Evidence-based medical leadership development: a systematic review

Oscar Lyons,1 Robynne George,2 Joao R Galante,3,4 Alexander Mafi,5 Thomas Fordwih,9 Jan Frich,6 Jaason Matthew Geerts7,8

ABSTRACT
Health systems invest significant resources in leadership development for physicians and other health professionals. Competent leadership is considered vital for maintaining and improving quality and patient safety. We carried out this systematic review to synthesise new empirical evidence regarding medical leadership development programme factors which are associated with outcomes at the clinical and organisational levels. Using Ovid MEDLINE, we conducted a database search using both free text and Medical Subject Headings. We then conducted an extensive hand-search of references and of citations in known healthcare leadership development reviews. We applied the Medical Education Research Study Quality Indicator (MERSQI) and the Joanna Briggs Institute (JBI) Critical Appraisal Tool to determine study reliability, and synthesised results using a meta-aggregation approach. 117 studies were included in this systematic review. 28 studies met criteria for higher reliability studies. The median critical appraisal score according to the MERSQI was 8.5/18 and the median critical appraisal score according to the JBI was 3/10. There were recurring causes of low study quality scores related to study design, data analysis and reporting. There was considerable heterogeneity in intervention design and evaluation design. Programmes with internal or mixed faculty were significantly more likely to report organisational outcomes than programmes with external faculty only (p<0.049). Project work and mentoring increased the likelihood of organisational outcomes. No leadership development content area was particularly associated with organisational outcomes. In leadership development programmes in healthcare, external faculty should be used to supplement in-house faculty and not be a replacement for in-house expertise. To facilitate organisational outcomes, interventions should include project work and mentoring. Educational methods appear to be more important for organisational outcomes than specific curriculum content. Improving evaluation design will allow educators and evaluators to more effectively understand factors which are reliably associated with organisational outcomes of leadership development.

INTRODUCTION
Health systems invest significant resources in leadership development for physicians and other health professionals. Competent leadership is considered vital for team effectiveness, for clinical and financial performance and for maintaining and improving quality and patient safety.1–5 Clinical leadership development involves activities to promote leadership competencies among clinicians, while medical leadership development refers to activities centred on doctors.

Research suggests that medical leadership development can improve outcomes at individual, organisational and clinical levels.6–11 Evidence backing medical leadership development activities has, however, been variable in quality.1,7–10 12–15 There has been a particular lack of research and evaluation that goes beyond individual learner feedback and subjective outcomes.6–9 One systematic review of 45 studies evaluating leadership development interventions for doctors found that effective interventions were characterised by the use of multiple learning methods, including seminars and group work, alongside action learning projects in multidisciplinary teams.6 These findings were echoed in a recent study by Geerts et al.,7 who emphasised that plans need to be in place for transferring learning from the intervention into the working environment.

We undertook this systematic review to synthesise recent empirical evidence regarding medical leadership development programme factors associated with outcomes at the clinical and organisational levels. We specifically investigated links between aspects of programme design, delivery and evaluation and improved outcomes. Given the variable quality of studies highlighted in previous reviews,7–9 we applied two validated critical appraisal instruments16 17 to isolate higher reliability findings. This review is the first to apply both instruments in order to identify and synthesise the highest quality empirical evidence in medical leadership development.

METHODS
The design of this review was guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses18 and the Best Evidence in Medical Education (BEME) guide for systematic reviews.19 Our methods were based on the review conducted by Frich et al.,8 with methodological changes drawn from other reviews.7,9 10 14 15 20 Following the BEME recommendations for systematic reviews,19 we hand-searched references and citations of known reviews extensively to supplement our database search. In line with recommendations from Geerts et al.7 and Rosenman et al.,1 we assessed study quality using the Medical Education Research Study Quality Indicator (MERSQI), which is designed to measure the methodological quality of quantitative medical education research studies.16 We added...
the Joanna Briggs Institute (JBI) Critical Appraisal Checklist, which is designed for meta-aggregation of qualitative research and is well-established in healthcare research.

**Search strategy**

We began this review by re-examining the data set identified in the review of leadership development for physicians by Frich et al. With assistance from a specialist librarian at the University of Oxford, we then based our search strategy on Frich et al’s review. Using the Ovid MEDLINE database, we conducted a search using both free text and Medical Subject Headings. The full search terms are listed in the online supplemental material. This search identified 501 unique publications. We then conducted an extensive hand-search of references and of citations in known healthcare leadership development reviews using Web of Science and Google Scholar. This identified an additional 107 studies for possible inclusion, for a total of 608 records for screening (figure 1).

**Inclusion criteria**

We included any peer-reviewed study published in English between January 2000 and January 2020 which:

1. Describes a leadership development intervention (programme, workshop, course and so on).
2. Includes physicians as learners (defined here as any practising doctor post-qualification).
3. Evaluates the leadership development intervention. Qualitative, quantitative and mixed evaluations were included. We excluded studies where leadership development was a minor focus or where the proportion of physicians was lower than 10% of intervention participants.

**Screening process**

Two members of the review team (OL and TF) independently screened all study titles and abstracts for eligibility. Articles that were approved by either reviewer progressed to full-text review.

Two members of the review team independently reviewed for inclusion the full text of all 207 articles that passed the title and abstract screen (TF and RG reviewed half each, OL reviewed all). Where there was disagreement about inclusion, all three reviewers (OL, TF, RG) reached consensus by discussion, with the third reviewer (TF or RG) arbitrating where required.

**Data abstraction**

After screening and reviewing for eligibility, 117 unique studies were included for abstraction and analysis. Data were abstracted and coded for educational setting, methods, content, evaluation methods and outcomes. Outcome data were categorised according to an adapted version of Kirkpatrick’s Framework for evaluation of training programmes (see table 1). One reviewer abstracted and coded all 117 included studies (OL). The second reviewers (RG/JRG/AM/TF) each abstracted and coded at least five studies in full to ensure consistency between reviewers. Data abstraction and coding for all 117 studies was then cross-checked by the second reviewers. Any differences were resolved by consensus, with a third reviewer arbitrating where required. Where possible, statistical tests performed in studies were replicated and checked for accuracy.

**Study quality appraisal**

Previous reviews have shown marked variation in the quality of studies of medical leadership development. To isolate the most reliable evidence linking medical leadership programmes to improved outcomes, two researchers independently critically appraised each included study using the MERSQI and JBI Instruments. Differences in MERSQI and JBI quality score were resolved by consensus, and a third researcher arbitrated where needed.

The MERSQI was applied to all 117 studies. The MERSQI is a validated appraisal tool consisting of 10 items in six domains which relate to design, sampling, type of data collected, validity of evaluation methods, analysis and outcomes. Each domain is
tics and outcomes were synthesised using a meta-substantial methodological heterogeneity, study characteris-
the pre-
as were qualitative and mixed-
also analysed separately to isolate the most reliable evidence,
approach.25 All study quality appraisal scores are presented in
evaluation instruments and analysis preclude summative comparison
(k=10). Fundamental differences in study design, sampling, eval-
pragmatic meta-
most appropriate qualitative critical appraisal tool for use in
aggregation of qualitative
s or qualitative studies to quantitative studies
level 4b
Level 4a
Level 3A
Level 3B
Level 4b
Behavioural change
(self-reported)
Transfer of learning to the workplace and changes to professional practice, as noted by participants themselves
Level 4a
Results (self-reported)
Organisational outcomes perceived by respondents and group effectiveness perceived by subordinates
Level 4b
Results (observed)
Tangible organisational outcomes, such as reduced costs, improved quality and safety, impact of projects
Kirkpatrick level Description
Level 1
Reaction
Participants’ satisfaction with the learning experience, its organisation, presentation, content, teaching methods and quality of instruction
Level 2A
Change in attitudes
Changes in the attitudes or perceptions among participant groups towards leadership, management and/or administration
Level 2B
Change in knowledge or skills
For knowledge, this relates to the acquisition of concepts, procedures and principles; for skills, this relates to the acquisition of thinking/problem-solving, psychomotor and social skills
Level 3A
Behavioural change (self-reported)
Transfer of learning to the workplace and changes to professional practice, as noted by participants themselves
Level 3B
Behavioural change (observed)
Transfer of learning to the workplace and changes to professional practice, as noted by a third party or by promotions

<table>
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<th>Kirkpatrick level</th>
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<td>Level 1 Reaction</td>
<td>Participants’ satisfaction with the learning experience, its organisation, presentation, content, teaching methods and quality of instruction</td>
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<td>Level 2A Change in attitudes</td>
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<td>Transfer of learning to the workplace and changes to professional practice, as noted by a third party or by promotions</td>
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Table 1 Kirkpatrick’s Framework for evaluation of training programmes, with adaptations from Frich et al.

Data analysis
MERSQI and JBI Scores were used to establish which studies presented more reliable evidence of outcomes. Summary statistics were calculated for all 117 studies. In line with Geerts et al.,9 studies with scores of 12 or higher were categorised as higher reliability studies (see the Data analysis section). The JBI Checklist for Qualitative Studies was also applied where a study used mixed methods (k=53) or qualitative methods (k=10). Fundamental differences in study design, sampling, evaluation instruments and analysis preclude summative comparison of mixed-methods or qualitative studies to quantitative studies using the MERSQI.26 21 23 24 The JBI Checklist is considered the most appropriate qualitative critical appraisal tool for use in pragmatic meta-aggregation of qualitative research.24 It includes 10 items which regard the study’s research questions, methods, analysis and reporting, for a total score of 0–10. Following recommendations from the JBI Reviewers’ Manual,17 a cut-off score for higher reliability studies was predetermined at 6/10. This score was chosen as studies obtaining six or more points included most key elements of high-quality design.

RESULTS
Study reliability (MERSQI and JBI)
Twenty-eight of 117 studies (25%) were categorised as higher reliability. Two studies were categorised as higher reliability by both the MERSQI and the JBI tool.26 27 14 studies (12%) by the MERSQI only and 12 studies (10%) by the JBI tool only. The median critical appraisal score according to the MERSQI was 8.5 (range 5–16 from possible range of 5–18) and the median critical appraisal score according to the JBI was 3 (range 0–9 from possible range of 0–10). Online supplemental table 1 includes the MERSQI and JBI Scores for all included studies.

Study design showed considerable room for improvement, as shown in online supplemental tables 2 and 3. Nearly half the of studies (46%) relied on post-programme evaluations only, and 92% did not include a control group. Of the nine studies that did include control groups, most had substantial methodological flaws in their selection of control groups. One common method for control group recruitment was to use unsuccessful course applicants.26–28 In terms of evaluation design, the median evaluation instrument score was 0 (range 0–3). The majority of studies (59%) did not fulfil any of the MERSQI requirements for evaluation instruments, including reporting questionnaire design, wording and content. Objective outcome measures were used in only a minority of studies, with 60% relying solely on self-reported measures.

Data analysis and reporting likewise showed considerable limitations. Only one in five studies (20%) met criteria for comprehensive analysis and reporting of data. Few studies analysed their data beyond descriptive statistics to consider the generalisability and implications (13%). In many cases, studies omitted basic statistical significance tests.

Many studies did not contain key reporting elements for qualitative research as outlined in the JBI tool (see online supplemental table 3). There was clear congruity between research methodologies chosen and the research objectives and methods employed in 60% of studies. A minority of studies adequately reported their analysis (28%) and interpretation of data (25%), the potential for the researcher to have influenced data collection and interpretation (23%) and the researcher’s cultural or theoretical orientation (15%). Participant voices were clearly represented through quotes in only 16/53 (30%) of mixed-methods studies and 5/10 (50%) of qualitative studies. There was a statement of ethical approval or ethics exemption in only 26 of 63 studies (40%) which used qualitative methods. No study included a statement of philosophical perspective (normally expected for qualitative research).17

Programme design
There was considerable heterogeneity in leadership development intervention design. It was often unclear whether established good practice for development of medical education interventions was followed, as shown in figure 2.29 31 Only 52 studies (44%) reporting having conducted a needs assessment before

Figure 2 Educational design components: studies which reported Kirkpatrick level 4 outcomes (k=34) compared with studies that did not report Kirkpatrick level 4 outcomes (k=83).
their intervention, and only 20 studies (17%) explicitly reported using an established capability or competency framework to inform leadership programme goals and objectives. There was, however, a plan for training transfer reported or built into 68 of 117 interventions (59%).

