

The Effect of an Educational Intervention Based on the Medical Leadership Competency Framework (MLCF) on Medical Students' Leadership and Management Skills: A Quasi-experimental Study

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Abstract

Background Leadership and management competencies are essential for ensuring safe, high-quality healthcare delivery. However, undergraduate medical curricula often lack structured training and systematic evaluation in these domains. This study examined the impact of a short course based on the Medical Leadership Competency Framework (MLCF) on medical students' self-reported leadership and management skills.

Methods A quasi-experimental pre–post study was conducted among 34 physiopathology and externship medical students. The intervention consisted of five MLCF-aligned modules, including leadership styles, communication, delegation, feedback, and direction. Each module was delivered through three 2-hour sessions, yielding a total instructional time of approximately 30 hours. A validated 10-item leadership competency scale, scored from 0 to 100, was administered before and after the intervention. Paired t tests were used to compare pre- and post-intervention scores, with a 95% confidence interval.

Results Statistically significant improvements were observed across all leadership and management domains ($p < 0.05$). The largest gains were found in leadership styles and direction, with mean score increases of approximately 20 points and large effect sizes. Overall, 97.1% of participants reported that the course was beneficial, and 82.4% indicated that they would recommend it to their peers.

Conclusion The MLCF-based educational intervention significantly improved medical students' leadership and management competencies, particularly in leadership styles and direction. These findings support the integration of structured leadership and management training into undergraduate medical curricula to enhance the preparedness of future healthcare professionals.

Keywords Leadership; Education, Medical, Undergraduate; Students, Medical; Attitude of Health Personnel; Program Evaluation

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1 Introduction

Physicians increasingly assume leadership roles within interprofessional teams operating in complex health systems, making leadership and management competencies essential for the delivery of safe, high-quality care.^[1,2] Despite growing recognition of their importance, undergraduate medical curricula, including those in Iran, often lack structured, competency-based training and rigorous evaluation in these areas. This gap contributes to a mismatch between physicians' clinical expertise and the skills required to coordinate teams, allocate resources, and lead quality improvement initiatives.^[2-4]

Globally, approaches to leadership education in medicine vary widely and include elective courses, short workshops, and integrated dual-degree programs such as MD, MBA tracks.^[5] To standardize expectations and support the development of undergraduate leadership training, the Medical Leadership Competency Framework (MLCF) was developed. This framework typically encompasses key domains such as leadership styles, effective communication, delegation, feedback, and direction, including planning and implementation.^[6-8] However, published evaluations of undergraduate leadership interventions remain heterogeneous, and studies with robust outcome-focused designs are relatively limited.^[9] In Iran, national policy documents and expert reports have emphasized the importance of management and leadership education for general practitioners, yet formal competency-based modules are inconsistently implemented across medical schools.^[10] Survey evidence indicates that the majority of Iranian medical students express strong interest in training related to management, communication, teamwork, and quality improvement.^[11] Together, these findings underscore the need for concise, competency-based leadership courses that can be feasibly integrated into undergraduate medical education and evaluated using appropriate methodological approaches. To address this gap, we developed a short educational course aligned with the MLCF, covering five core domains, including leadership styles, communication, delegation, feedback, and direction. We evaluated the impact of this intervention using a quasi-experimental single-group pre-post design. The primary aim of this study was to assess whether participation in the course was associated with changes in medical students' self-reported leadership and management confidence. To our knowledge, this study represents one of the first evaluations of an MLCF-based undergraduate leadership intervention in Iran and contributes empirical evidence on domain-specific and overall effect sizes with corresponding confidence intervals.

2 Methods

Study design and setting

A single-group quasi-experimental pre-post study was conducted at Urmia University of Medical Sciences (UMSU), Iran, between August and September 2024. The study evaluated a short, competency-based educational course aligned with the Medical Leadership Competency Framework (MLCF) among medical students in the physiopathology (preclinical) and externship (clinical) phases.

Participants and recruitment

All students enrolled in the physiopathology and externship phases at UMSU ($N = 873$) were invited to participate through posters, the faculty website, and official social media channels. Participation was voluntary. Interested students registered and attended an orientation session prior to course initiation. The analytic sample included students who completed both the pre-test and post-test questionnaires. A participant flow diagram describing invitations, enrolment, attrition, and the final analytic sample is presented in the Results section.

