confidence and contributing in the group [50]. In total, although interactive course work and activities may be more resource intensive and logistically taxing, it is the preferred method of students and was the most frequent teaching method used in the most recent literature.

Somewhat surprisingly, the importance of student organizations and institutional participation was highlighted in many ways. From what is currently important and present in undergraduate medical education as reported by US medical school deans, to the community service component evaluated in Singapore, there is already a robust identification of the importance of student engagement [4, 6]. Those same sentiments also echo through graduate medical education selection in reference to emergency medicine residency selection, which noted the importance of student organizations in building leadership skills [13]. There also was a notable focus on students' engagement at the student organization and institutional level based upon the interventional studies evaluated, with 17.14% ($n = 6$) of the studies directly involving student organizations as the overarching type of intervention and a frequency of $n = 13$ for extracurricular activities as a method of leadership training.

Additionally, methods of evaluating the leadership skills and the methods used were often through an in-house survey designed by the investigators. The frequent use of non-standardized tools for evaluation underscore another need in leadership development in the USA specifically—a consensus for the use of a validated assessment instrument and an agreed upon, competency—based leadership model with clear curricular goals, not unlike what Mangrulkar et al. described. Such a model would allow for uniform classification of curricular goals and outcomes and provide a framework for research focus and overarching curricular goals moving forward. The absence of that unified framework also resulted in a limitation of our categorization of current curricular domain coverage, representing inherent limitations in this review, where studies had to be generalized to fit the framework, rather than the interventions being driven by that framework initially. Development of those uniform standards not only would be able to guide the intervention development, but a uniform assessment in the skills gained as a result.

There were further limits to this literature review as well. As a scoping review, this review was limited in its scope in regard to the literature search process including potential selection bias, as well as limited assessment of the quality of the included studies, a structural issue of this type of review, identified by Grant et al. [51]. While some studies did make reference to long-term follow up as to the maintenance of these skills, it was not a significant enough number to quantify, so there may be loss of these skills later on, especially if the intervention was a single activity or class period, representing both a limitation of our own review's validity and conclusions, as well as a gap that the field may need to move toward in future interventions.

Conclusions

Physicians are quickly being called upon to lead, not only because of the SARS-CoV-2 crisis, but because of the current model of an interdisciplinary medical team, with an increasing component requiring business and management knowledge. There is consensus that this leadership training needs to begin in undergraduate medical education, but there has not been a consensus curricular content, teaching modalities, or evaluation framework leading to a uniformly prepared resident physician which is widely accepted. There have been many attempts to develop different programs to address this need, but very few are required by all medical students. However, one common theme among the examined interventions for leadership development implies a focus on student engagement, through methods of teaching, as well as a focus on student organizations. Among interventions, it appears there has been a consistent curriculum that revolves around the most traditional components of leadership development, general leadership, change agency, and teamwork. But in this scoping review, there have been fewer interventions focused on more indirect but needed knowledge, like interprofessionalism, evidence-based medicine and practice, and professionalism and ethics as they relate to, and define, leadership. Moving forward, leadership-based interventions may be more effective if geared toward a wider audience, encompassing most, if not all, medical students and other health professions students, as well as highlighting a diverse curriculum focusing on all of the components of

leadership and management that the contemporary physician needs to function as an effective and efficient leader.

Declarations

Competing Interest The authors declare no competing interests.