The majority of interventions were carried out in a single hospital department (27%), single hospital (22%) or a single university (12%). Just under a quarter (23%) of interventions were conducted in multiple healthcare centres. A further 15% of studies were conducted within a specialty training programme outside healthcare centres.

Most of the studies took place in the USA (67%) or the UK (16%). The remainder of studies were in other European countries (7%), Canada (4%) or Australia (3%), with a single study each from Africa,32 India,33 Israel34 and Qatar.35

Programmes ranged in length from 2 hours to 4 years. The median intervention length was 6 months, and the most common length was 1 year (19%). Only 18 interventions (15%) lasted longer than 1 year. Five interventions (4%) were shorter than 1 day.

Programme faculty
Programmes were predominately delivered by either in-house faculty (36%) or a mix of in-house and external faculty (32%). Programmes delivered by mixed faculty were most likely to show organisational outcomes, as shown in figure 3. The professional backgrounds, qualifications and experience of faculty were generally not reported.

Participants
The majority of programmes included doctors only (76%). Physician learners ranged from residents (60%) to full specialists (30%) and academic medical faculty (19%). Only nine studies of 117 involved doctors from more than one category. Behavioural outcomes were reported in a similar percentage of higher reliability studies for each category (85%–92%), while organisational outcomes were more commonly reported in programmes with academic medical faculty (50%) or full specialists (44%) than in programmes with only residents (20%). The 26 studies (24%) reporting multidisciplinary programmes included a combination of nurses (12%), managers (15%) and allied health professionals (9%). Most studies did not report the gender of participants (74%) or the age of participants (87%).

In terms of participant selection criteria, the majority of interventions included participants who volunteered (27%), were nominated (19%) or who applied to the programme (16%). In some cases the application process was highly competitive. Interventions were mandatory in one-fifth of studies (20%). A considerable proportion of all studies (23%) did not report the selection process for their learners, including one quarter (25%) of the studies categorised as higher reliability by MERSQI criteria.

Educational methods
A wide range of educational methods were employed in various combinations across the reviewed studies, as shown in figure 4. Most interventions included lectures (68%) and small group work (61%). Project work was included in the majority of studies which did not report organisational outcomes (33%) but only in a minority of studies which did not report organisational outcomes (33%). Individual or team mentoring was also more prevalent where organisational outcomes were reported (47% vs 23%).

Educational content
Educational content varied considerably among interventions. The most consistent content area was leadership theory (reported in 65% of interventions). The other common content areas were performance management (44%), self-management (41%), change management (39%), communication (36%), teamwork (33%), quality improvement (30%), healthcare policy (27%), healthcare finance (26%) and leadership behaviours (20%). There were no notable educational content differences in higher reliability studies or in studies which reported organisational outcomes (Kirkpatrick level 4).

Evaluation methods
A wide range of evaluation methods were employed across the included studies. Nearly half used quantitative methods only for their evaluation (46%). Of the remainder, most studies used mixed methods (45%), with 10 studies (9%) using purely
Review

Behavioural and organisational outcomes in higher reliability studies

A full summary of outcomes from all 117 studies is provided in online supplemental table 1.

There was a range of behavioural (Kirkpatrick level 3) and organisational (Kirkpatrick level 4) outcomes demonstrated in higher reliability studies.

Behavioural changes were objectively demonstrated in higher reliability studies through observed changes in behaviour,44 45 increased responsibilities or titles28 46–49 and improved organisational outcomes, which were subjectively indicated through reports of improved staff retention36 and improvement in organisational effectiveness.27

Organisational outcomes in higher reliability studies were reported more frequently from programmes delivered by a mix of internal and external faculty than from programmes delivered by only external faculty (83% vs 11%), as shown in figure 2. Organisational outcomes were also more frequently reported from interventions conducted in a whole hospital (57%) or multiple hospitals (40%), compared with interventions conducted in a single specialty (conference or outside-hospital training programme) (33%), single university (25%) or in a single department (0%). There were no notable differences in outcomes related to specific educational content.

Higher reliability studies that reported organisational outcomes were more likely to have included project work (70% vs 44%), mentoring (50% vs 22%), coaching (22% vs 11%) and reflective instruments such as personality type assessments (22% vs 6%) than higher reliability studies that did not report organisational outcomes. Organisational outcomes were reported less frequently in higher reliability studies that included simulation or role play (10% vs 33%).

DISCUSSION

The aim of this review was to synthesise recent empirical evidence and explore factors associated with higher level outcomes in physician leadership development.

We found a substantial increase in the number of studies which evaluate medical leadership development interventions compared with previous reviews.6–10 14 15 In many studies, it is still not clear whether best practices for design, delivery and evaluation are being followed.31 It is also not clear whether there are sufficient behavioural and organisational outcomes to justify the considerable and increasing investments in medical leadership development.

Compared with previous reviews, we found an increase in the proportion of studies which report the use of active learning methods such as project work, simulation, discussions and reflections, which are widely accepted to be a vital component of leadership development55 and which were associated in our review with increased Kirkpatrick level 4 outcomes.

No single leadership development content area was particularly associated with improved outcomes. With respect to educational methods, however, there was an association between the inclusion of individual or group project work and of mentoring with organisational outcomes. This may support the established position that educational methods are more important than specific curriculum content for leadership development.58 Simulation and role play were less common in higher reliability studies which reported organisational outcomes that those that did not report organisational outcomes. This unexpected finding could result from these studies being situated in a training environment rather than a working environment. Alternatively, it could result from the evaluation process and study designs rather than from a lack of organisational impact. Studies which included simulation and role play tended to focus their evaluations on objective changes in behaviour at the expense of evaluating organisational outcomes (see online supplemental table 1). Interestingly, lacking a leadership development framework did not seem to impede programmes from reporting organisational...
outcomes. This may indicate that programmes which are designed as bespoke solutions to local needs are more likely to achieve organisational impact than pre-packaged approaches to leadership development.

There was an additional association of more senior participant level with organisational outcomes. This may be related to the wider scope of influence or practice of senior physicians compared with resident physicians. It could also indicate that there is a longer post-programme development period before residents are able to have an impact on organisational outcomes. This would align with the finding that programmes which evaluated longer-term outcomes were more likely to report organisational outcomes.

Importantly, our findings indicated that leadership development interventions which used a combination of internal and external faculty were more likely to report organisational outcomes, and those interventions which used external faculty only were least likely. This could have significant implications for procurement and design of leadership development interventions across healthcare, particularly as courses run internally are associated with significantly reduced costs.

As in previous physician leadership development reviews that used critical appraisal instruments, we found that studies frequently did not meet criteria for high reliability. Many studies failed to report important methodological features, which restricts readers' ability to appraise studies and learn from their findings. This was particularly notable in terms of questionnaire design, with fewer than one in 10 studies using validated questionnaires or reporting their questionnaire content in detail. Most studies also did not report or analyse outcome evaluation data comprehensively. Many study designs were biased towards obtaining positive results, particularly in terms of the absence of control groups, having stringent or undisclosed selection criteria, including leading questions on questionnaires and relying solely on self-ratings. This is likely to have resulted in improved reported outcomes. The lack of evaluation quality seems to indicate perfunctory attention paid to evaluation design and precludes confident conclusions from these studies. Future studies could benefit from consulting study quality appraisal checklists such as the MERSQI and JBI in advance, in order to effectively design their evaluations.

This review does indicate that certain recommendations for improved programme evaluation are beginning to be applied into research. Whereas only 29% of the studies reviewed by Frich et al. included qualitative components, 63 (54%) of the 117 studies included in our review used mixed or qualitative methods. In a nascent and complex field such as medical leadership development research, qualitative methods can have value in terms of establishing effective programme design features to achieve desired outcomes, as well as helpful nuances of how, for whom, to what extent or in what circumstances interventions are effective or not.

Additionally, many studies in this systematic review evaluated outcomes at Kirkpatrick level 3 behavioural change (57%) or level 4 organisational outcomes (24%). This is a significant improvement from previous reviews. Changes in behaviour (level 3) and organisational outcomes (level 4) are more closely associated with transfer of learning to the working environment than participant reaction (level 1) and learning (level 2).

**Limitations and strengths**

This review was limited by the reliability of the studies included. We attempted to control for study reliability using critical appraisal tools with cut-off scores for higher reliability studies. To the best of our knowledge, this is the first systematic review of healthcare leadership development interventions to use the JBI critical appraisal tool to critically appraise qualitative studies. The JBI tool enabled us to identify 12 additional higher reliability qualitative and mixed-methods studies which were not identified using the MERSQI. Marked heterogeneity of studies and evaluations precluded a formal meta-analysis, therefore, we adopted a meta-aggregation approach. This enabled us to highlight design components that are correlated with behavioural and organisational outcomes in higher reliability studies.

A substantial majority of studies reported only positive outcomes, which could represent a publication bias, and we limited our review to English language peer-reviewed studies. In line with Frich et al., our database search was limited to MEDLINE, however, we augmented our database search with an extensive hand-search of reference lists and citations using Web of Science and Google Scholar. The hand-search revealed that many relevant empirical studies were absent from recent reviews despite some of those reviews searching a greater range of research databases. This could indicate flaws in healthcare leadership development literature tagging and filing procedures within medical and educational databases.

**CONCLUSION**

Our review has practical implications for those commissioning, designing and evaluating medical leadership development programmes in healthcare. No specific area of curriculum content and no particular leadership development framework were clearly associated with behavioural or organisational outcomes. While relevance and appropriateness of educational content is important, this systematic review has more clear implications for leadership development methods than for specific content. Where possible, interventions should include projects and individual or group mentoring. Transfer of learning from the programme into learners’ daily work and their organisations should be planned into the programme and where possible active learning educational designs should be employed, including opportunities for learners to set their own goals for development. External faculty should be judiciously used to supplement in-house faculty, not as a replacement for in-house expertise.

In terms of evaluation design, efforts should be made to ensure that evaluations are cost-effective and produce data that is useful for both practitioners and researchers. Effective mixed-methods evaluation strategies should be integrated into evaluation designs. Study quality checklists such as the MERSQI and JBI could be consulted in the programme design phase to help build high quality quantitative and qualitative evaluation methods into programmes. At the minimum, evaluation design should include consideration of assessment at multiple time points, inclusion of control groups and collection of objective data, as well as collection of qualitative data from interviews, focus groups, questionnaires or observations. Programme goals and intended organisational outcomes should be explicitly considered during evaluation design so that measures of organisational outcomes (including project outcomes) can be incorporated into the evaluation design. Improving study design and building robust evaluation methods into programmes will allow evaluators and educators to more effectively understand factors which are reliably associated with high level programme outcomes. This could both inform the improvement of individual programmes and
contribute to the medical leadership literature as a whole. It is only through more considered and thorough evaluation of physician leadership development programmes that we will be able to invest the time they represent.

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Contributors OL, RG and JRG planned the review. OL, RG and TF screened studies for inclusion. OL, RG, JRG, AM and TF abstracted and coded studies. OL, RG, JRG, AM, TF, JF and JMG contributed to analysis, writing and editing the manuscript.

