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Medical leadership systematic review: Do hospitals and healthcare organisations perform better when led by doctors?

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Leadership, management, physician executive, clinician-manager, organisational performance, patient outcomes

ABSTRACT

Objectives: Despite a common assumption that doctors are well placed to lead hospitals and healthcare organisations, there is little evidence in the peer-reviewed literature on the performance of doctors in leadership roles in comparison with that of non-medical managers. The aim of this systematic review is to determine whether medical training is associated with superior management performance in terms of organisational performance or patient outcomes.

Methods: We searched for peer-reviewed, English language studies using Medline and Embase between 2005 and 2015. We included empirical studies on middle and upper level healthcare managers where participants were both doctors and leaders. We were particularly interested in studies that examined the contribution of medical training or background to performance. Studies were excluded if they did not have full-text available, did not include any organisational or patient measure, or did not allow for performance of medical leaders to be compared with that of non-medically trained managers.

Results: The search, conducted in the Medline (n=2,160) and Embase (n=1,166) databases yielded a total of 3,326 entries. After application of inclusion and exclusion criteria, five studies remained. While all five included studies found that there were differences between medical and non-medical managers, only two studies correlated findings with hospital performance or patient outcomes. There were no common themes, with studies examining varied topics: risk aversion, IT adoption, patient care arrangements, financial reporting, staff-to-patient ratios, and the composition of hospital boards and committees.

Conclusion: Despite considerable interest in the topic, few studies provided robust evidence on whether hospitals and healthcare organisations perform better when led by doctors. None of the studies identified in our review provided the definitive evidence we seek.

Strengths and limitations of this study

- To the best of our knowledge, this is the first systematic review of the literature published over the last decade to determine whether healthcare leaders who are doctors perform better than

those with non-medical backgrounds in terms of organisational performance or patient outcomes

- We developed robust search strategies and a rigorous reviewing process with the aim to minimise bias and ensure the objectiveness and transparency of the systematic review
- There were insufficient studies meeting inclusion criteria to enable our research question to be fully answered
- Most studies examined only one or two aspects of leadership; this limited the generalisation of findings

BACKGROUND

Prior to the 1970s, clinicians very often ran hospitals[1 2] and administrators played a subordinate, coordination, rather than a leadership, role. As healthcare moved towards a more business-bureaucratic[3] model of practice, administrators were engaged to manage general organisational-operational business performance, but doctors continued to expend substantial resources and manage the major decisions affecting patient care. In 1983, the Griffiths Report[4] was released in the UK, paving the way for the introduction of a new purchaser-provider model of healthcare. In the USA, the idea which became known as clinical directorates was established.[5] These ushered in the move to widely establish the Medical Director role and clinical directors, and enabled over time more senior managers to have greater control over resources. Doctors did not always consider such roles attractive, but felt that they needed to take up these part-time appointments in order to continue to partake in decisions affecting their work. In the 1990s, when managed care was established in the USA,[6] new drivers emerged as physicians moved from part-time advisory roles into full-time management in order to contribute to running health care organisations, secure greater control over resource allocation and participate in senior decision making.

Today, clinicians are well-established in management roles, with the first survey of Accountable Care

Organisations (ACOs) in the USA finding that by 2014, 51% were led by doctors.[7] Within hospitals and other healthcare organisations, medical departments are normally led by doctors, and these medical leaders are typically a member of the executive team (see Dwyer[8] for a literature based review on the roles of medical managers). By the turn of the 21st century in the USA, 50% of physician executives no longer practiced medicine,[6] and physician executives began to gain acceptance as administrators of managed care institutions.[9 10] In the UK[2 11] (and elsewhere[11 12]), where the culture was historically less well disposed to accepting doctors who relinquish their clinical work,[13] the majority of medical executives today act as 'hybrid managers', who continue to manage a clinical workload alongside their management responsibilities. Current focus on engaging doctors in leadership centres on efforts to link clinical decisions with those of strategic management, and has broadened to include key accountabilities for quality of care in addition to resource management.[14]