References

1. Gabel S. Expanding the scope of leadership training in medicine. Acad Med. 2014;89:848–52.
2. Merriam-Webster Leadership. 2021.
3. Arnold L, Cuddy PG, Hathaway SB, Quaintance JL, Kanter SL. Medical school factors that prepare students to become leaders in medicine. Acad Med [Internet]. 2018;93:274–82. Available from: http://journals.lww.com/00001888-201802000-00035.
4. Loh AZ, Tan JS, Lee JJ, Koh GC. Voluntary community service in medical school: a qualitative study on student leaders' motivations, experiences, and outcomes. Med Teach [Internet]. 2016;38:683–90. Available from: https://www.tandfonline.com/doi/full/https://doi.org/10.3109/0142159X.2016.1150985.
5. Amalba A, Abantanga FA, Scherpbier AJJA, van Mook WNKA. Community-based education: the influence of role modeling on career choice and practice location. Med Teach [Internet]. 2017;39:174–80. Available from: https://www.tandfonline.com/doi/full/https://doi.org/10.1080/0142159X.2016.1246711.
6. Neeley SM, Clyne B, Resnick-Ault D. The state of leadership education in US medical schools: results of a national survey. Med Educ Online [Internet]. 2017;22:1301697. Available from: https://www.tandfonline.com/doi/full/https://doi.org/10.1080/10872981.2017.1301697.
7. Varkey P, Peloquin J, Reed D, Lindor K, Harris I. Leadership curriculum in undergraduate medical education: a study of student and faculty perspectives. Med Teach. 2009;31:244–50.
8. Abbas MR, Quince TA, Wood DF, Benson JA. Attitudes of medical students to medical leadership and management: a systematic review to inform curriculum development. BMC Med Educ [Internet]. BioMed Central Ltd; 2011;11:93. Available from: http://www.biomedcentral.com/1472-6920/11/93.
9. Maddalena V. Leadership training for undergraduate medical students. Leadersh Heal Serv. 2016;29:348–51.
10. Lyons O, Su'a B, Locke M, Hill A. A systematic review of leadership training for medical students. N Z Med J [Internet]. 2018;131:75–84. Available from: http://www.ncbi.nlm.nih.gov/pubmed/29346359.
11. Gorsky D, MacLeod A. Shifting norms and expectations for medical school leaders: a textual analysis of career advertisements 2000–2004 cf. 2010–2014. J High Educ Policy Manag [Internet]. 2016;38:5–18. Available from: http://www.tandfonline.com/doi/full/https://doi.org/10.1080/1360080X.2015.1126893.
12. Pingleton SK, Jones EVM, Rosolowski TA, Zimmerman MK. Silent bias: challenges, obstacles, and strategies for leadership development in academic medicine-lessons from oral histories of women professors at the University of Kansas. Acad Med [Internet]. 2016;91:1151–7. Available from: http://journals.lww.com/00001888-201608000-00029.
13. Shanahan R, Rosen B, Schofer J, Fisher AS, Wald D, Weiner S, et al. Medical student leadership in emergency medicine. J Emerg Med [Internet]. Elsevier Inc; 2020;1–3. Available from: https://doi.org/10.1016/j.jemermed.2020.02.023.
14. Fraser TN, Blumenthal DM, Bernard K, Lyasere C. Assessment of leadership training needs of internal medicine residents at the Massachusetts General Hospital. Baylor Univ Med Cent Proc [Internet]. 2015;28:317–20. Available from: https://www.tandfonline.com/doi/full/https://doi.org/10.1080/08998280.2015.11929260.
15. Sonnenberg LK, Pritchard-Wiart L, Busari J. The resident physician as leader within the healthcare team: an exploratory inquiry into the perspectives of interprofessional clinicians. Leadersh Heal Serv. 2018;31:167–82.
16. Moore JM, Wininger DA, Martin B. Leadership for all: an internal medicine residency leadership development program. J Grad Med Educ. 2016;8:587–91.
17. Peters MDJ, Godfrey CM, Khalil H, McInerney P, Parker D, Soares CB. Guidance for conducting systematic scoping reviews. Int J Evid Based Healthc. 2015;13:141–6.
18. Mangrulkar RS, Tsai A, Cox SM, Halaas GW, Nelson EA, Nesse RE, et al. A proposed shared vision for leadership development for all medical students: a call from a coalition of diverse medical schools. Teach Learn Med [Internet]. Routledge; 2020;0:1–8. Available from: https://doi.org/10.1080/10401334.2020.1754835.
19. NHS Institute for Innovation and Improvement and Academy of Medical Royal Colleges. Medical Leadership Competency Framework: Enhancing Engagement in Medical Leadership. 2010.
20. Uehlinger FD, Freeman DA, Waldner CL. The One Health Leadership Experience at the University of Saskatchewan, Canada. J Vet Med Educ [Internet]. 2019;46:172–83. Available from: https://jvme.utpjournals.press/doi/https://doi.org/10.3138/jvme.0617-082r.
21. Hopkins J, Fassiotto M, Ku MC, Mammo D, Valantine H. Designing a physician leadership development program based on effective models of physician education. Health Care Manage Rev [Internet]. 2018;43:293–302. Available from: http://journals.lww.com/00004010-201810000-00004.
22. Sokal-Gutierrez K, Ivey SL, Garcia RM, Azzam A. Evaluation of the Program in Medical Education for the Urban Underserved (PRIME-US) at the UC Berkeley–UCSF Joint Medical Program (JMP): The First 4 Years. Teach Learn Med [Internet]. 2015;27:189–96. Available from: http://www.tandfonline.com/doi/full/https://doi.org/10.1080/10401334.2015.1011650.
23. Meador CB, Parang B, Musser MA, Haliyur R, Owens DA, Dermody TS. A workshop on leadership for senior MD–PhD students. Med Educ Online [Internet]. 2016;21:31534. Available from: https://www.tandfonline.com/doi/full/https://doi.org/10.3402/meo.v21.31534.
24. Martins AC, Oliveira FRA, Delfino BM, Pereira TM, de Moraes FHP, Barbosa GV, et al. How we enhanced medical academics skills and reduced social inequities using an academic teaching program. Med Teach [Internet]. 2015;37:1003–7. Available from: http://www.tandfonline.com/doi/full/https://doi.org/10.3109/0142159X.2014.970618.