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<th>Source First Author, Year</th>
<th>Setting</th>
<th>Learner Number</th>
<th>Learner Type</th>
<th>Intervention Length</th>
<th>Intervention Description</th>
<th>Teaching Methods</th>
<th>Educational Content</th>
<th>Main Findings by Kirkpatrick Level</th>
<th>JBI Score</th>
<th>MERSQI Score</th>
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<tr>
<td>Scottsdale, 2019 [1]</td>
<td>Single UK hospital residency</td>
<td>43</td>
<td>Residents (Emergency Medicine)</td>
<td>4 days</td>
<td>4 days of simulation scenarios</td>
<td>Learning activities, small group skill practice, problem-solving sessions, feedback and reinforcement of skills, assignment, assessments, feedback</td>
<td>Leadership, communication, coordination, problem solving/conflict management, and team culture</td>
<td>4a. Led to increased satisfaction with their own communication and leadership skills</td>
<td>13.5</td>
<td>13.5</td>
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<tr>
<td>Lyons O, et al. 2019</td>
<td>Single hospital in Canada</td>
<td>56</td>
<td>Consultants and senior healthcare professionals and managers</td>
<td>12 months</td>
<td>12 months with 4 workshops days spread over 6 months</td>
<td>Face-to-face delivery, ongoing telephone coaching and the use of a benchmarked 360-degree profile. Project work. Interactive sessions.</td>
<td>1. Effectiveness of programme rated at 4/5</td>
<td>2a. Significant improvements in self-reported knowledge and skills</td>
<td>13.5</td>
<td>13.5</td>
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**Higher Quality Studies (All Text)**

- **Pallavi, 2019 [17]**
  - Single US hospital department
  - 21 Academic surgeons from assistant to full professor grade
  - 8 months
  - 1 full day per month
  - Didactic and experiential learning; case studies, team improvement projects, multi-source feedback, debriefing with executive coach
  - Leadership, team building, business acumen, and health care context
  - 1. Participants reported higher levels of satisfaction with the programme, ranked a 6/7/10 (10 being excellent) out of their time.
  - 2a. Participants "not only enabled but also capable of effecting change in their local environment".
  - 2b. Participants reported increased self-awareness and increased team-building skills, and improvement of leadership knowledge.
  - 3a. Participants reported improved ability to foster collaborative relationships, and general improvement of interactions and networks.
  - 3b. 1. Ratings of 4.5 for evaluation of eight content sessions (lowest average 8.3).
  - 2. Completing did assessment, 360 feedback and coach supported development plan
  - 3. Increased percentage considering themselves to be leaders after the programme (78% vs. 72%
  - 3b. Increased perceived leadership capability and knowledge across multiple skills and abilities.
  - 4a. Increased functional skills in 6/8 areas.
  - 4b. 1 out of 6 projects fully implemented

- **Thomazatos, 2014 [18]**
  - US Regional healthcare system
  - 21 Physicians across a range of specialties
  - 10 months
  - 2-3 meetings/month (n = 2-3 of additional learning opportunities)
  - Beliefs and style assessment, multi-source feedback, coaching, online discussions, online learning modules, learning in small group
  - intra/interpersonal effectiveness; resiliency; coaching; communication; teamwork; change management; business acumen; quality focus
  - 1. Participants reported high levels of satisfaction with the programme, ranked a 8.5/10 (10 being excellent) out of their time.
  - 2a. Participants reported improved ability to foster collaborative relationships, and general improvement of interactions and networks.
  - 2b. Significant but small increase in test scores compared with control group.
  - 3a. 2/3 (63%) of respondents reported noticeable changes in leadership skills.
  - 3b. 98.6% of respondents reported noticeable changes in leadership skills.
  - 4a. 100% return on investment calculated from “intangible benefits”
  - 1. Participants emphasised the importance of the group as a "protected zone".
  - 2. Participants felt that they had been able to develop in leadership.
  - 3. Participants from all groups reported using techniques in their workplace and personal lives.

- **Montague, 2018 [20]**
  - National UK programme
  - 111 Doctor (junior and senior) and other health professionals, allied health professionals, managers
  - 3-4 months
  - 1. 3-month placement in a resource-poor country
  - Group dynamics, communication, leadership theories
  - 1. All interviewees agreed that the experience was valuable.
  - 2a. Increased percentage considering themselves to be leaders after the programme (78% vs. 72%)(b). Interviewees reported increased confidence and aspiration.
  - 2b. Increased self-awareness and leadership skills reported in questionnaire. Interviewees reported increased awareness of leadership styles of others.
  - 3a. 75% reported using their new skills, 88% reported not being able to use their skills.
  - 4a. Several respondents noted that they had planned to leave the NHS and decided to stay after the programme.