Despite the prevalence of physician executives occupying leadership roles in health systems, we do not know to what extent medical training or experience affects the performance of healthcare managers. Previous research has found no difference in performance between medical and non-medical managers;[15-17] however, opinion on the topic of 'which profession should manage hospitals' is rife. Doctors prefer to be led by doctors,[11] and articles in favour of medical leadership (invariably written by those with medical qualifications) cite doctors' strengths in addressing patient outcomes, quality and safety issues, decision making, ability to specialise, and intelligence. Articles against, cite doctors' lack of formal management training, and their purported weaknesses in financial management, organisational strategy, ability to generalise from medicine to management, and teamwork. In a survey of hospital managers in Nepal,[18] for example, just over 50% respondents said that the best people to manage hospitals were professional hospital managers. However, the answer varied between the professions of the manager. Only 35% of doctors believed that hospitals should be managed by professional managers. Instead, 57% of doctors believed that doctors should manage hospitals, compared to 25% for other staff. There appears to be a view, generally held by physicians, that the physician mindset is different to

that of the general healthcare manager.[19 20]

The prevailing opinion in some quarters is that physicians are not suitable for executive management as they are conservative individualists rather than team players, and that they identify more with their professional responsibilities than their management role.[12 21-23] Contrary to this view, a recent study surveying clinicians' reactions to hospital reform found that clinicians who were also leaders reacted more positively to hospital reform than clinicians who spent most of their time caring for patients.[24] Clearly, the question 'do hospitals and healthcare organisations perform better when led by doctors?' has not been settled.

METHODS

This study presents the results of a systematic review of the literature published over the last decade on medical leadership. The literature review was undertaken in order to determine what is known about doctors in executive management, in particular whether medical training is associated with superior management performance in terms of organisational performance or patient outcomes. The review was framed by the research question: Do hospitals and healthcare organisations perform better when led by doctors?

Search strategy

We searched for peer-reviewed, English language studies using Medline and Embase between 1st January 2005 and 31st December 2015 (Search strategies are presented in table 1). The search was designed to capture both the executive leadership and the medical practitioner role. Three terms were included for executive leadership and linked using the Boolean operator OR to maximise the sensitivity of the search: "executive", "leader", or "manager". For the role of medical practitioner, terms including "physician", "clinician", and "doctor" are used sometimes interchangeably in literature. Thus we searched for all three terms using the OR operator. Both searches were combined, and refined using a

proximity operator. Search results from Medline and Embase were then aggregated and imported to an EndNote library. Duplicate entries were removed and four reviewers (RCW, KL, ZL and LT) conducted a title and abstract screen of the remaining citations. The reviewers worked in pairs, and cross-checked 5% of the citations to establish inter-rater reliability.

Table 1. Medline and Embase search strategies

Database	**Medline**	
Strategy	**Searches**	**Results**
#1	((executive$ or leader$ or manager$) adj3 (physician$ or doctor$ or clinician$)).ab.	2,722
#2	Limit #1 to (English language and yr="2005 - Current")	1,218
#3	*Physician Executives/	2,794
#4	Limit #3 to (English language and yr="2005 - Current")	1,003
#5	#2 or #4	2,160

Database	**Embase**	
Strategy	**Searches**	**Results**
#1	((executive$ or leader$ or manager$) adj3 (physician$ or doctor$ or clinician$)).ab.	3,607
#2	Limit #1 to (English language and yr="2005 - Current" and article)	1,166

Eligibility criteria

We included studies on middle and upper level managers in healthcare organisations that included either participants who were both doctors and leaders, or data pertaining to managers who were also doctors. Studies were excluded if they were not peer-reviewed, or did not report findings from empirical research. We also excluded studies that did not examine the contribution of medical training or background to performance. Further criteria were added following discussion among the reviewers during the full-text review, and studies were excluded if they did not have full-text available, did not include any organisational or patient measure, or did not allow for performance of medical leaders to be compared with that of non-medically trained managers.