Inclusion and exclusion criteria

Inclusion criteria were current enrollment in the physiopathology or externship phase, no participation in a similar leadership or management course within the previous 12 months, and provision of written informed consent. Exclusion criteria included withdrawal during the course, accumulation of four or more total absences or two or more consecutive absences within any domain, and more than 20% missing responses on either the pre-test or post-test questionnaire.

Intervention (MLCF-aligned course)

The intervention consisted of five modules aligned with the MLCF domains, including leadership styles, effective communication, delegation, giving and receiving feedback, and direction, defined as planning and implementation (Table 1). Each module was delivered through three 2-hour sessions conducted across two non-consecutive days. Two sessions were held on a Thursday to minimize conflicts with the formal curriculum, followed by a consolidation session conducted 5 to 7 days later on a non-Thursday day. An orientation session preceded the course, during which the pre-test questionnaire was administered.

In total, participants attended 15 instructional sessions, corresponding to approximately 30 hours of instruction. Teaching methods included brief mini-lectures, case vignettes, role-play exercises, small-group discussions, guided reflection, scenario-based tasks, and short knowledge checks. Facilitator checklists and standardized rubrics were used to support instructional fidelity and formative assessment.^[2]

Table 1 Intervention timetable and instructional formats (MLCF-aligned)

Domain (MLCF)	Sessions	Duration	Schedule	Instructional methods	Assessment & materials
Leadership styles	1–2 + 3	2 h each	Day 1 (Thu): S1 & S2 with break Day 2 (non-Thu, 5–7 d later): S3 (consolidation)	Mini-lecture, case vignettes, small-group discussion, guided reflection on leadership roles	Brief knowledge checks, facilitator checklist, slides/handouts; post-test per protocol at consolidation
Effective communication	1–2 + 3	2 h each	Thu + non-Thu	Role-play (SBAR/closed-loop), debrief, communication drills, peer observation	Peer-feedback rubric, facilitator checklist, short quiz; media clips/handouts
Delegation	1–2 + 3	2 h each	Thu + non-Thu	Team tasks with rotating lead, scenario-based delegation, workload triage	Scenario checklist, reflection prompt, short quiz; task cards
Giving/receiving feedback	1–2 + 3	2 h each	Thu + non-Thu	Feedback frameworks (e.g., SBI), paired practice, micro-teaching, debrief	Feedback rubric, self-assessment, short quiz; cue cards
Direction (planning/implementation)	1–2 + 3	2 h each	Thu + non-Thu	Planning workshop, goal setting, Gantt/driver diagram basics, PDSA mini-cycle	Plan rubric, brief knowledge check, short quiz; templates

- Each domain was delivered in three 2-hour sessions across two non-consecutive days: two sessions on Thursday (to avoid curricular conflicts) and one consolidation session 5–7 days later on a non-Thursday day.
- A course orientation preceded instruction; the pre-test was administered immediately before the first instructional block. The post-test was administered at consolidation per study protocol.
- MD is defined elsewhere as Post – Pre; positive values indicate improvement.

Measures

Leadership and management competencies were assessed using a 10-item instrument scored on a 0 to 100 scale, adapted from Richard et al. (2019). The instrument was translated into Persian and reviewed by 10 faculty experts to establish face and content validity. In a pilot study involving 20 students, internal consistency was acceptable, with a Cronbach's alpha of 0.81. Pre-test and post-test responses were matched using anonymous four-digit codes. The primary measure was the total score, while domain-level scores were summarized descriptively.^[2]

Outcomes

The primary outcome was the mean change in the total instrument score between the post-test and pre-test assessments. Secondary outcomes included mean changes in each domain score, participants' perceptions of course usefulness, defined as the proportion reporting the course as beneficial, and recommendation intent, defined as the proportion willing to recommend the course to peers. Exploratory analyses examined associations between change scores and participant characteristics, including age, sex, training phase, and prior managerial experience.

Statistical analysis

Data were analyzed using parametric statistical methods following inspection of distributional assumptions. Normality of paired difference scores was assessed using the Shapiro–Wilk test. Primary analyses employed paired t tests to compare pre-test and post-test mean scores. Results are reported as Mean Difference, defined as post-test minus pre-test, with corresponding 95% confidence intervals and two-sided p values, using a significance level of $\alpha = 0.05$. Exploratory analyses included Pearson correlation coefficients for continuous variables and independent t tests or one-way analysis of variance for group comparisons.