- **Tsoh, 2019 [21]**
  - Single US academic healthcare centre
  - 136 Faculty members pursuing/holding leadership potential
  - 20 weeks
  - Experiential learning NOS
  - Self-awareness, critical thinking, effective communication, inclusion, collaboration, empowered professionalism
  - 1. Programme completion rate is 97.8%
  - 2a. 76% of respondents self-reported as demonstrating improved attitudes toward their role and/or job at the university.
  - Qualitative comments indicated improved confidence and aspiration.
  - 3a. 90.7% of respondents reported no changes in leadership attitudes or behaviors.
  - 4a. 62.5% reported seeking new leadership opportunities.
<table>
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<tr>
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<th>Main Findings by Kirkpatrick level</th>
<th>JBI Score</th>
<th>BMRSQI Score</th>
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<tbody>
<tr>
<td>Beamish, 2012 (22)</td>
<td>Single Australian residency program (surgery)</td>
<td>32</td>
<td>Residents (Surgical trainees, medical students across all specialties)</td>
<td>2 days</td>
<td>Two-day simulation course</td>
<td>Simulation, peer observations, multi-source feedback, reflection, lectures, videos, small group discussions</td>
<td>Patient-centered communication, inter-professional communication, teamwork, leadership and professionalism</td>
<td>3b. All participants reported a new leadership position, 4b. 84% of failure graduates, 88% of underperforming residency graduates. 1. All participants rated the course as good or very good. One third of participants described the communication scenario as &quot;less than useful&quot;. All other aspects of the course were considered useful or highly useful. 2a. Increased awareness of the broader situation and the value of high-quality communication and teamwork. 2b. Self-reported achievement of learning objectives including increased knowledge 1. Participants satisfied 0.5%-0.75, useful 0.25-0.8, helpful on 70% 2. 50%-80% report intention to implement</td>
<td>8</td>
<td>7.5</td>
</tr>
<tr>
<td>Corey, 2015 (23)</td>
<td>12 US Primary Care residency (4 locations)</td>
<td>30</td>
<td>Faculty (Family medicine, internal medicine, Family)</td>
<td>6 months</td>
<td>2-day session with follow-up over 6 months</td>
<td>Didactic small group sessions workshops case studies by core faculty</td>
<td>Leadership change management frameworks and educational simulation and clinical exercises competency assessment patient-centered patient-centered medical home principles</td>
<td>1. Scanned for relevance and quality of simulations on questionnaire and free text comments rated 4/5 2. The simulation helped participants recognize problems with speaking up 2a. Gained understanding about shifting from blame to learning centered leadership, facilitating communication and teamwork, being welcomed rather than defensive, and other self-reflections</td>
<td>8</td>
<td>6.5</td>
</tr>
<tr>
<td>Cooper, 2011 (24)</td>
<td>Single US academic medical centre</td>
<td>108</td>
<td>Physicians, nurses, allied health professionals, administrators, managers</td>
<td>1 day</td>
<td>Workshop</td>
<td>Seminar simulation review of data from safety climate survey team project</td>
<td>Teamwork, patient safety, communications, individual and collective leadership, recognizing differences in perspectives between managers and clinicians, how to speak up to voice concerns, specifically</td>
<td>1. Participants were happy with the course 2a. Participants reported increased confidence and judgement skills 2b. Participants reported improved leadership skills 3. Participants reported taking new approaches to their roles 3b. Participants reported new roles</td>
<td>7</td>
<td>10.5</td>
</tr>
<tr>
<td>Agui, 2015 (25)</td>
<td>Single UK pharmacy</td>
<td>8</td>
<td>Specialty trainees (Pharmacists, Pharmacists, Pharmacy, NHS managers)</td>
<td>4 years</td>
<td>Four-year part-time programme to Master’s level with academic and vocational components</td>
<td>Diploma/MSc modules Action learning sets Workplace-based projects Shadowing placements Leadership development tools (self reflect)</td>
<td>NHS competencies: Leadership, policy, organizational development, governance</td>
<td>1. Participants were happy with the course 2a. Participants reported improved confidence and judgement skills 2b. Participants reported improved leadership skills 3a. Participants reported increased self-confidence as leaders (87% of respondents) and willingness to speak up 2b. Increased understanding of health systems, policy, team working skills with diverse groups, networking</td>
<td>7</td>
<td>10.5</td>
</tr>
<tr>
<td>Midkimm, 2019 (26)</td>
<td>National UK programme</td>
<td>145</td>
<td>Residents (Surgery and GP doctors in training)</td>
<td>1 year</td>
<td>Immersive internship out of practice with the most senior personnel in national and healthcare-related organisations</td>
<td>Immersive internship visits to other host organisations and Parliament, teaching on leadership and management, and action learning sets</td>
<td>Policy development, project management, research and analysis, writing and publishing, professional networking skills</td>
<td>1. Participants overwhelmingly endorsed the programme and would recommend it to other trainees. 2a. Increased self-confidence as leaders (87% of respondents) and willingness to speak up 2b. Increased understanding of health systems, policy, team working skills with diverse groups, networking</td>
<td>7</td>
<td>10.5</td>
</tr>
<tr>
<td>Cohen, 2017 (27)</td>
<td>Multiple UK health care organizations (London)</td>
<td>69</td>
<td>Consultants (22), Registrars (55), Grade not identified (2)</td>
<td>1 day</td>
<td>Workshop</td>
<td>Lecture-style presentations: policy leadership simulation</td>
<td>Background of NHS reform healthcare challenges</td>
<td>1. Participants were happy with the course 2a. Participants reported improved confidence and judgement skills 2b. Participants reported improved leadership skills 3a. Participants reported increased self-confidence as leaders (87% of respondents) and willingness to speak up 2b. Increased understanding of health systems, policy, team working skills with diverse groups, networking</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>Ruston, 2010 (28)</td>
<td>Single UK pharmacy</td>
<td>3</td>
<td>Residents (General Practice Specialty Trainees)</td>
<td>4 months</td>
<td>2 days per week for 4 months</td>
<td>Peer learning sets, meetings, project work, reflective diaries</td>
<td>Strategic and contextual issues, commissioning design and delivery of health care, service redesign, public health agenda, leadership, management and partnership skills</td>
<td>1. Participants were happy with the course 2a. Participants reported increased confidence and judgement skills 2. Participants were happy with the course 2b. Participants reported improved confidence and judgement skills 3a. 60% of graduates report being actively involved in service improvement post-programme. 68% of graduates reported difficulties transferring their training back to their workplace. 3b. 60% of graduates had gone on to further leadership management development as a result of the programme. 4a. Host organisations describe a range of benefits and examples of the impact of fellows’ work on their organisations, including financial impact (e.g. Income generated, cost savings) and a range of defensors (e.g. Reports, publications, research studies). 5. All measures above 4/5 on Likert scale indicating “I recommend this simulation to colleagues at my professional stage” (4-6) and “I would like to take part in similar simulation events in the future”. 2b. Participants reported new roles 3a. Participants reported increased self-confidence as leaders (87% of respondents) and willingness to speak up 3b. Participants reported new roles 4b. Participants reported new roles</td>
<td>6</td>
<td>10.5</td>
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<tr>
<td>Other included Studies</td>
<td></td>
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<tr>
<td>Hatchwell, 2018 (29)</td>
<td>Single US hospital</td>
<td>98</td>
<td>Medical faculty members with supervisory or team leader responsibility</td>
<td>10 months</td>
<td>60 hours of learning over 10 month course. Two one day seminars, one two day off-site session, seven monthly four hour meetings, reading assignments</td>
<td>Seminar, experiential activities, small group discussions, multimedia feedback, teambuilding activities, reading</td>
<td>Emotional Intelligence, leadership behaviors, leadership foundation skills</td>
<td>1. 84% of participants would recommend the programme to others, training rated as worthwhile investment (6.7/7) 2a. Statistically significant increased confidence in leadership ability 2b. Statistically significant increase in self-efficacy in leadership skills 3a. Statistically significant increase in seeing ways to maximize application of leadership strengths and overcome leadership limitations 3b. Statistically significant improvement in communication of leadership strengths and in confidence as seen by managers</td>
<td>3</td>
<td>11.5</td>
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<tr>
<td>ATAMIAN, 2014 [8]</td>
<td>Family medicine residency programme (Canada)</td>
<td>38</td>
<td>Residents (family medicine year 1-4)</td>
<td>5 days</td>
<td>5 day in-practice management workshop</td>
<td>Didactic teaching; case studies; small group discussions; team exercises</td>
<td>Professional/supervision; interprofessional skills; practice-based learning and improvement system-based practice</td>
<td>2A - Increased confidence 2B - Increased self-assessed risk management, conflict management, communication skills; time management; ability to write algorithms 3A - Supervisor-reported increase in effective use of hospital resources; coordination of patient care; patient communications skills</td>
<td>4</td>
<td>11</td>
</tr>
<tr>
<td>Fernandez, 2016 [35]</td>
<td>Single US college (MDM)</td>
<td>37</td>
<td>Obstetricians (Senior fellow, young physicians, seniors, fellows, specifically distinguished)</td>
<td>5 3 days</td>
<td>5 day national intensive leadership development for MDM physicians resident</td>
<td>Interactive skills building workshops, series of leadership and psychological assessment tools, including a 360-degree assessment, small group discussions and workshops; orientation, large group meetings, two-hour peer meetings, monthly small group/virtual roundtable discussion; personality type instrument; 3x coaching; structured networking; independent reading and reflection; individual leadership project</td>
<td>Organizational culture; leadership and empowerment, communication; motivation, advocacy, skills, negotiation, skills; health policy</td>
<td>3A - Respondents reported having used skills learned in their day-to-day job. 3B - 90% respondents felt expanded leadership responsibilities in a new role.</td>
<td>1</td>
<td>11</td>
</tr>
<tr>
<td>Chang, 2019 [32]</td>
<td>Three US healthcare organisations in 24 US states</td>
<td>65</td>
<td>49 Physicians (46 Generalists) 1 Dentist 3 Nurses 6 Pharmacists 1 Psychologist 1 Social Worker 1 Speech Pathologist</td>
<td>9 months</td>
<td>Silus</td>
<td>Adoptive leadership managing reactive change and generating vision, goals, data/desires/motivation and resilience focusing on leadership skills and perception strategies and attitude presentation skills for leadership and marketing strategies and stakeholders evaluation design scaling up business case and budget measuring impact project management</td>
<td>Unclear</td>
<td>3A - 93% reported the programme has made them more effective leaders. 85% report that they have become advocates for the organisation's strategy. Graduates reported being more effective in committees within their school or institution. 3B - 9/26 respondents had expanded leadership responsibilities in a new role.</td>
<td>4</td>
<td>11</td>
</tr>
<tr>
<td>Day, 2010 [35]</td>
<td>Single UK specialty association (orthopaedic)</td>
<td>100</td>
<td>Orthopaedic surgeons</td>
<td>1 year</td>
<td>Mentoring by established orthopaedic leader</td>
<td>Mentoring</td>
<td>Strategic thinking and personal awareness, Leadership qualities, Leadership best practices, Navigating tactics and managing conflict, Human resources and talent management, Building collaborations and influence, Skills, Marketing, Communication, Time management, Crisis management</td>
<td>2B - Participants &quot;appear to have gained tremendous personal benefit&quot; which focused on confidence to operate outside their initial comfort zone; greater clarity about their leadership vision, influence and career decision.</td>
<td>4</td>
<td>11</td>
</tr>
<tr>
<td>Korschun, 2007 [34]</td>
<td>Single US academic medical centre</td>
<td>70</td>
<td>Physicians (35, nurses, and a wide range of administrators)</td>
<td>5 months</td>
<td>Five three-day sessions over five months</td>
<td>Lectures, seminars, case studies, experimental exercises, individual assessment, executive coaching, including a 360° assessment, mentoring, team project work</td>
<td>Strategic thinking and personal awareness. Leadership qualities; Leadership best practices; Navigating Tactics and managing conflict; Human resources and talent management; Building collaborations and influence; Skills, Marketing, Communication, Time management, Crisis management</td>
<td>2B - Participants &quot;appear to have gained tremendous personal benefit&quot; which focused on confidence to operate outside their initial comfort zone; greater clarity about their leadership vision, influence and career decision.</td>
<td>4</td>
<td>11</td>
</tr>
<tr>
<td>McCabe, 2008 [35]</td>
<td>Multiple US and UK Academic Medical Centres (ACM)</td>
<td>79</td>
<td>Associate or full professor</td>
<td>7 months</td>
<td>Three 1-week meetings across 7 months</td>
<td>Leadership skill development, mentoring, and networking</td>
<td>The curriculum focuses on building knowledge and skills in seven domains: communication, organizational and interpersonal effectiveness; ethical reasoning and decision making; organizational and institutional leadership; management and organizational development; the management of complex change, improving patient experience (including a 360° assessment, mentoring, team project work)</td>
<td>2B - Significant increases in knowledge, communication, and marketing strategy and stakeholders influence ability. 2A - Participants reported increased willingness to take on leadership roles and that the course was relevant and valuable.</td>
<td>4</td>
<td>11</td>
</tr>
<tr>
<td>Edmonstone, 2011 [36]</td>
<td>UK National programme (Scotland)</td>
<td>117</td>
<td>Senior leaders in filled full-time clinical roles, primary care doctors, nurses, AHP, pharmacists, psychologists, dentists, paramedics</td>
<td>12 months</td>
<td>A three-day residential development centre followed by nine two-day residential events held every six weeks</td>