Data collection process

Data from the included studies were extracted into a locally developed form for analysis. Elements extracted were: a) the full reference, b) location, c) language, d) period of data collection, e) study type, f) study primary and secondary aims, g) exclusion criteria, h) data: total number of organisations, type of organisations, data types and sources used to performance and/or outcomes, methodological/statistical approach to identify performance and/or outcomes, i) methods: methods used to study contextual/success factors associated with medical leaders (e.g., interview, survey, observation), participants, and data analysis methods, j) findings: quantitative results and qualitative results or contextual factors most important for explaining relationship between medical background of leader and performance, and k) implications.

Synthesis of results

Results were synthesised through inductive interpretive analysis of extracted data. Extracted data were coded and organised to explore connections between data elements and to develop sets of concepts. Segments of data were then linked in a formal fashion in order to allow themes to emerge, and to determine relationships that may exist between different data elements.

RESULTS

Search strategy

The search results and review process are presented in Figure 1 using the Preferred Reporting Items for Systematic Review and Meta-analyses (PRISMA) flow chart. The search performed on Medline (n=2,160) and Embase (n=1,166) yielded a total of 3,326 entries, among which 1108 were identified as duplicates and removed from the EndNote library. Title and abstract of the remaining citations (n=2,218) were screened by four reviewers (RCW, KL, ZL and LT). The citations were randomised and 5% (n=110) were subject to a double-review process, in which the reviewing team split into two pairs (KL and ZL pair 1, RCW and LT pair 2) and each pair reviewed 55 citations. To test inter-rater reliability, we used Cohen's Kappa and found high levels of agreement between the paired reviewers, K=.78 (p<.0001) for pair 1 and

K=.88 (p<.0001) for pair 2. The remaining 95% of the citations were evenly divided among the team and the reviewing process was conducted independently and simultaneously by each reviewer, with regular discussions held at team meetings. The screening of title and abstract resulted in 80 studies eligible for full-text review. During the full-text review stage, a set of predetermined exclusion criteria was applied, leaving 13 studies included in the penultimate pool. Upon further review and consultation with the team, an additional exclusion criterion was added to enable comparison of medical and non-medical leadership, which eliminated eight more studies.

Description of included studies

Four broad categories of articles were found in the search: (1) individual perspectives on medical management, (2) empirical research based on opinion about medical management (surveys, interviews, focus groups), (3) objective empirical research on the role or characteristics of healthcare leaders (observations, other data), and (4) objective empirical research on the relationship between medical leaders and outcomes (hospital performance data, patient outcomes).

Thirteen studies included participants who were both doctors and leaders, however only five studies compared the performance of doctors with that of non-medical managers to address our primary question of 'Do hospitals and healthcare organisations perform better when led by doctors?' The remaining eight studies presented data on managers who were also doctors, but presented data that were peripheral to our question. Even then, few studies addressed more than one or two narrow aspects of healthcare leadership. All five included studies conducted quantitative analysis of questionnaire survey data; one study (Jiang et al.[25]) also provided processes of care data. Three studies were from the USA, one from Ireland and one from Germany (Table 2).

O'Keefe[26] measured and compared risk aversion in 788 Irish clinicians, clinical managers, non-clinical managers, and non-clinical public representatives, in terms of willingness to discharge a patient from

the Emergency Department (ED). The study found no significant difference between clinicians and clinician managers, but found significant differences between clinicians and non-clinicians (including between clinical and non-clinical managers), with the non-clinical participants being more risk averse. Limitations included: (1) there was a large variation in risk tolerance, even between clinicians, (2) it was a single study in a single country, and (3) clinicians are likely to be more familiar both with actual events depicted in the scenarios, and also with the process of making treatment choices that may result in death. The study did not provide indication of an objectively appropriate level of risk, but the authors suggested that the clinicians had a more pragmatic approach to decision-making.

In the USA, Colla et al.[7] measured how doctor-led organisations compared with other Accountable Care Organisations (ACOs) in terms of structure, size and care provided, and explored the degree of doctor engagement in managing ACOs. ACOs are groups of providers that are jointly responsible for caring for a nominated population of patients. Fifty one percent of the 173 ACOs in the study self-identified as physician-led, 33% as jointly led by hospital and physician, and the remainder were led by hospitals or other entities. Doctor-led ACOs were found to be more likely to have advanced IT capabilities and better outpatient care than non doctor-led ACOs, and were more likely to measure and report financial performance at practice and clinicians levels; however this finding was confounded by the fact that physician-led ACOs are less likely to include hospitals and more likely to include physician groups. Performance of ACOs was not assessed, therefore it was not possible to determine whether performance was related to whether leaders were doctors or non-medical managers.