3 Results

Figure 1 presents the flow of participants from initial invitation to inclusion in the final analytic sample, including reasons for exclusion during the course. Among enrolled students, the final response rate was 54.8% (34 of 62 participants).

Baseline characteristics of the analyzed sample are summarized below. The mean age of participants was 21.88 ± 1.83 years, with a range of 20 to 28 years. Female students constituted 52.9% of the sample, and 55.9% were in the physiopathology phase of training. Two

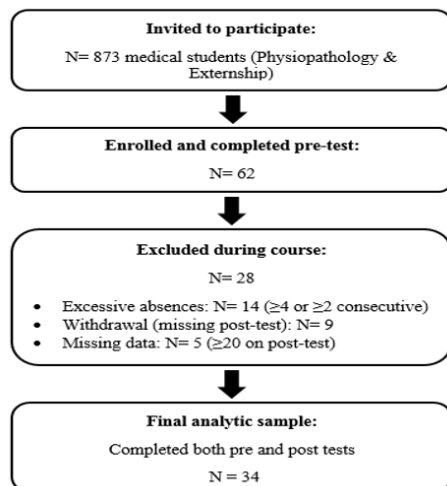


Figure 1 Participant flow through the study, including invitations, enrollment, exclusions, and final analytic sample.

participants reported prior managerial experience, with a mean duration of 1.5 years. Reasons for attending the course were diverse and included interest in leadership and management knowledge, interest in managerial career pathways, interest in management-related job opportunities, preparation for effective interaction with managers during clinical practice, and participation alongside peers. Multiple responses were permitted. Participant perceptions of the course are reported next. The communication module was most frequently identified as the most useful component, reported by

41.2% of respondents. Approximately 60% of participants indicated that at least one module was surprising or particularly engaging, while 5.9% reported that one or more modules did not meet their expectations. Overall, 97.1% of participants considered the course beneficial for their current phase of training, and 88.2% perceived it as beneficial for future professional practice. In addition, 82.4% indicated that they would recommend similar leadership and management training to their peers.

Pre-test to post-test changes in leadership and management competency scores are presented at both the domain and overall levels. Statistically significant improvements were observed across all five domains and for the overall score. The largest gains were noted in leadership styles, with a Mean Difference of 20.50 (95% confidence interval, 14.43 to 26.57), and in direction, defined as program and strategy development, with a Mean Difference of 20.05 (95% confidence interval, 13.46 to 26.64). The feedback domain demonstrated a smaller but statistically significant improvement, with a Mean Difference of 3.79 (95% confidence interval, 1.96 to 5.62). The overall leadership and management competency score increased by a Mean Difference of 15.60 (95% confidence interval, 11.70 to 19.50).

Item-level pre-test and post-test means with standard deviations for each question and domain are presented in [Table 2](#). Domain-level mean differences, corresponding t statistics, 95% confidence intervals, and p values are reported in [Table 3](#).

Table 2 Item-level mean scores ($\pm$ SD) in pre-test and post-test by training domain