<td>Coaching, Mentoring, Action Learning, Change Management, Leadership Development Centre. Mentorship/Workshops, Observation Tools, Specific Leadership Supper Club, Specific Leadership Supper Club, Specific Leadership Supper Club, Specific Leadership Supper Club, Specific Leadership Supper Club, Specific Leadership Supper Club, Specific Leadership Supper Club, Specific Leadership Supper Club</td>
<td>Strategic thinking and personal awareness. Leadership qualities; Leadership best practices; Navigating Tactics and managing conflict; Human resources and talent management; Building collaborations and influence; Skills, Marketing, Communication, Time management, Crisis management.</td>
<td>2B - Participants reported increased willingness to take on leadership roles and that the course was relevant and valuable. 2A - Participants reported increased willingness to take on leadership roles and that the course was relevant and valuable.</td>
<td>4</td>
<td>11</td>
</tr>
<tr>
<td>ModPsi, 2015 [37]</td>
<td>Single Australian Hospital Department (Geriatric, Rehabilitation and Palliative Care)</td>
<td>39</td>
<td>Non-executive middle or senior level medical nursing and allied health professionals</td>
<td>9-10 months</td>
<td>2-hour monthly sessions, group projects, site-visits</td>
<td>Guest speakers and discussions external stakeholders, project, presentation</td>
<td>Organizational structure; healthcare context; leadership and strategy setting; crisis, ambiguity, quality of care and clinical errors, Complex systems, communication, engagement with patients, conflict, negotiation, change management</td>
<td>1. Participants reported almost unanimously (96-100%) for all measures including that the course was relevant and valuable. 2. Participants reported increased willingness to take on leadership roles 3. Participants reported increased participation in community meetings and project development</td>
<td>5</td>
<td>10.5</td>
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<th>BMJ Leader Score</th>
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</thead>
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<tr>
<td>Correia, 2014 [48]</td>
<td>Single Integrated health care organization</td>
<td>50</td>
<td>Residents (including Chief Residents)</td>
<td>3 days</td>
<td>80%</td>
<td>3 clusters weekly three weeks prior to course: didactic sessions, simulated teaching encounters</td>
<td>Teaching methods, interactive role-play exercises, discussion, role-modeling of critical thinking, and patient safety</td>
<td>Leadership, management, and core feedback skills, interpretation of emotional intelligence inventory, biographical communication skills and professionalism</td>
<td>80% agreed that the program met their learning needs. Participants reported continuing the G-DUT project.</td>
<td>3</td>
</tr>
<tr>
<td>Patel, 2015 [49]</td>
<td>Single US hospital</td>
<td>30</td>
<td>Residents (PGY-4)</td>
<td>2 years</td>
<td>2 year healthcare leadership in quality residency track</td>
<td>Core curriculum (102 hours) over 2 years: including lectures, readings, videos, small group activities, online modules, facilitated discussion</td>
<td>Leadership, management, organizational behavior and team building, team-based learning, team dynamic, project management</td>
<td>Methods and tools of quality improvement and patient safety, human factors engineering and safety culture.</td>
<td></td>
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</tr>
<tr>
<td>Nakayaka, 2015 [46]</td>
<td>Four African and 4 US universities</td>
<td>15</td>
<td>Unclear</td>
<td>1 year</td>
<td>1 year fellowship</td>
<td>8 weeks of didactic teaching with two 4.5 month experiential rotations in health organizations and 6 online modules. Mentoring (weekly meetings, monthly mentoring team meeting)</td>
<td>Leadership, communication, mentoring, health informatics, research methodology, grant writing, implementation science, and responsible conduct of research.</td>
<td></td>
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<tr>
<td>Kuo, 2010 [41]</td>
<td>Single US residency program</td>
<td>16</td>
<td>Residents (Radiology PGY-3)</td>
<td>3 years</td>
<td>Bespoke residency programme</td>
<td>7x 3-hour modules</td>
<td>Leadership, critical thinking, and communication</td>
<td>Themes of leadership, critical thinking, and communication. Topics include policy making, project management, decision making and communication</td>
<td></td>
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</tr>
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<tr>
<td>Wichnam, 2019 (98)</td>
<td>Single US hospital department</td>
<td>6</td>
<td>Residents (Psychiatry PGY4)</td>
<td>8 months</td>
<td>Weekly seminars (8 modules x 4 sessions each), with projects and mentoring</td>
<td>Lectures, discussions, projects, mentoring</td>
<td>Financial management, human resource management, planning and marketing, information management, risk management, Governance and organizational dynamics, Business and clinical operations, Professional responsibility.</td>
<td>4b. Participants reported feeling more prepared for a range of leadership requirements, including understanding decisions and working in teams and with managers</td>
<td>9.5</td>
<td>n/a</td>
</tr>
<tr>
<td>Monaghan, 2018 (50)</td>
<td>Single UK hospital trust</td>
<td>12 (6 doctors)</td>
<td>Residents (non-clinical training and training departmentship, fellows, managers of academic departments)</td>
<td>6 months</td>
<td>6-month paired learning mentorship with managers, Shadowing, conversations, reflections</td>
<td>6-month paired learning mentorship with doctors, managers, Shadowing, conversations, reflections</td>
<td>2a. Participants reported feeling more prepared for a range of leadership requirements, including understanding decisions and working in teams and with managers</td>
<td>9</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>Voogt, 2016 (51)</td>
<td>Six Dutch teaching hospitals</td>
<td>28 (18)</td>
<td>Residents</td>
<td>1 year</td>
<td>Four 1hr meetings to discuss and work on projects</td>
<td>Facilitated discussions, project work</td>
<td>Quality improvement and leadership, not otherwise specified</td>
<td>2a. Interviewees reported feeling empowered</td>
<td>3</td>
<td>n/a</td>
</tr>
<tr>
<td>Heneghan, 2017 (52)</td>
<td>Single UK hospital department</td>
<td>98</td>
<td>Residents (radiology)</td>
<td></td>
<td>One-hour fortnightly journal club meeting every fortnight</td>
<td>Journal club, projects, mentoring, leadership role placement</td>
<td>Leadership (topics chosen by the group on an ad hoc basis)</td>
<td>0</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>Pearson, 2018 (53)</td>
<td>UCL leadership fellowship</td>
<td>13</td>
<td>Residents (senior, medicina/ general, practice, surgery, obstetrics and gynaecology, paediatric surgery and psychiatry)</td>
<td>1 year</td>
<td>1 year son-off-programme fellowship in a host organization</td>
<td>Symposium and conferences, one-to-one coaching sessions, action learning sets, shadowing opportunities and reflective practice including completion of a portfolio</td>
<td>Minimal reported. Communication, working styles and leadership framework mentioned</td>
<td>0</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>Crimi, 2004 (54)</td>
<td>Single US residency program (Internal medicine and paediatric)</td>
<td>13</td>
<td>Residents (PGY4-6)</td>
<td>1 year</td>
<td>Monthly seminar series</td>
<td>Casing, Coaching, Group dynamics, Human resources, Risk management</td>
<td>2a. Interviewees reported increased awareness of the business of radiology</td>
<td>n/a</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>Dickey, 2014 (55)</td>
<td>Single UK hospital</td>
<td>Unclear (13 leadership projects described)</td>
<td>Residents (Psychiatry PGY4)</td>
<td>4 years</td>
<td>Modular leadership programme over 4 years with monthly mentoring components</td>
<td>Seminars, with voluntary simulations, action teams work, electives, mentoring</td>
<td>Philosophy of leadership, healthcare delivery systems, quality assurance, risk management, qualities of exceptional leaders</td>
<td>0</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>Foster, 2008 (56)</td>
<td>Single UK medical centre</td>
<td>13</td>
<td>Residents</td>
<td>2 years</td>
<td>2 week intensive orientation, 11 month MPH degree and leadership coursework, weekly 2-3 day didactic sessions, monthly journal club, monthly open-ended sessions, 2 year cardiology leadership academy</td>
<td>MPH degree, leadership coursework, change project, mentoring</td>
<td>Leadership of small systems in healthcare</td>
<td>4b. Projects completed</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Freeman, 2016 (57)</td>
<td>Single US training programme</td>
<td>30</td>
<td>Cardiology fellows in training and early career professionals</td>
<td>2 years</td>
<td>2 year cardiology leadership academy</td>
<td>Mentoring, not otherwise clear</td>
<td>Measurement of the outcomes of health service interventions</td>
<td>4b. Participants reported increased confidence across a range of key curriculum areas</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Sarvo, 2017 (58)</td>
<td>Single German university hospital</td>
<td>50</td>
<td>Residents (PGY4-6 across specialties)</td>
<td>4 weeks</td>
<td>Weekly 2.5 hr sessions after clinical duties</td>
<td>Didactic module, standardised simulations, one-on-one feedback on recorded simulations, &quot;practicing communication techniques&quot;</td>
<td>Full Range Leadership Model (Bass), transactional and transformational leadership, simulation of critical incidents, communication techniques</td>
<td>4b. Participants reported increased confidence across a range of key curriculum areas</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Schub, 2015 (59)</td>
<td>US surgical department specialty</td>
<td>9</td>
<td>Residents (DVT)</td>
<td>6 months</td>
<td>Virtual strength assessments (VSA); leadership readings, thought of the day, Internal and external faculty training and development, leadership basic training course</td>
<td>Virtual leadership, curriculum not otherwise specified</td>
<td>Conflict management, team leadership, influencing others, navigating challenging conversations, and how to achieve work-life balance</td>
<td>2a. Participants reported increased confidence across a range of key curriculum areas</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Stakler, 2007 (60)</td>
<td>Single US hospital network</td>
<td>Unclear (roughly 400)</td>
<td>Emerging physician leaders</td>
<td>9 months</td>
<td>Eight sessions offered roughly once monthly on Fridays at an off-site retreat centre, Longitudinal project</td>
<td>Seminars, business case project</td>
<td>Marketing in healthcare, Healthcare finance, Writing a business plan, Emotional intelligence, situational leadership, conflict resolution and negotiation, Medico-legal issues</td>
<td>3b. 60 business plans were submitted over 13 courses</td>
<td>n/a</td>
<td>n/a</td>
</tr>
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<td>Refs</td>
<td>GB Score</td>
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<tr>
<td>Arntzen, 2019 [41]</td>
<td>German Medical Education in Medicine</td>
<td>67</td>
<td>World of senior consultants, 8 consultants, 2 senior residents, one pharmacist, one financial controller</td>
<td>100 days teaching time over a master’s degree</td>
<td>Master’s degree</td>
<td>Project work, didactic teaching, discussions, thesis</td>
<td>Leadership and management, quality management and legal aspects, medical ethics, project management, empirical research methods, communication/dialogue skills, change management, diversity management, management accounting, health economics, computer science, education and didactic, educational management</td>
<td>1. 94% of participants completed the activities in full 2b. More than 30 projects implemented over the course of the masters. 4b. Projects successfully integrated into existing structures</td>
<td>n/a</td>
<td>9</td>
</tr>
<tr>
<td>Warren, 2014 [62]</td>
<td>Single US hospital</td>
<td>56</td>
<td>Residents (PGY2 Internal Med)</td>
<td>4 weeks</td>
<td>2-3hrs a week for 4 weeks, work between Large-group discussions, small groups, role-plays, small-group meetings</td>
<td>Human development, team leadership, effective team leadership</td>
<td>1. Sessions perceived to be relevant 2a. Increased confidence in managing teams prepared to lead teams immediately post. 2b. 50% of participants indicated that their perspectives on leadership had changed as a result of the programme.</td>
<td>4</td>
<td>8.5</td>
<td>n/a</td>
</tr>
<tr>
<td>Sadeh, 2011 [63]</td>
<td>Single US university</td>
<td>543</td>
<td>Academic faculty members who had demonstrated leadership potential within the school of medicine.</td>
<td>30 weeks</td>
<td>2 to 7 hour weekly training sessions over a 10-week period for an approximate total of 100 hours</td>
<td>Instructional sessions, self-analysis using MBTI and the leadership skills inventory</td>
<td>Didactic and small-group instruction tools, conflict management and negotiation skills, team-building skills</td>
<td>1. Qualitative report of satisfaction with the programme 3a. 81% of participants indicated that they had changed their professional behavior as a result of the programme. 3b. 50% of respondents were interested in or offered positions post-programme</td>
<td>2</td>
<td>8.5</td>
</tr>
<tr>
<td>Elder, 2013 [64]</td>
<td>Single US residency programme (pediatric anaesthesiology)</td>
<td>10</td>
<td>Residents (First-year anaesthesiology residents)</td>
<td>1 year</td>
<td>1 year administrative resident programme</td>
<td>Reading, experiential learning, feedback, self-assessment, mentoring</td>
<td>Organisation culture, human factors, quality assurance (QA) and continuous quality improvement (CQI), operating room scheduling, and resident selection, decision making, technical planning, interpersonal or professional skills, and conflict resolution</td>
<td>1. 99% of participants rated the programme valuable (15%) or very valuable (84%); 2. 83% of respondents reported having undertaken a voluntary leadership activity, particularly quality improvement projects and running educational sessions. Those who did not, freq</td>
<td>n/a</td>
<td>9</td>
</tr>
<tr>
<td>Richardson, 2003 [62]</td>
<td>UC/Canada education in academic medicine</td>
<td>200</td>
<td>Midcareer female faculty or medical or dental school at associate in full professor rank</td>
<td>1 year</td>
<td>Two-week long residential session (in September and November), annual conference, mandatory assignments</td>
<td>Lectures, panel discussions case studies, computer simulations, role playing, small group workshops, individual and group projects, resident assessment, coaching</td>
<td>Didactic and small-group instruction tools, conflict management and negotiation skills, team-building skills</td>