Kuntz et al.[27] assessed the relationship between the amount of medical involvement in leadership and staff-to-patient ratios. The study was conducted in Germany, where hospitals are managed by an executive leadership team consisting of a commercial director, medical director and nursing director. The study was controlled for the size and case mix of the 604 participating hospitals, whether they were public or private, the degree to which they were rural, and whether the doctors were salaried or

contracted. High staff-to-patient ratios for both nurses and doctors are associated with better hospital performance.[28 29] The study found a relationship between full-time Medical Director (MD) or heavily involved part-time MD and a higher staff-to-patient ratio. Full time MDs significantly improved the staff-to-patient ratios for both doctors and nurses (physicians 1.96, p<0.01; nurses: 4.44, p<0.01), whereas part-time MDs only improved the staff-to-patient ratios for doctors (e.g., an increase of part-time involvement from 15 to 25%, resulted in an increase of 2.49 physicians per thousand inpatients).

Goodall[30] examined the relationship between hospital performance and whether the Chief Executive Officer (CEO) was a doctor or a non-medical manager. Hospital performance was determined by media-generated league tables, produced by US News and World Report's (USNWR) 'Best Hospitals' in 2009. Three hundred healthcare executives from three specialties (cancer, digestive disorders, heart and heart surgery) were surveyed in the top 100 USA hospitals. Positive association was found between physician CEOs and hospital performance for all three hospital specialties (p<0.001). While higher performing hospitals were associated with physician CEOs, causation was not able to be determined (e.g., higher performing hospitals may just prefer to have physicians as leaders).

Jiang et al.[25] examined whether differences exist in quality performance of 490 USA hospitals in relation to adoption of particular practices in board oversight of quality. Data consisted of 1) a survey of 562 hospital CEOs on board practices, (2) process of care measures for three clinical conditions (heart attack, heart failure, pneumonia), and (3) outcomes measures, consisting of risk adjusted mortality rates, for the same three conditions. Significantly better performance in processes of care and/or mortality was found for hospitals that had representatives with clinical expertise serving on the quality board. Sixty percent of participating hospitals had a Chief Medical Officer or Vice President of Medical Affairs on the committee; this resulted in significantly higher process of care scores (85.3% vs 81.0%, p<0.05) and lower risk adjusted mortality rates (5.6% vs 7.3%, p<0.05) than hospitals that did not have a Chief Medical Officer or Vice President of Medical Affairs as a committee member. Eighty three percent of

participating hospitals had medical staff on the committee; this resulted in significantly higher process of care scores (84.2% vs 80.9%, p<0.05) but no difference in risk adjusted mortality rates. Sixty three percent of participating hospitals had a clinical board member on the committee; this resulted in no difference in process of care scores but significantly lower risk-adjusted mortality rates (5.7% vs 7.2%, p<0.05).

Table 2. Characteristics of included studies

Study	Country	Study type	Sample size	Analysis method
O'Keefe (2015)[26]	Ireland	Questionnaire survey	788 respondents (180 physicians, 47 clinical managers, 143 non-clinical managers, 418 public representatives)	Quantitative analysis
Colla et al. (2014)[7]	USA	Questionnaire survey	173 Accountable Care Organisations	Quantitative analysis
Kuntz et al. (2013)[27]	Germany	Questionnaire survey	604 hospitals	Quantitative analysis
Goodall (2011)[30]	USA	Questionnaire survey	300 healthcare executives	Quantitative analysis
Jiang et al. (2009)[25]	USA	Questionnaire survey, Processes of care	562 healthcare executives, 490 hospitals	Quantitative analysis

Risk of bias

Risk of bias was assessed using criteria developed by Hawker, et al.[31] Ratings were assigned (poor, fair, good) across nine different categories: 1) abstract and title, 2) introduction and aims, 3) method and data, 4) sampling, 5) data analysis, 6) ethics and bias, 7) results, 8) transferability or generalisability, 9) implications and usefulness (Table 3).[31] While studies were generally well designed and executed, generalisability and usefulness of the findings was low.