25. Sandoval RS, Afolabi T, Said J, Dunleavy S, Chatterjee A, Ölveczky D. Building a tool kit for medical and dental students: addressing microaggressions and discrimination on the wards. MedEdPORTAL [Internet]. 2020;16:mep_2374–8265.10893. Available from: http://www.mededportal.org/doi/https://doi.org/10.15766/mep_2374-8265.10893.

26. Black J, Bauer K, Spano G, Voelkel S, Palombaro K. Grand rounds: a method for improving student learning and client care continuity in a student-run physical therapy pro bono. J Scholarsh Teach Learn [Internet]. 2017;17:68–88. Available from: http://dx.doi.org/https://doi.org/10.14434/josotl.v17i3.21158.

27. Lawson L, Lake D, Lazorick S, Reeder T, Garris J, Baxley EG. Developing tomorrow's leaders: a medical student distinction track in health system transformation and leadership. Acad Med [Internet]. 2019;94:358–63. Available from: http://journals.lww.com/00001888-201903000-00027.

28. Born KB, Moriates C, Valencia V, Kerssens M, Wong BM. Learners as leaders: a global groundswell of students leading choosing wisely initiatives in medical education. Acad Med [Internet]. 2019;94:1699–703. Available from: http://journals.lww.com/00001888-201911000-00027.

29. Matthews JH, Morley GL, Crossley E, Bhanderi S. Teaching leadership: the medical student society model. Clin Teach [Internet]. 2018;15:145–50. Available from: http://doi.wiley.com/https://doi.org/10.1111/tct.12649.

30. Dickerman J, Sánchez JP, Portela-Martinez M, Roldan E. Leadership and academic medicine: preparing medical students and residents to be effective leaders for the 21st century. MedEdPORTAL [Internet]. 2018;14:mep_2374–8265.10677. Available from: http://www.mededportal.org/doi/https://doi.org/10.15766/mep_2374-8265.10677.

31. Kelly C, Coutinho AJ, Goldgar C, Gonsalves W, Gutkin C, Kellerman R, et al. Collaborating to achieve the optimal family medicine workforce. Fam Med [Internet]. 2019;51:149–58. Available from: https://journals.stfm.org/familymedicine/2019/february/kelly-2018-0296/.

32. Hsiang EY, Breithaupt AG, Su P, Rogers AT, Milbar N, Desai S V. Medical student healthcare consulting groups: a novel way to train the next generation of physician-executives. Med Teach [Internet]. Informa UK Ltd.; 2018;40:207–10. Available from: https://doi.org/10.1080/0142159X.2017.1387647.

33. Andre C, Deerin J, Leykum L. Students helping students: vertical peer mentoring to enhance the medical school experience. BMC Res Notes [Internet]. BioMed Central; 2017;10:176. Available from: http://bmcresnotes.biomedcentral.com/articles/https://doi.org/10.1186/s13104-017-2498-8.

34. Dhaese SM, Van de Caveye I, Bussche P, Bogaert S, De Maeseneer J. Student participation: to the benefit of both the student and the faculty. Educ Heal [Internet]. 2015;28:79. Available from: http://www.educationforhealth.net/text.asp?2015/28/1/79/161921.