<td>1. All workshops rated highly 2b. There was no significant change in the self-rated confidence in leadership skills or team working skills when compared post.</td>
<td>3b. 66% of respondents were invited to apply for or offered positions post-programme</td>
<td>n/a</td>
</tr>
<tr>
<td>Farmer, 2014 [64]</td>
<td>Single US hospital</td>
<td>165</td>
<td>Residents (New Chief Residents)</td>
<td>2 days</td>
<td>2-day Chief Residents’ Leadership Workshop</td>
<td>-</td>
<td>Leadership and management, quality management and legal aspects, medical ethics, project management, empirical research methods, communication/dialogue skills, change management, diversity management, management accounting, health economics, computer science, education and didactic, educational management</td>
<td>1. 99% of participants rated the programme valuable (15%) or very valuable (84%); 2. 83% of respondents reported having undertaken a voluntary leadership activity, particularly quality improvement projects and running educational sessions. Those who did not, freq</td>
<td>n/a</td>
<td>9</td>
</tr>
<tr>
<td>Gregg, 2014 [67]</td>
<td>Single US trauma centre</td>
<td>20</td>
<td>Residents (Trauma, gyn)</td>
<td>6-10 months</td>
<td>Evaluation of communication skills and weekly discussion of meetings</td>
<td>-</td>
<td>Leadership and management, quality management and legal aspects, medical ethics, project management, empirical research methods, communication/dialogue skills, change management, diversity management, management accounting, health economics, computer science, education and didactic, educational management</td>
<td>1. All workshops rated highly 2b. There was no significant change in the self-rated confidence in leadership skills or team working skills when compared post.</td>
<td>n/a</td>
<td>8.5</td>
</tr>
<tr>
<td>H.2, 2018 [68]</td>
<td>Single US hospital</td>
<td>7</td>
<td>Residents (surgical residents)</td>
<td>3 weeks</td>
<td>3-week course with senior residents giving lectures and presentations 2-3 weeks a week. Training and frequently updated on specific content</td>
<td>Presentations to participants by junior residents reflecting on readings from the course reading book</td>
<td>Leadership skills, personnel management and team building, program management, communication skills, negotiation skills, program finance, educational guidelines for family practice</td>
<td>1. 99% of participants rated the programme valuable (15%) or very valuable (84%); 2a. Enhanced job satisfaction, reduced job stress, and an expanded network of educational contacts and resources. 4b. It has increased the level of stress. Participants reported enhanced job satisfaction, reduced job stress, and an expanded network of educational contacts and resources.</td>
<td>n/a</td>
<td>9</td>
</tr>
<tr>
<td>Pagen, 2003 [68]</td>
<td>USA residency director program</td>
<td>96</td>
<td>Residency directors (neurology)</td>
<td>9 months</td>
<td>9-months, comprising three one-day sessions, two one-half day sessions, and one one-day session. Project work, mentoring</td>
<td>Didactic and small group sessions, project</td>
<td>Leadership skills, personnel management and team building, program management, communication skills, negotiation skills, program finance, educational guidelines for family practice</td>
<td>1. 99% of participants rated the programme valuable (15%) or very valuable (84%); 2a. Enhanced job satisfaction, reduced job stress, and an expanded network of educational contacts and resources. 4b. It has increased the level of stress. Participants reported enhanced job satisfaction, reduced job stress, and an expanded network of educational contacts and resources.</td>
<td>n/a</td>
<td>9</td>
</tr>
<tr>
<td>Denney, 2019 [70]</td>
<td>Single UK deanship (South East Scotland)</td>
<td>98</td>
<td>Residents (Clinical Practice: Trainee, Year 1)</td>
<td>6 months</td>
<td>Single session on leadership, recommended menu of possible experiences</td>
<td>Guideline, didactic feedback, encouragement to seek out specific leadership activities</td>
<td>Recommendations: starting a meeting, “fresh pair of eyes” exercise NEI, running an educational session, practice-leve project, clinical protocols, website design, mini-quality improvement project</td>
<td>2a. All trainers who completed the survey reported that development of leadership skills is either “important” or “very important” for a trainer’s future career. 3a. 50% of trainers felt more involved in their GP practice as a result of their leadership activity. 2b. There was no significant change in the self-rated confidence in leadership skills or team working skills when compared post</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>Source (First Author, Year)</td>
<td>Setting</td>
<td>Learner Number</td>
<td>Learner Type</td>
<td>Intervention Length</td>
<td>Intervention Description</td>
<td>Teaching Methods</td>
<td>Educational Context</td>
<td>Main Findings by Kirkpatrick Level</td>
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<tr>
<td>McAuley, 2005 (74)</td>
<td>Single US hospital</td>
<td>34</td>
<td>Physicians (new cohort)</td>
<td>2 years</td>
<td>24 monthly training sessions, 1 half-day session every 6 months</td>
<td>Active learning, interactive questions, case-based scenarios.</td>
<td>Development, problem solving, strategy, change, situational leadership, communication, negotiation, coaching and mentoring, conflict, finances.</td>
<td>1. Mean score (4.7/5) for satisfaction, 4.8 for quality of instruction. 2a. Participants reported increased effectiveness (1.95), teamwork (1.95) and team building (2.5), as well as new roles (1.95). Participants reported using skills learned. 3. Significant increase in self-awareness. 4. Improved organizational collaboration towards strategic initiatives. 5. Participants reported increased self-awareness. 6. Demonstrated increased knowledge of authentic leadership concepts. 7. Self-reported long-term (6 years) application of skills learned into clinical practice.</td>
<td>6.8</td>
<td></td>
</tr>
<tr>
<td>Shah, 2013 (72)</td>
<td>Single US specialty training</td>
<td>80</td>
<td>Consultants (orthopaedic surgeons)</td>
<td>2 days</td>
<td>2x2½ day interactive sessions</td>
<td>Case-based small group discussions presented back to large group.</td>
<td>Admitting vulnerability and uncertainties, taking responsibility for managing risk, doing self and peer reflection, internalizing authentic leadership.</td>
<td>Feedback &amp; discussion.</td>
<td>1.8</td>
<td></td>
</tr>
<tr>
<td>Clapp, 2018 (73)</td>
<td>Single US hospital</td>
<td>36</td>
<td>Residents (Department of Anesthesiology and Critical Care)</td>
<td>1 year</td>
<td>2½ 4 hour interactive sessions</td>
<td>Case-based small group discussions presented back to large group.</td>
<td>Admitting vulnerability and uncertainties, taking responsibility for managing risk, doing self and peer reflection, internalizing authentic leadership.</td>
<td>Feedback &amp; discussion.</td>
<td>1.8</td>
<td></td>
</tr>
<tr>
<td>Babitch, 2006 (77)</td>
<td>Single US hospital</td>
<td>113</td>
<td>Residents (Neurosurgery)</td>
<td>1 year</td>
<td>Monthly 2½ sessions</td>
<td>Interactive lecture, self-assessment activities, case studies, small group discussions, and reading materials.</td>
<td>Leadership style, conflict management, effective feedback, team building, team leadership, motivation, moving from peer to leader.</td>
<td>1. Significant increase in self-awareness in leadership knowledge. 2. Significant increase in self-awareness in leadership knowledge.</td>
<td>0.8</td>
<td></td>
</tr>
<tr>
<td>Vonders, 2014 (75)</td>
<td>Single US residency programme</td>
<td>80</td>
<td>Residents (Radiology, PGY 1-4)</td>
<td>4 years</td>
<td>Year residency programme in leadership fundamentals and leadership tracks.</td>
<td>Monthly lectures for first 2 years, research work with imaging scientists, mentoring, project work</td>
<td>Research, education, business/management, quality care/service, and information technology.</td>
<td>1. &quot;universal prior&quot; from participants for the mandatory first 2 years, 100% opted into the optional year 3-4. 2. 4 participants have worked on projects as part of the programme, with one having submitted academic manuscripts resulting from her project.</td>
<td>0.8</td>
<td></td>
</tr>
<tr>
<td>Grover, 2006 (76)</td>
<td>Single US health system</td>
<td>27</td>
<td>Physicians and residents (Finance, IT, nursing, public relations)</td>
<td>8 months</td>
<td>Case-based leadership discussions during two-four sessions</td>
<td>Management, leadership, forming vision, professional and personal coaching, clinical leadership.</td>
<td>Leadership styles, leadership competencies, effective feedback, team building, strategic management, professional development, quality care/service, and information technology.</td>
<td>1. High ratings for the course 4.6/5 for comparison to other leadership and education programmes experienced. 2. Improved self-confidence in leadership, intended changes to leadership style. 3. Increased knowledge of desirable leadership characteristics in the organization. 4. Several of the participants reported experimenting in their current leadership assignments with concepts discussed during a session, one participant used one of the tools to heighten the leadership awareness of some of his own subordinates. Reported personal benefits of the programmes experienced.</td>
<td>0.8</td>
<td></td>
</tr>
<tr>
<td>Robbins, 2006 (77)</td>
<td>Single US residency program (pandemic)</td>
<td>98</td>
<td>Residents (Radiology, PGY 2-3)</td>
<td>9 months</td>
<td>Lectures</td>
<td>A core curriculum focusing on physician communication, medical economics, healthcare systems, leadership and communication, career planning, contracts, health law, and customer service</td>
<td>Leadership styles, leadership competencies, effective feedback, team building, strategic management, professional development, quality care/service, and information technology.</td>
<td>1. Satisfaction scores &quot;between 3 and 4&quot; on a four-point scale. 2. Improvement in some comprehension of the subject matter of each lecture, with an average increase of 20% to 40% between tests (4-point scale).</td>
<td>0.8</td>
<td></td>
</tr>
<tr>
<td>Gudi K, 2018 (78)</td>
<td>Indian health care organisation</td>
<td>96</td>
<td>Clinicians and hospital administrators from public and private sector organisations</td>
<td>3 days</td>
<td>Didactic lectures, small group workshops, focus group discussions, and experience sharing</td>
<td>Didactic lectures, small group workshops, focus group discussions, and experience sharing.</td>
<td>Didactic lectures, group discussion, workshops, case studies, student presentations, clinical pedagogy.</td>
<td>2. Statistically significant increase in all 30 items related to knowledge and skills.</td>
<td>0.8</td>
<td></td>
</tr>
<tr>
<td>Skelton, 2004 (79)</td>
<td>Single US residency program (internal medicine)</td>
<td>32</td>
<td>Residents (PGY-1)</td>
<td>1 day</td>
<td>One day retreat</td>
<td>Group simulation exercise, group discussion.</td>
<td>Leadership competencies, self awareness.</td>
<td>1. All attendees rated the retreat as valuable. 2. Based on significant changes in residents' responses on the postretirement questionnaire, the retreat enhanced their abilities to be better physicians, resident supervisors, and leaders (p&lt;0.05). 3. Postretirement questionnaires (n=20) indicated significant increase in agreement that goal leaders challenge the process, make decisions based on shared vision, allow others to act, recognize individual contributions, and serve as good role models. 4. Participants discussed the programmes, partly due to high expectations not being met. 5. Feedback and satisfaction</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>Edmonstone, 2009 (80)</td>
<td>Multiple UK strategic health authorities</td>
<td>200</td>
<td>Senior medical leaders in primary and secondary care and public health</td>
<td>12 months</td>
<td>Two ½ day residential courses at the beginning and end of each programme, and three 2½ day interaction days spread over the subsequent 6 months.</td>
<td>Personal development plan, coaching, mentoring</td>
<td>Leadership for partnership. Personal development through the creation of a personal development plan, provision of coaching, and support for personal development.</td>
<td>1. Mean score of 3.8/5 for re-accreditation of the next programme. 2. 50% of participants reported increased effectiveness, 50% of participants reported increased knowledge of desirable leadership characteristics. 3. 100% of participants reported increased self-awareness. 4. Improved organizational collaboration towards strategic initiatives. 5. Participants reported increased self-awareness. 6. Demonstrated increased knowledge of authentic leadership concepts. 7. Self-reported long-term (4 years) application of skills learned.</td>
<td>0.8</td>
<td></td>
</tr>
<tr>
<td>Strogies, 2008 (81)</td>
<td>Single Canada residency program</td>
<td>52</td>
<td>Residents (PGY-1-6, DOY/20)</td>
<td>4½ days</td>
<td>Workshops (four half-days)</td>
<td>Interactive teaching as much as possible. Didactic teaching and small group discussions, interactive techniques (buzz groups, brain-storming, think-pair-share discussions, a debate, and clinical case studies)</td>
<td>Didactic teaching/lectures student presentations, small group discussions.</td>
<td>1. Attendance averaged 59% overall. Workshops averaged 62% of those invited. Participants appreciated the reflective and interactive components of the workshops and valued the hands-on exercises and the use of case studies and &quot;real life&quot; examples. They suggested that more time be dedicated to quality improvement and medical error and opportunities to take part in administrative committees and quality improvement projects at their host hospital sites. Focus requested on current efforts rather than historical overview. 2. Objectives respected skills and knowledge gained were met (75% as an overall score).</td>
<td>1.8</td>
<td></td>
</tr>
<tr>
<td>Berkowicz, 2014 (82)</td>
<td>Single Dutch university medical centre</td>
<td>14</td>
<td>Residents (OB/GYN, paediatrics, internal medicine)</td>
<td>8 hours</td>
<td>2 x 4 hour sessions 2 weeks apart with homework between</td>
<td>Didactic teaching/lectures student presentations.</td>
<td>Knowledge of the healthcare system time management.</td>
<td>1. Rated 74/80 (&quot;75/5 is great in our current postgraduate medical training&quot;) 2. Increased interest in leadership development. 3. No significant changes (underpowered).</td>
<td>0.75</td>
<td></td>
</tr>
<tr>
<td>Wark, 2007 (83)</td>
<td>11 residency</td>
<td>146</td>
<td>Residents</td>
<td>2 days</td>
<td>2 day programme</td>
<td>Experiential small-group</td>
<td>Leadership competencies, self awareness,</td>
<td>1. High satisfaction scores of 6.2 on a scale of 1-7 (6 = fully satisfied)</td>
<td>0.75</td>
<td></td>
</tr>
</tbody>
</table>