Table 3. Methodology rigour and risk of bias

Study	O'Keefe (2015)[26]	Colla et al. (2014)[7]	Kuntz et al. (2013)[27]	Goodall (2011)[30]	Jiang et al. (2009)[25]
Abstract and title	Good	Fair	Fair	Fair	Fair
Introduction and aims	Fair	Fair	Good	Fair	Fair
Method and data	Fair	Good	Good	Fair	Fair
Sampling	Good	Good	Good	Poor	Fair
Data analysis	Good	Poor	Good	Fair	Fair

Ethics and bias	Good	Poor	Good	Poor	Fair
Findings	Fair	Good	Good	Fair	Fair
Generalisability	Fair	Good	Fair	Poor	Fair
Implications and usefulness	Poor	Fair	Fair	Poor	Fair

DISCUSSION

Themes

While all five included studies found that there were differences between medical and non-medical managers, only two studies[25 30] correlated findings with hospital performance or patient outcomes. While Goodall[26] found that there was an association between medical leadership and hospital performance, the study did not provide sufficient information that would allow us to determine why that might be the case. Neither of these studies provided data on the characteristics of medical leaders that were associated with higher performance. There were no common themes, with studies examining varied topics: risk aversion, IT adoption, patient care arrangements, financial reporting, staff-to-patient ratios, and the composition of hospital boards and committees.

Additional evidence

While we were specifically looking for studies that compared managers who are also doctors with managers who do not have medical qualifications, and that attempted to identify associated organisational or patient outcomes, our search also identified studies that explored the characteristics of managers who were doctors, including barriers or enablers for doctors seeking to enter management. While not answering our research question, these studies provide clues to where medical and non-medical managers may differ. Ham et al.[32] investigated, via 22 qualitative interviews, the experiences of doctors who become chief executives of UK National Health Service organisations. They identified the type of doctor that becomes a manager, and barriers and enablers to doctors entering management, and found that medical managers tended to be “keen amateurs” rather than trained managerial

professionals. Kisa and Ersoy,[33] via a 31 item time management questionnaire, characterised the time management difficulties of physician administrators working in 48 primary healthcare facilities in Turkey, and found that medical managers have poor time management skills. Medical managers are not usually trained in leadership,[11 32] which may explain both these findings and some of the negative perceptions of doctors as managers. Doctors who receive leadership or management training, however, may perform well in leadership roles. Xirasagar et al.[34 35] for example, when examining the relationship between leadership styles, training, and effectiveness of doctors who are managers, concluded that doctors who completed managerial training such as MBAs, MHAs, MPHs, or more than 30 days of in-service training were likely to be more effective leaders.

There are also some indications that doctors should adopt a more multidisciplinary approach to be effective leaders. West and Barron[36] investigated, via qualitative interviews, the social and geographical boundaries of the networks of senior nurse executive and physician leaders and managers in acute care hospitals in the UK. They found that medical managers consult or network mostly with other medical managers, and that it is the non-medical managers who act as brokers between professional groups. This finding is supported by other work in the field.[37]

Finally, there were some indications that doctors who combined management with clinical practice were less likely to be effective in their non-clinical leadership role. Two studies examined the role of the hybrid medical manager. Kippist and Fitzgerald[12] examined tensions between hybrid clinician managers' professional values and healthcare organisations' management objectives in Australian hospitals via 14 semi-structured interviews and observation of interactions between team members at several team meetings. Their study found that hybrid managers would prioritise clinical work over management, leading to additional burden on their managerial colleagues, thereby questioning the effectiveness of the hybrid clinician manager. Spehar et al.[23] explored influences and strategies employed by 30 hybrid leaders in four hospitals in Norway via interviews and observations. The study concluded that doctors

who were managers could not influence other doctors without drawing on professional power, and that doctors felt they had to maintain their clinical skills to retain credibility among peers. This emphasis on professional skill constrained doctors from drawing effectively on positional power. This expert power was not retained and had to be continuously regenerated. In addition, rather than collaborating, doctors saw clinician managers of other departments as competitors, and saw themselves as representatives of their own professional group.