35. Idso JM, Helmen ZM, Hueston WJ, Meurer JR. Student leadership development initiative: a pilot for a sustainable, replicable model for incorporating leadership into medical education. WMJ [Internet]. 2019;118:39–41. Available from: http://www.ncbi.nlm.nih.gov/pubmed/31083833.

36. Richard K, Noujaim M, Thorndyke LE, Fischer MA. Preparing medical students to be physician leaders: a leadership training program for students designed and led by students. MedEdPORTAL [Internet]. 2019;15:mep_2374–8265.10863. Available from: http://www.mededportal.org/doi/https://doi.org/10.15766/mep_2374-8265.10863.

37. Moran D, Edwardson J, Cuneo CN, Tackett S, Aluri J, Kironji A, et al. Development of global health education at Johns Hopkins University School of Medicine: a student-driven initiative. Med Educ Online [Internet]. 2015;20:28632. Available from: https://www.tandfonline.com/doi/full/https://doi.org/10.3402/meo.v20.28632.

38. Komattil R, Hande SH, Mohammed CA, Subramaniam B. Evaluation of a personal and professional development module in an undergraduate medical curriculum in India. Korean J Med Educ [Internet]. 2016;28:117–21. Available from: http://kjme.kr/journal/view.php?doi=https://doi.org/10.3946/kjme.2016.17.

39. Ellington M, Farrukh S. Are battlefield and prehospital trauma scenarios an effective educational tool to teach leadership and crisis resource management skills to undergraduate medical students? J R Army Med Corps [Internet]. 2019;jramc-2018–001146. Available from: http://jramc.bmj.com/lookup/doi/https://doi.org/10.1136/jramc-2018-001146.

40. Barry ES, Grunberg NE, Kleber HG, McManigle JE, Schoomaker EB. A four-year medical school leader and leadership education and development program. Int J Med Educ [Internet]. 2018;9:99–100. Available from: http://www.ijme.net/archive/9/a-four-year-medical-school-leader/.

41. Zhang XC, Balakumar A, Rodriguez C, Sielicki A, Papanagnou D. The Zoom picture book game: a creative way to promote teamwork in undergraduate medical education. Cureus [Internet]. 2020;12. Available from: https://www.cureus.com/articles/26491-the-zoom-picture-book-game-a-creative-way-to-promote-teamwork-in-undergraduate-medical-education.

42. Alizadeh M, Mirzazadeh A, Parmelee DX, Peyton E, Mehrdad N, Janani L, et al. Leadership identity development through reflection and feedback in team-based learning medical student teams. Teach Learn Med [Internet]. Taylor & Francis; 2018;30:76–83. Available from: https://doi.org/10.1080/10401334.2017.1331134.

43. Portney DS, VonAchen P, Standiford T, Carey MR, Vu J, Kirst N, et al. Medical student consulting: providing students leadership and business opportunities while positively impacting the community. MedEdPORTAL [Internet]. 2019;15:mep_2374–8265.10838. Available from: http://www.mededportal.org/doi/https://doi.org/10.15766/mep_2374-8265.10838.

44. Chao C, Wooten K, Spratt H, Sarraj H, Aronson J, Hommel J, et al. Integration of leadership training for graduate and medical students engaged in translational biomedical research: examining self-efficacy and self-insight. J Clin Transl Sci [Internet]. 2018;2:48–52. Available from: https://www.cambridge.org/core/product/identifier/S2059866118000092/type/journal_article.

45. Sonsale A, Bharamgoudar R. Equipping future doctors: incorporating management and leadership into medical curriculums in the United Kingdom. Perspect Med Educ [Internet]. 2017;6:71–5. Available from: http://link.springer.com/https://doi.org/10.1007/s40037-017-0327-3.

46. Jena AB. Leadership & professional development: searching for ideas close to home. J Hosp Med [Internet]. 2019;14:551–551. Available from: https://www.journalofhospitalmedicine.com/jhospmed/article/206920/hospital-medicine/leadership-professional-development-searching-ideas-close.

47. Sayampanathan A, Wilnard TYT. Leadership development in undergraduate education. Clin Teach [Internet]. 2016;13:374–5. Available from: http://doi.wiley.com/https://doi.org/10.1111/tct.12387.