BMJ Leader
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<tr>
<th>Source/First Author, Year</th>
<th>Setting</th>
<th>Learner Number</th>
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<th>Main Findings by Knowledge Level</th>
<th>JBI Score</th>
<th>MERSQI Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>program at Australia</td>
<td></td>
<td>20</td>
<td>residents and 14 resident medical officers</td>
<td>10 months</td>
<td>Large group lectures, discussions, role-playing, simulations, group discussions, leadership exercises</td>
<td>group work, individual exercises, self-assessment, seminars, group discussions, didactic content</td>
<td>group discussion and training styles, conflict resolution, involving as teacher, time management, delegation, leadership styles, managing stress, safety and quality, team building, feedback and action planning</td>
<td>1. Significant increase in confidence in all areas of the hospital questionnaire. Examples include working effectively as a team, effective communication, self-assessment. 2. Participants agreed that the information was relevant to their future careers. 3. No significant increase in self-awareness (only 53% agreed or strongly agree that understanding of own behaviour and motivations improved immediately post, only 43% agreed or strongly agree at 6 months)</td>
<td>7.5/7.5</td>
<td>7.5/7.5</td>
</tr>
<tr>
<td>Doughty, 2018 [94]</td>
<td>Single UK hospital trust</td>
<td>NR (≠18)</td>
<td>Specialty trainees, ST4-5</td>
<td>10 months</td>
<td>Large group lectures, discussions, role-playing, simulations, didactic content</td>
<td>large group discussions, active learning (pp or patient safety)</td>
<td>Medical leadership project management; patient safety and (pp methodology; trust overview and patient-clinician experience</td>
<td>1. Significant increase in confidence in all areas of the hospital questionnaire. Examples include working effectively as a team, effective communication, self-assessment. 2. Participants agreed that the information was relevant to their future careers.</td>
<td>5/5</td>
<td>5/5</td>
</tr>
<tr>
<td>Fing, 2010 [95]</td>
<td>Single US hospital department</td>
<td>200</td>
<td>Residents (Paediatric Oncology)</td>
<td>2 months</td>
<td>20-weeks</td>
<td>Facilitated leadership projects</td>
<td>Leadership training</td>
<td>1. Increased in self-confidence in all the 26 categories in each of the program's five cohorts (significant not required)</td>
<td>7/7</td>
<td>7/7</td>
</tr>
<tr>
<td>Hunt, 2017 [96]</td>
<td>Single UK training camp</td>
<td>20</td>
<td>Residents (interns at the start of PGY1)</td>
<td>NR</td>
<td>Surgical residents</td>
<td>Surgical residents</td>
<td>Leadership training</td>
<td>1. Some impact on confidence in areas such as working as a team, effective communication, self-assessment. 2. Participants agreed that the information was relevant to their future careers.</td>
<td>7/7</td>
<td>7/7</td>
</tr>
<tr>
<td>Muntz, 2011 [97]</td>
<td>Programme across 3 US states</td>
<td>1/20 (not specified)</td>
<td>All participants</td>
<td>1 year</td>
<td>Extended year</td>
<td>Facilitated leadership projects</td>
<td>Leadership training</td>
<td>1. Increased in self-confidence in all the 26 categories in each of the program's five cohorts (significant not required)</td>
<td>7/7</td>
<td>7/7</td>
</tr>
<tr>
<td>Trask, 2018 [98]</td>
<td>Single UK hospital trust</td>
<td>20</td>
<td>Residents (PGY4-5 Psychiatry residents)</td>
<td>1 year</td>
<td>6 month</td>
<td>Facilitated leadership projects</td>
<td>Leadership training</td>
<td>1. Increased in self-confidence in all the 26 categories in each of the program's five cohorts (significant not required)</td>
<td>7/7</td>
<td>7/7</td>
</tr>
<tr>
<td>Patterson, 2013 [99]</td>
<td>Single UK GP Deanery (South Yorkshire Region)</td>
<td>8</td>
<td>Residents (GP trainees, PGY3-5)</td>
<td>8 months</td>
<td>8 months</td>
<td>Facilitated leadership projects</td>
<td>Leadership training</td>
<td>1. Increased in self-confidence in all the 26 categories in each of the program's five cohorts (significant not required)</td>
<td>7/7</td>
<td>7/7</td>
</tr>
<tr>
<td>Moss, 2016 [100]</td>
<td>Single Israeli health provider</td>
<td>256</td>
<td>Physician-managers</td>
<td>8 weeks</td>
<td>8 weeks</td>
<td>Facilitated leadership projects</td>
<td>Leadership training</td>
<td>1. Increased in self-confidence in all the 26 categories in each of the program's five cohorts (significant not required)</td>
<td>7/7</td>
<td>7/7</td>
</tr>
<tr>
<td>Steinert, 2003 [101]</td>
<td>Single Canadian department</td>
<td>16</td>
<td>Faculty (Family Medicine)</td>
<td>2 days</td>
<td>2 days</td>
<td>Facilitated leadership projects</td>
<td>Leadership training</td>
<td>1. Increased in self-confidence in all the 26 categories in each of the program's five cohorts (significant not required)</td>
<td>7/7</td>
<td>7/7</td>
</tr>
<tr>
<td>Satiani, 2014 [102]</td>
<td>Single UK hospital department</td>
<td>24</td>
<td>Surgeons who wish to assume administrative or leadership roles</td>
<td>18 months</td>
<td>18 months</td>
<td>Facilitated leadership projects</td>
<td>Leadership training</td>
<td>1. Increased in self-confidence in all the 26 categories in each of the program's five cohorts (significant not required)</td>
<td>7/7</td>
<td>7/7</td>
</tr>
<tr>
<td>Lee, 2004 [103]</td>
<td>Single UK residency programme ( pediatrics, Hawaii)</td>
<td>10</td>
<td>Residents (PGY2)</td>
<td>3hrs</td>
<td>3-hour interactive workshop during resident retreat</td>
<td>Case scenarios, problem solving, role playing, interactive discussions and self-reflection</td>
<td>Leadership competency, strategic planning and vision, financial management, business planning, communication skills, change management, quality improvement, negotiation and problem-solving, stress management and leadership issues, business knowledge and talent management, diversity for healthcare leaders, healthcare law, medico-legal issues, ethics, communication and learning styles, conflict resolution</td>
<td>1. Increased in self-confidence in all the 26 categories in each of the program's five cohorts (significant not required)</td>
<td>7/7</td>
<td>7/7</td>
</tr>
<tr>
<td>Skinner, 2004 [104]</td>
<td>Single UK department of psychiatry</td>
<td>13</td>
<td>Residents and post-doctoral fellows</td>
<td>6 months</td>
<td>6 months</td>
<td>Facilitated leadership projects</td>
<td>Leadership training</td>
<td>1. Increased in self-confidence in all the 26 categories in each of the program's five cohorts (significant not required)</td>
<td>7/7</td>
<td>7/7</td>
</tr>
<tr>
<td>Awad, 2004 [105]</td>
<td>Single US residency program (surgery)</td>
<td>NR</td>
<td>Residents (Surgery)</td>
<td>6 months</td>
<td>6 months</td>
<td>Facilitated leadership projects</td>
<td>Leadership training</td>
<td>1. Increased in self-confidence in all the 26 categories in each of the program's five cohorts (significant not required)</td>
<td>7/7</td>
<td>7/7</td>
</tr>
<tr>
<td>Source (First Author, Year)</td>
<td>Setting</td>
<td>Learner Number</td>
<td>Learner Type</td>
<td>Intervention Length</td>
<td>Intervention Description</td>
<td>Teaching Methods</td>
<td>Educational Context</td>
<td>Main Finding by Kilpatrick level</td>
<td>JBI Score</td>
<td>MERSQI Score</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>---------</td>
<td>----------------</td>
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<td>----------------</td>
</tr>
<tr>
<td>Bayard, 2008 [96]</td>
<td>Single US residency program (family medicine)</td>
<td>NR</td>
<td>Residents (Family Medicine PGY2-3)</td>
<td>2 years</td>
<td>Nine half-day sessions (first year), monthly one-hour sessions (second year)</td>
<td>Interactive lectures and group assignments</td>
<td>Early through midcareer, self-awareness, and integrity. A practice management curriculum: Determining/balancing personal and professional goals, practice opportunities, facilities, organization, operation and management, staff policies, legal issues, marketing, resources and hospital issues. Giving feedback and delegating duties, building effective teams, dealing with stress, coping with stress, effective learning while on duty, facing difficult and in the OR, and managing conflicts. Managing employment, managing personal finances, handling malpractice risk, and managing a private practice. Leadership NOS.</td>
<td>I. Reported that the course was beneficial, a positive experience. 1. “Junior residents expressed frustration that the program was taking them away from their responsibilities as upper-level residents (p = .0002) and felt better prepared to deal with the challenges they would face in their future.” 2a. Participants reported improved skills in giving feedback, delegating, negotiating employment, managing personal finances, handling malpractice risk, and managing a private practice. 2b. Participants reported improved skills in giving feedback, delegating, negotiating employment, managing personal finances, handling malpractice risk, and managing a private practice. 1. Participants reported their likelihood of recommending the program at 7.8 (10 being extremely likely); 2a. Confidence seemed to increase (limited data reported). 2b. Overall self-confidence score improved from 2.8 to 3.</td>
<td>6</td>
<td>6.5</td>
</tr>
<tr>
<td>Source (First Author, Year)</td>
<td>Setting</td>
<td>Learner Number</td>
<td>Learner Type</td>
<td>Intervention Length</td>
<td>Intervention Description</td>
<td>Teaching Methods</td>
<td>Educational Content</td>
<td>Main Findings by Kirkpatrick Level</td>
<td>JBI Score</td>
<td>MERSQI Score</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
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<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>O’Donnell, 2011 [116]</td>
<td>Single US hospital</td>
<td>NR</td>
<td>Residents (PGY1)</td>
<td>1/2 day</td>
<td>(1) seminar focused on evidenced intelligence</td>
<td>Readings, formalized presentations, analysis of videos, role-play</td>
<td>Emotional intelligence</td>
<td>1. Seminar was felt by participants to have provided relevant content</td>
<td>n/a</td>
<td>6</td>
</tr>
<tr>
<td>Johnson, 2014 [111]</td>
<td>Single US hospital</td>
<td>NR</td>
<td>Residents (junior medical residents)</td>
<td>2.5 hours</td>
<td>2.5 hour workshop delivered by modules</td>
<td>Active learning, small group discussions, case scenarios, assignments, reflection exercises, multidisciplinary leadership coaching (depending on which tier of the program)</td>
<td>Principles of leadership, creating change and conflict management, mentoring, creating value, managing difficult people, personal wellness</td>
<td>1. “Average rating for all components was 4.44 on a 6-point Likert scale”. Components were not specified, nor the anchors of the Likert scale</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Bircher, 2013 [110]</td>
<td>Single Canadian hospital</td>
<td>29</td>
<td>Physicians, leaders</td>
<td>8 months</td>
<td>8 months dedicated to new senior leadership roles</td>
<td>Multi-source feedback, self-reflection, readings, group learning projects, coaching</td>
<td>Alignment of competencies, a synergistic approach, effective learning strategies</td>
<td>1. Participants reported increased ability to be confident and vulnerable as a leadership</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Biese, 2011 [113]</td>
<td>Single US hospital</td>
<td>12</td>
<td>Residents (PGY4)</td>
<td>1 year</td>
<td>1 year of educational experience</td>
<td>Didactic teaching, online learning environment, supervision, project work as an individual</td>
<td>Educational Content</td>
<td>1. Overall course rated 4.6 out of 5. Examples of cross-departmental collaboration have been seen.</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Torbeck, 2014 [109]</td>
<td>Single US academic department</td>
<td>Unclear</td>
<td>Faculty up to senior leadership/chairs</td>
<td>2 to 12 months</td>
<td>2 to 12 month workshop delivered by modules</td>
<td>Active learning, small group discussions, case scenarios, assignments, reflection exercises, multidisciplinary leadership coaching (depending on which tier of the program)</td>
<td>Principles of leadership, creating change and conflict management, mentoring, creating value, managing difficult people, personal wellness</td>
<td>1. Only 20% of faculty attended basic programme. Overall reaction post-session was positive to extremely positive.</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Skerrett, 2015 [108]</td>
<td>Single US hospital</td>
<td>NR</td>
<td>Residents (PGY1)</td>
<td>2.5 hrs</td>
<td>2.5 hour workshop delivered by modules</td>
<td>Active learning, small group discussions, case scenarios, assignments, reflection exercises, multidisciplinary leadership coaching (depending on which tier of the program)</td>
<td>Principles of leadership, creating change and conflict management, mentoring, creating value, managing difficult people, personal wellness</td>
<td>2a. Comments cited increased awareness and understanding of leadership principles.</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Bircher, 2013 [111]</td>
<td>Single US hospital</td>
<td>NR</td>
<td>Residents (GP trainees)</td>
<td>2 years</td>
<td>2 years dedicated to new senior leadership roles</td>
<td>Didactic teaching, online learning environment, supervision, project work as an individual</td>
<td>Educational Content</td>
<td>1. Participants reported increased ability to be confident and vulnerable as a leadership</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Kocher, 2008 [112]</td>
<td>Single US academic medical centre</td>
<td>30</td>
<td>Faculty members</td>
<td>5 months</td>
<td>5 months, 9-day course in three segments over five months</td>
<td>Sessions, lectures</td>
<td>Leadership, communication, strategic planning, alignment of competencies, a systems and professional debrief, mentoring, coaching</td>
<td>1. Only 20% of faculty attended basic programme. Overall reaction post-session was positive to extremely positive.</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Wise, 2011 [112]</td>
<td>Single US hospital department</td>
<td>NR</td>
<td>Residents (Senior Residents, Emergency Medicine)</td>
<td>1 year</td>
<td>1 year of educational experience</td>
<td>Didactic classroom discussions, expert panel presentations, interactive case-based learning, group exercises, skill enhancement workshops, individual project with supervision</td>
<td>Principles of leadership, innovation, creative problem solving, and communication</td>
<td>2a. Increased confidence in having difficult conversations 2b. Participants reported improved time management and application of skills learnt</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Cherry, 2011 [114]</td>
<td>Single US university</td>
<td>44</td>
<td>Junior Faculty</td>
<td>9 months</td>
<td>2.5 hours per week</td>
<td>Didactic classroom discussions, expert panel presentations, interactive case-based learning, group exercises, skill enhancement workshops, individual project with supervision</td>
<td>Principles of leadership, innovation, creative problem solving, and communication</td>
<td>2a. Increased confidence in having difficult conversations 2b. Participants reported improved time management and application of skills learnt</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Johnson, 2014 [111]</td>
<td>Single US hospital</td>
<td>Unclear</td>
<td>(14 respondents to survey)</td>
<td>1.25 hrs</td>
<td>(1) seminar focused on evidenced intelligence</td>
<td>Readings, formalized presentations, analysis of videos, role-play</td>
<td>Emotional intelligence</td>
<td>1. Seminar was felt by participants to have provided relevant content</td>
<td>n/a</td>
<td>6</td>
</tr>
<tr>
<td>O’Donnell, 2011 [116]</td>
<td>Single US hospital (residency programs)</td>
<td>NR</td>
<td>Residents (PGY1)</td>
<td>4 weeks</td>
<td>4 week course on resident rotation in case management</td>
<td>Readings, formalized presentations, analysis of videos, role-play</td>
<td>Emotional intelligence</td>
<td>1. Seminar was felt by participants to have provided relevant content</td>
<td>n/a</td>
<td>6</td>
</tr>
<tr>
<td>Wagstaff, 2018 [117]</td>
<td>Single US residency programme</td>
<td>36</td>
<td>Residents (Family Medicine, PGY4)</td>
<td>NR</td>
<td>NR</td>
<td>Readings, formalized presentations, analysis of videos, role-play</td>
<td>Emotional intelligence</td>
<td>1. Seminar was felt by participants to have provided relevant content</td>
<td>n/a</td>
<td>6</td>
</tr>
</tbody>
</table>