Limitations

There were insufficient studies meeting inclusion criteria to enable our research question to be robustly answered. Most studies examined only one or two aspects of leadership; this limited the generalisation of findings.

CONCLUSION

Despite considerable interest in healthcare on whether hospitals and healthcare organisations perform better when led by doctors, and much opinion on the matter, there are few studies that have examined this topic in a robust way or directly compared the performance of medical and non-medical managers. We found only five studies that provided empirical data in respect of this question, yet none of the studies provided the definitive answer we seek.

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COMPETING INTERESTS

The authors have read and understood the *BMJ* policy on declaration of interests and declare that we have no competing interests.

DATA SHARING

The full dataset is available from the corresponding author on request.

AUTHORS' CONTRIBUTIONS

RC-W and JB conceptualised the study, KL, ZL and LT conducted the database searches. RC-W, KL, ZL and LT conducted the search and review strategy, RC-W drafted the manuscript, all authors reviewed the manuscript for critical content.

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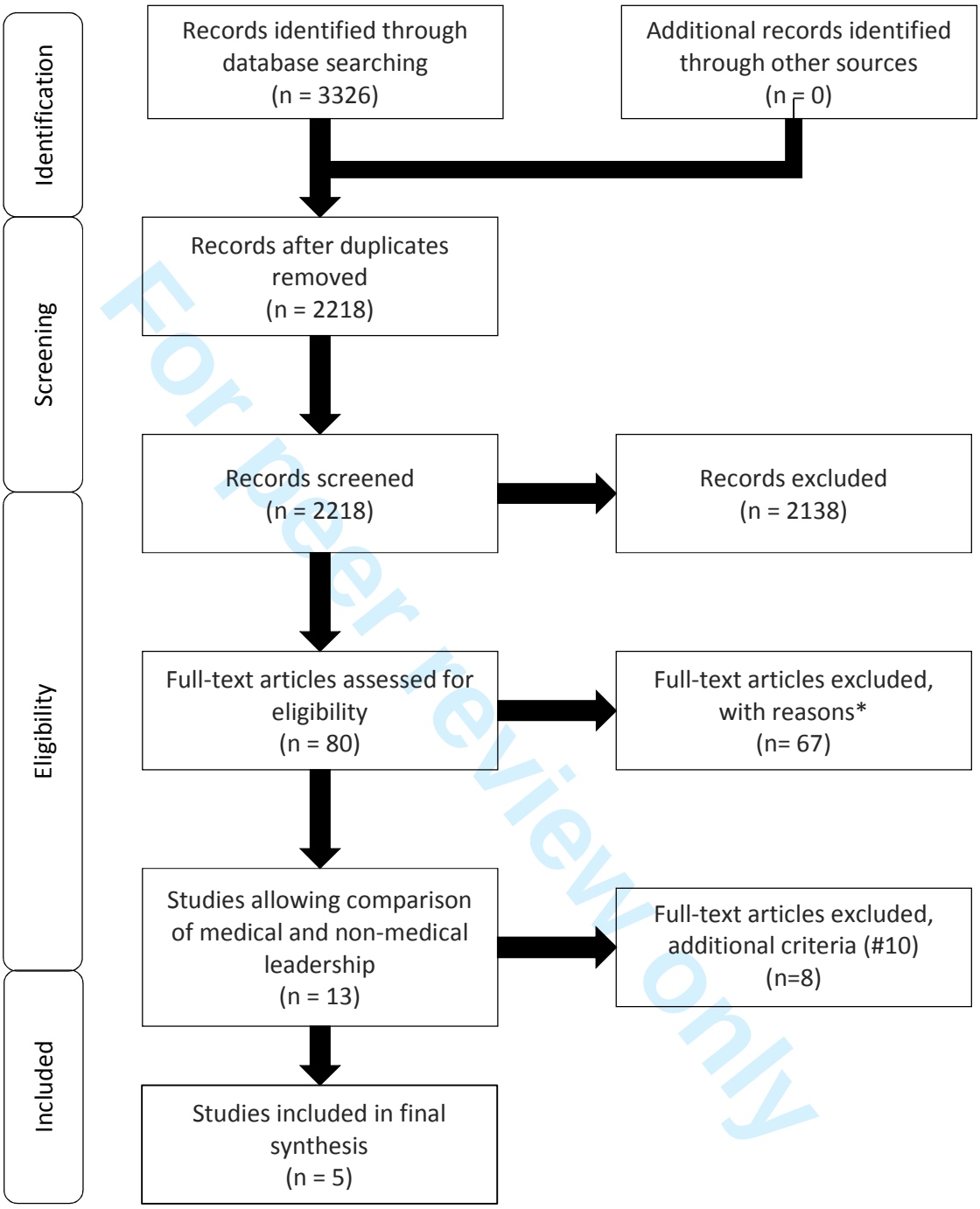