Axis of Training	Question	Pre-Test	Post-Test
Leadership Styles	I have strengths that indicate my ability to manage.	Mean $\pm$ SD: 62.82 $\pm$ 14.15	Mean $\pm$ SD: 83.67 $\pm$ 13.37
	I have identified areas within myself that need improvement to become an effective manager.	Mean $\pm$ SD: 58.91 $\pm$ 16.13	Mean $\pm$ SD: 79.08 $\pm$ 14.56
Effective Communication	In teamwork, I communicate effectively with members from diverse backgrounds.	Mean $\pm$ SD: 63.82 $\pm$ 19.04	Mean $\pm$ SD: 81.11 $\pm$ 15.83
	I am able to recognize situations where communication is effective or where improvement is needed.	Mean $\pm$ SD: 61.97 $\pm$ 12.80	Mean $\pm$ SD: 78.00 $\pm$ 12.76
Delegation	When in a team setting, I delegate responsibilities appropriately.	Mean $\pm$ SD: 67.58 $\pm$ 16.22	Mean $\pm$ SD: 81.26 $\pm$ 14.95
	I am aware of my limitations in performing roles and know when and how to seek help.	Mean $\pm$ SD: 62.14 $\pm$ 13.18	Mean $\pm$ SD: 82.52 $\pm$ 15.88
Feedback (Giving and Receiving)	I provide appropriate and effective feedback to others.	Mean $\pm$ SD: 64.67 $\pm$ 16.26	Mean $\pm$ SD: 66.35 $\pm$ 16.24
	When needed, I seek appropriate feedback from a coach (specialist) in a professional manner.	Mean $\pm$ SD: 61.44 $\pm$ 17.42	Mean $\pm$ SD: 67.35 $\pm$ 14.41
Direction/program and Strategy Development	When faced with a challenge or obstacle, I develop a suitable and successful strategy/program.	Mean $\pm$ SD: 63.67 $\pm$ 17.13	Mean $\pm$ SD: 82.67 $\pm$ 11.71
	I use my management/leadership skills to achieve my future goals.	Mean $\pm$ SD: 62.05 $\pm$ 18.60	Mean $\pm$ SD: 83.17 $\pm$ 11.73

Table 3 Pre-test to post-test changes in leadership and management competencies by domain, n = 34

Axis of Training	Pre-Test Mean	Post-Test Mean	Mean Difference	t	95% CI	p value
Leadership Styles	60.86	81.36	20.50	6.87	14.43,26.57	< 0.001
Effective Communication	62.89	79.55	16.66	5.77	10.79,22.53	< 0.001
Delegation	64.86	81.89	17.02	5.93	11.18,22.86	< 0.001
Feedback	63.05	66.85	3.79	4.21	1.96,5.62	< 0.001
Program and Strategy Development	62.86	82.92	20.05	6.19	13.46,26.64	< 0.001
Overall	62.9	78.52	15.60	8.14	11.70,19.50	< 0.001

- All statistical tests were two-sided ($\alpha=0.05$). Effect sizes and 95% CIs are provided to facilitate interpretation.
- Multiple responses were allowed in items assessing reasons for participation; percentages may sum to >100%.

4 Discussion

This study demonstrated that a brief educational course aligned with the Medical Leadership Competency Framework was associated with statistically and educationally meaningful improvements in medical students' self-reported leadership and management competencies. The largest gains were observed in leadership styles and direction, defined as planning and implementation. These findings are consistent with previous evidence indicating that competency-based, modular leadership interventions can produce measurable improvements in learners' perceived leadership confidence.^[2,12]

The domain-level pattern of results aligns with findings from systematic reviews and primary studies showing that short, well-designed leadership courses, particularly those incorporating active learning approaches such as case vignettes, role-play, and small-group work, combined with spaced consolidation, tend to yield substantial gains in leadership-related skills.^[2,13] The large effects observed for leadership styles and direction are comparable to outcomes reported in undergraduate interventions in which structured exposure to role clarification, planning exercises, and applied leadership scenarios resulted in pronounced improvements in learners' confidence to lead teams and set direction.^[13,14] In contrast, the smaller but statistically significant improvement in the feedback domain is consistent with literature suggesting that feedback competencies often require sustained, coached practice and repeated assessment to achieve improvements comparable to those seen in more cognitively oriented or planning-focused domains.^[15,16]

Within the Iranian context, these findings support national policy recommendations that emphasize the integration of competency-based management and leadership education into undergraduate medical curricula.^[17] The observed pattern of domain gains, stronger effects in planning and leadership styles and more modest effects in feedback, mirrors result from Iranian survey and qualitative studies indicating that medical students value managerial competencies but have limited opportunities

for supervised, practice-based learning within existing curricula. The high level of acceptability observed in this study, with 97.1% of participants reporting the course as beneficial, suggests that short, modular leadership courses are feasible in this setting. Nevertheless, attrition and self-selection should be carefully considered when interpreting the generalizability of the findings.