Supplementary Table 1: Summary of included studies. NR= Not Reported; NOS=Not Otherwise Specified; n/a=not applicable. MERSQI=Medscape Education Research Study Quality Instrument; JBI=Joanna Briggs Institute Critical Appraisal Checklist for Qualitative Research.
References:


41 Kuo AK, Thyne SM, Chen HC, et al. An innovative residency program designed to develop leaders to improve the health of children. *Acad Med* 2010;85:653. doi:10.1097/ACM.0b013e3181b6f0f6


Saravo B, Netzel J, Kiesewetter J. The need for strong clinical leaders - Transformational and transactional leadership as a framework for resident leadership training. *PLoS One* 2017;12:e0183019. doi:https://dx.doi.org/10.1371/journal.pone.0183019


105 Ninan D, Patel D. Career and Leadership Education in Anesthesia Residency Training. Cureus 2018;10:e2546. doi:https://dx.doi.org/10.7759/cureus.2546


114 Cherry RA, Davis DC, Thornodyke L. Transforming culture through physician leadership development. Physician Exec 2010;36:38–44.


doi:10.1097/ncm.0b013e31821b0785

<table>
<thead>
<tr>
<th>MERSQI Component</th>
<th>Classification</th>
<th>All studies (117)</th>
<th>MERSQI&gt;12 (16)</th>
<th>JBI&gt;6 (14)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Study Design</strong></td>
<td>Single Group Cross-Sectional or post-programme only</td>
<td>54 (46%)</td>
<td>0 (0%)</td>
<td>8 (57%)</td>
</tr>
<tr>
<td></td>
<td>Single Group Pre and Post Programme</td>
<td>54 (46%)</td>
<td>9 (56%)</td>
<td>5 (36%)</td>
</tr>
<tr>
<td></td>
<td>Non-Randomised Two Group</td>
<td>8 (7%)</td>
<td>6 (38%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td></td>
<td>Randomised Controlled Trial</td>
<td>1 (1%)</td>
<td>1 (6%)</td>
<td>1 (7%)</td>
</tr>
<tr>
<td><strong>Institution #</strong></td>
<td>Single</td>
<td>81 (69%)</td>
<td>10 (63%)</td>
<td>9 (64%)</td>
</tr>
<tr>
<td></td>
<td>Double</td>
<td>1 (1%)</td>
<td>1 (6%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td></td>
<td>Multi</td>
<td>35 (30%)</td>
<td>5 (31%)</td>
<td>5 (36%)</td>
</tr>
<tr>
<td><strong>Response Rate</strong></td>
<td>&lt;50% or NR</td>
<td>44 (38%)</td>
<td>3 (19%)</td>
<td>1 (7%)</td>
</tr>
<tr>
<td></td>
<td>50-75%</td>
<td>23 (20%)</td>
<td>3 (19%)</td>
<td>6 (43%)</td>
</tr>
<tr>
<td></td>
<td>&gt;75%</td>
<td>48 (41%)</td>
<td>9 (56%)</td>
<td>7 (50%)</td>
</tr>
<tr>
<td><strong>Type of Data</strong></td>
<td>Self-reported</td>
<td>70 (60%)</td>
<td>2 (13%)</td>
<td>9 (64%)</td>
</tr>
<tr>
<td></td>
<td>Observed</td>
<td>47 (40%)</td>
<td>14 (88%)</td>
<td>5 (36%)</td>
</tr>
<tr>
<td><strong>Questionnaire Construct Validity</strong></td>
<td>Reported</td>
<td>9 (8%)</td>
<td>7 (44%)</td>
<td>2 (14%)</td>
</tr>
<tr>
<td></td>
<td>Not Reported</td>
<td>108 (92%)</td>
<td>9 (56%)</td>
<td>12 (86%)</td>
</tr>
<tr>
<td></td>
<td>Reported</td>
<td>45 (38%)</td>
<td>14 (88%)</td>
<td>5 (36%)</td>
</tr>
<tr>
<td></td>
<td>Not Reported</td>
<td>72 (62%)</td>
<td>2 (13%)</td>
<td>9 (64%)</td>
</tr>
<tr>
<td></td>
<td>Reported</td>
<td>8 (7%)</td>
<td>5 (31%)</td>
<td>3 (21%)</td>
</tr>
<tr>
<td></td>
<td>Not Reported</td>
<td>108 (92%)</td>
<td>11 (69%)</td>
<td>11 (79%)</td>
</tr>
<tr>
<td><strong>Questionnaire Content Validity</strong></td>
<td>Reported</td>
<td>23 (20%)</td>
<td>14 (88%)</td>
<td>6 (43%)</td>
</tr>
<tr>
<td></td>
<td>Not Reported</td>
<td>94 (80%)</td>
<td>2 (13%)</td>
<td>8 (57%)</td>
</tr>
<tr>
<td><strong>Relationships to Other Variables</strong></td>
<td>Reported</td>
<td>102 (87%)</td>
<td>7 (44%)</td>
<td>11 (79%)</td>
</tr>
<tr>
<td></td>
<td>Not Reported</td>
<td>15 (13%)</td>
<td>9 (56%)</td>
<td>3 (21%)</td>
</tr>
<tr>
<td><strong>Data Analysis Comprehensiveness</strong></td>
<td>Comprehensive</td>
<td>23 (20%)</td>
<td>14 (88%)</td>
<td>6 (43%)</td>
</tr>
<tr>
<td></td>
<td>Less Comprehensive</td>
<td>94 (80%)</td>
<td>2 (13%)</td>
<td>8 (57%)</td>
</tr>
<tr>
<td></td>
<td>Descriptive only</td>
<td>102 (87%)</td>
<td>7 (44%)</td>
<td>11 (79%)</td>
</tr>
<tr>
<td></td>
<td>Beyond Descriptive</td>
<td>15 (13%)</td>
<td>9 (56%)</td>
<td>3 (21%)</td>
</tr>
<tr>
<td><strong>Outcomes (Kirkpatrick Level)</strong></td>
<td>Level 1</td>
<td>80 (68%)</td>
<td>8 (50%)</td>
<td>14 (100%)</td>
</tr>
<tr>
<td></td>
<td>Level 2a</td>
<td>70 (60%)</td>
<td>7 (44%)</td>
<td>13 (93%)</td>
</tr>
<tr>
<td></td>
<td>Level 2b</td>
<td>79 (68%)</td>
<td>11 (69%)</td>
<td>11 (79%)</td>
</tr>
<tr>
<td></td>
<td>Level 3a</td>
<td>51 (44%)</td>
<td>7 (44%)</td>
<td>10 (71%)</td>
</tr>
<tr>
<td></td>
<td>Level 3b</td>
<td>54 (46%)</td>
<td>14 (88%)</td>
<td>7 (50%)</td>
</tr>
<tr>
<td></td>
<td>Level 4a</td>
<td>9 (8%)</td>
<td>1 (6%)</td>
<td>2 (14%)</td>
</tr>
<tr>
<td></td>
<td>Level 4b</td>
<td>26 (22%)</td>
<td>7 (44%)</td>
<td>4 (29%)</td>
</tr>
</tbody>
</table>

*Supplementary Table 2: Study characteristics organised by MERSQI heading. Brackets in headings refer to original MERSQI items where headings have been adapted for clarity.*
<table>
<thead>
<tr>
<th>JBI Component</th>
<th>Description of component</th>
<th>High-reliability studies (n=14)</th>
<th>Mixed-Methods Studies (n=53)</th>
<th>Qualitative Studies (n=10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Philosophical Perspective</td>
<td>Congruity between the stated philosophical perspective and the research methodology</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Objectives</td>
<td>Congruity between the research methodology and the research question or objectives</td>
<td>39 (63%)</td>
<td>33 (62%)</td>
<td>6 (60%)</td>
</tr>
<tr>
<td>Methods</td>
<td>Congruity between the research methodology and the methods used to collect data</td>
<td>38 (61%)</td>
<td>32 (60%)</td>
<td>6 (60%)</td>
</tr>
<tr>
<td>Analysis</td>
<td>Congruity between the research methodology and the representation and analysis of data</td>
<td>18 (29%)</td>
<td>15 (28%)</td>
<td>3 (30%)</td>
</tr>
<tr>
<td>Interpretation</td>
<td>Congruity between the research methodology and the interpretation of results</td>
<td>17 (27%)</td>
<td>13 (25%)</td>
<td>4 (40%)</td>
</tr>
<tr>
<td>Researcher Location</td>
<td>Statement locating the researcher culturally or theoretically</td>
<td>10 (16%)</td>
<td>8 (15%)</td>
<td>2 (20%)</td>
</tr>
<tr>
<td>Researcher Influence</td>
<td>Influence of the researcher on the research addressed</td>
<td>13 (21%)</td>
<td>12 (23%)</td>
<td>1 (10%)</td>
</tr>
<tr>
<td>Participant Representation</td>
<td>Participants and their voices adequately represented</td>
<td>21 (34%)</td>
<td>16 (30%)</td>
<td>5 (50%)</td>
</tr>
<tr>
<td>Ethics</td>
<td>Evidence of ethical approval by an appropriate body</td>
<td>26 (42%)</td>
<td>23 (43%)</td>
<td>3 (30%)</td>
</tr>
<tr>
<td>Conclusions Supported</td>
<td>Conclusions drawn in the research report flow from the analysis or interpretation of the data</td>
<td>20 (32%)</td>
<td>16 (30%)</td>
<td>4 (40%)</td>
</tr>
</tbody>
</table>

Supplementary Table 3: Proportion of studies which met Joanna Briggs Institute (JBI) Critical Appraisal Items for Qualitative Studies. Descriptions are adapted from the JBI tool. Higher Reliability Studies scored 6 or more on the JBI tool.
Supplementary Figure 1: Medline (OVID) Search Strategy, January 2020