***Legends**

Reason for exclusion		**Number of studies***
1	Pre-2005	0
2	Other languages	0
3	Not peer-reviewed literature	0
4	Not healthcare	0

5	Full-text not available	5
6	Not primary research/systematic review	4
7	Does not include participants who are both doctors or leaders	17
8	Neither medical background/training or leadership is assessed as a variable in the data analysis	12
9	Does not include organisational and/or patient outcomes	47
10	Does not include medical and non-medical leaders in the data analysis	8

Figure 1. Search and review strategy (PRISMA flow diagram)
*The numbers do not add up to the total number of studies excluded because a proportion of studies were excluded based on multiple criteria.

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	3
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	4-6
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	6
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	NA
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	7
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	6-7
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	6-7
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	7-9
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	7-9
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	7
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	12-13
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	NA
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	8

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	12-13
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	NA
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	8-9
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	9-12
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	12-13
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	9-12
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	NA
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	12-13
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	NA
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	13-15
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	15
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	15
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	15

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(6): e1000097. doi:10.1371/journal.pmed1000097

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Medical leadership systematic review: Do hospitals and healthcare organisations perform better when led by doctors?

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Leadership, management, physician executive, clinician-manager, organisational performance, board director, patient outcomes

ABSTRACT

Introduction: Despite common assumptions that doctors are well placed to lead hospitals and healthcare organisations, the peer-reviewed literature contains little evidence on the performance of doctors in leadership roles in comparison with that of non-medical managers.

Objectives: To determine whether there is an association between the leader's medical background and management performance in terms of organisational performance or patient outcomes

Methods: We searched for peer-reviewed, English language studies using Medline, Embase and Emerald Management between 2005 and 2017. We included quantitative, qualitative, and mixed method empirical studies on the performance of senior healthcare managers where participants were both doctors and leaders, and where comparative performance data were provided on non-medical leaders. Studies without full-text available, or that did not include organisational, leadership behaviour or patient measures, were excluded.

Results: The search, conducted in Medline (n=3,395), Embase (n=1,913) and Emerald Management (n=454) databases, yielded 3,926 entries. After application of inclusion and exclusion criteria, sixteen studies remained. Twelve studies found that there were positive differences between medical and non-medical leaders, and eight studies correlated those findings with hospital performance or patient outcomes. Six studies examined the composition of boards of directors; otherwise there were few common areas of investigation. Five interrelated themes emerged from a narrative analysis: the impact of medical leadership on outcomes; physicians on boards; contribution of qualifications and experience; the medical leader as an individual or part of a team; and doctors transitioning into the medical leadership role.

Discussion and conclusion: A modest body of evidence supports the importance of including physicians on organisational governing boards. Despite many published articles on the topic of whether hospitals and healthcare organisations perform better when led by doctors, there were few empirical studies that directly compared the performance of medical and non-medical managers. This is an under-researched area that requires further funding and focus.