Several features of the intervention likely contributed to the observed improvements. First, explicit alignment with the Medical Leadership Competency Framework provided a clear and structured competency map, allowing teaching and assessment to focus on observable behaviors rather than abstract leadership concepts. Second, the educational design elements employed, including active learning strategies and spaced consolidation, are supported by meta-analytic and narrative review evidence as effective components of leadership training and may have enhanced retention and transfer within a relatively short intervention period. Third, scheduling instructional sessions outside core curricular hours, with Thursday sessions followed by consolidation sessions, may have improved engagement among participants. However, the substantial attrition observed indicates ongoing challenges related to implementation, accessibility, and competing academic demands that warrant further attention.

Based on the present findings and the broader literature, several practical recommendations can be proposed. Short modules aligned with the Medical Leadership Competency Framework should be integrated into undergraduate medical curricula during preclinical and early clinical phases to introduce foundational leadership competencies with minimal disruption to existing timetables.^[15,17] Active and experiential learning methods, including role-play, team-based tasks, and coached feedback, combined with spaced delivery through consolidation sessions, should be prioritized to maximize learning gains and learner engagement.^[7] Domains requiring behavioral change, particularly feedback and teamwork, may benefit from longitudinal reinforcement through simulation-based assessments, objective structured clinical examination leadership stations, supervised team activities, and follow-up

coaching.^[18] In addition, facilitator training and the use of fidelity tools, such as standardized rubrics and checklists, may improve consistency and strengthen the internal validity of educational interventions.^[9] Finally, systematic monitoring of participation and attrition is recommended, with consideration of flexible scheduling, multiple cohort offerings, or targeted incentives to improve completion rates. At the policy level, pilot scale-up with embedded evaluation, including objective performance measures, and multi-institution collaborations may enhance generalizability and sustainability.^[15]

Key strengths of this study include clear alignment with an established competency framework, a pragmatic course design compatible with curricular constraints, and transparent reporting of effect sizes with corresponding 95% confidence intervals, facilitating interpretation beyond statistical significance alone. Several limitations should also be acknowledged. The single-group pre-post design and reliance on self-reported outcomes raise the possibility of response-shift and social desirability biases, which may overestimate true performance improvements. The high attrition rate, from 62 enrolled students to 34 analyzed participants, introduces potential selection bias, as completers may differ from non-completers in motivation or baseline competence. The single-institution setting further limits external validity. In addition, the absence of objective performance measures, such as observed structured clinical examinations or direct observation of team tasks, and the lack of longer-term follow-up restrict conclusions regarding the durability and practical translation of the observed gains.

Future studies should prioritize controlled designs, including randomized or quasi-experimental studies with comparison groups, multi-site implementations, and the inclusion of objective performance outcomes to more robustly evaluate effectiveness and sustainability. Incorporating workplace-based assessments, such as leadership-focused objective structured clinical examination stations, team simulations, and multisource feedback, and assessing outcomes at medium and longer-term follow-up intervals would help clarify whether short leadership courses result in sustained behavior change and improved team performance. In addition, economic and feasibility evaluations are needed to inform scalability across diverse medical schools in Iran and comparable settings.

5 Conclusion

A brief, modular educational intervention aligned with the Medical Leadership Competency Framework was associated with meaningful improvements in medical students' self-reported leadership and management competencies, particularly in leadership styles and planning. These findings support the pragmatic inclusion

of competency-based leadership training within undergraduate medical curricula, while underscoring the need for controlled evaluations, objective outcome measures, and targeted strategies to reduce attrition in future implementations.

Declarations

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Artificial Intelligence Disclosure

The authors declare that no artificial intelligence (AI) tools were used in the preparation or writing of this manuscript.

Authors' Contributions

S.M. contributed to conceptualization, methodology, project coordination, supervision, and manuscript review and editing. M.S. contributed to conceptualization, methodology, investigation, validation, data analysis, and manuscript review and editing. A.P. contributed to investigation, data curation, data analysis, and manuscript review and editing. L.R. contributed to investigation, data curation, data analysis, and manuscript review and editing. All authors read and approved the final version of the manuscript.

Availability of Data and Materials

Anonymized datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request, subject to institutional and ethical approvals.

Conflict of Interest

The authors declare that they have no competing interests.

Consent for Publication

Not applicable.

Ethical Considerations

The study was approved by the Biomedical Research Ethics Committee of Urmia University of Medical Sciences (IR.UMSU. REC.1402.166). Written informed consent was obtained from all participants before enrollment.

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