48. Wagenschutz H, McKean EL, Mangrulkar R, Zurales K, Santen S. A first-year leadership programme for medical students. Clin Teach [Internet]. 2019;16:623–9. Available from: https://onlinelibrary.wiley.com/doi/abs/https://doi.org/10.1111/tct.13005.

49. Burgess A, van Diggele C, Mellis C. Students as facilitators in a teacher training program: motivation for leadership roles. Adv Med Educ Pract [Internet]. 2015;615. Available from: https://www.dovepress.com/students-as-facilitators-in-a-teacher-training-program-motivation-for--peer-reviewed-article-AMEP.

50. Earis J, Garner J, Haddock D, Jenkins J, Jha V. Medical students' unique experience of army leadership training: a qualitative study.

J R Army Med Corps [Internet]. 2017;163:329–32. Available from: http://jramc.bmj.com/lookup/doi/https://doi.org/10.1136/jramc-2016-000731.

51. Grant MJ, Booth A. A typology of reviews: an analysis of 14 review types and associated methodologies. Health Info Libr J. 2009;26:91–108.

52. Ginzburg SB, Deutsch S, Bellissimo J, Elkowitz DE, Stern JN, Lucito R. Integration of leadership training into a problem/case-based learning program for first- and second-year medical students. Adv Med Educ Pract [Internet]. 2018;Volume 9:221–6. Available from: https://www.dovepress.com/integration-of-leadership-training-into-a-problemcase-based-learning-p-peer-reviewed-article-AMEP.

53. Ginzburg SB, Schwartz J, Gerber R, Deutsch S, Elkowitz DE, Ventura-Dipersia C, et al. Assessment of medical students' leadership traits in a problem/case-based learning program. Med Educ Online [Internet]. Taylor & Francis; 2018;23:1542923. Available from: https://doi.org/10.1080/10872981.2018.1542923.

54. Krishnan A, Johnson-Paben R, Arnold CM, Zuo SW, Ho T, Molloy MJ, et al. A student and faculty partnership to develop leaders in primary care at a research-oriented institution. Educ Prim Care [Internet]. 2017;28:171–5. Available from: https://www.tandfonline.com/doi/full/https://doi.org/10.1080/14739879.2016.1258335.

55. Wrenn G, Johnson V, Edukuye O, Seawell M. Academic psychiatry elective: mentored academic leadership development for medical students. Acad Psychiatry [Internet]. 2016;40:434–5. Available from: http://link.springer.com/https://doi.org/10.1007/s40596-015-0444-4.

56. Kelly C, Coutinho AJ, Bhuyan N, Gits A, Alavi M, Ho T, et al. Student and resident involvement in family medicine for America's health. Fam Med [Internet]. 2019;51:166–72. Available from: https://journals.stfm.org/familymedicine/2019/february/coutinho-2018-0291/.

57. Rao SK, Carballo V, Cummings BM, Millham F, Jacobson JO. Developing an interdisciplinary, team-based quality improvement leadership training program for clinicians: the Partners Clinical Process Improvement Leadership Program. Am J Med Qual [Internet]. 2017;32:271–7. Available from: http://journals.sagepub.com/doi/https://doi.org/10.1177/1062860616648773.

58. Kallail KJ, Shaw P, Hughes T, Berardo B. Enriching medical student learning experiences. J Med Educ Curric Dev [Internet]. 2020;7:238212052090216. Available from: http://journals.sagepub.com/doi/https://doi.org/10.1177/2382120520902160.

59. Soni A, Fahey N, Jaffe A, Raithatha S, Raithatha N, Prabhakaran A, et al. RAHI–SATHI Indo-U.S. collaboration: the evolution of a trainee-led twinning model in global health into a multidisciplinary collaborative program. glob Heal Sci Pract [Internet]. 2017;5:152–63. Available from: http://www.ghspjournal.org/lookup/doi/https://doi.org/10.9745/GHSP-D-16-00190.

60. Johnson MO, Gandhi M. A mentor training program improves mentoring competency for researchers working with early-career investigators from underrepresented backgrounds. Adv Heal Sci Educ [Internet]. 2015;20:683–9. Available from: http://link.springer.com/https://doi.org/10.1007/s10459-014-9555-z.