Strengths and limitations of this study

- To the best of our knowledge, this is the first systematic review of the literature published over the last decade to determine whether healthcare leaders who are doctors perform better than those with non-medical backgrounds in terms of organisational performance or patient outcomes
- We developed robust search strategies and a rigorous reviewing process with the aim to minimise bias and ensure the objectiveness and transparency of the systematic review
- A modest body of evidence supports the importance of including physicians in the composition of governing boards to improve organisational performance
- There were insufficient studies meeting inclusion criteria to enable our research question to be fully answered

INTRODUCTION

Rationale

Prior to the 1970s, doctors very often ran hospitals[1 2] and administrators played a subordinate, coordination, rather than a leadership, role. As healthcare moved towards a more business-bureaucratic[3] model of practice, administrators were engaged to manage general organisational-operational business performance, but doctors continued to expend substantial resources and manage the major decisions affecting patient care. In 1983, the Griffiths Report[4] was released in the UK, paving the way for the introduction of a new purchaser-provider model of healthcare. In the USA, the idea which became known as clinical directorates was established.[5] The Medical Director role and clinical directorates became more widely established, and over time enabled more senior managers to have greater control over resources. Doctors did not always consider such roles attractive,[5] but felt that they needed to take up these part-time appointments in order to continue to partake in decisions affecting

their work. In the 1990s, when managed care was established in the USA,[6] new drivers emerged as physicians moved from part-time advisory roles into full-time management in order to contribute to running healthcare organisations, secure greater control over resource allocation and participate in senior decision-making.

Today, physicians are well-established in management roles, with the first survey of Accountable Care Organisations (ACOs) in the USA finding that by 2014, 51% were led by doctors.[7] Within hospitals and other healthcare organisations, medical departments are normally led by doctors, and report to the Medical Director (or equivalent) who is typically a member of the executive team (see Dwyer[8] for a literature-based review on the roles of medical managers). By the turn of the 21st century in the USA, 50% of physician executives no longer practiced medicine,[6] and physician executives began to gain acceptance as administrators of managed care institutions.[9 10] In the UK[2 11] (and elsewhere[11 12]), where the culture was historically less well disposed to accepting doctors who relinquish their clinical work,[13] the majority of medical executives today act as 'hybrid managers', who continue to manage a clinical workload alongside their management responsibilities. In the UK National Health Service (NHS), where doctors hold positions of power within healthcare organisations that enable them to confound managerial decisions, enhancing medical engagement in leadership is seen as a factor that may contribute to improved organisational performance.[11] Benefits to employing doctors in healthcare management roles may include bottom-up leadership, greater political influence, and improved communications between doctors and senior management.[14] Current focus on engaging doctors in leadership centres on efforts to link clinical decisions with those of strategic management, and has broadened to include key accountabilities for quality of care in addition to resource management.[15] Today's leaders in healthcare perform many tasks. For this review, we have adopted the King's Fund description of the healthcare leadership task: "to ensure direction, alignment and commitment within teams and organisations".[16, p2] This task may incorporate elements of leadership, management and administration.

Despite the prevalence of physician executives occupying leadership roles in health systems, we do not know to what extent prior medical training or experience as a physician affects the performance of healthcare executives. Research questions include: Do healthcare executives who are doctors perform better than those who are not; and, if so, in what ways do they perform better? What is it about a physician that might enhance their leadership ability: medical training, experience in the physician role, or something else? Is it important for organisational performance to have doctors as members of the executive leadership team, and if so, why?

Previous research has found no difference in performance between medical and non-medical managers;[17-19] however, opinion on the topic of 'which profession should manage hospitals' is prevalent and polarised. There appears to be a view that the physician mindset is different to that of the general healthcare manager.[20 21]Arguing against the benefits of medical leadership, papers cite doctors' over-identification with their professional clinical role, tendency to be conservative individualists rather than team players, lack of formal management training, and their purported weaknesses in financial management and organisational strategy.[12 22-24]

However, doctors prefer to be led by doctors,[11] and articles in favour of medical leadership cite doctors' strengths in addressing patient outcomes, quality and safety issues, decision-making, ability to specialise, and intelligence. A recent study surveying doctors' reactions to hospital reform found that doctors who were also leaders reacted more positively to hospital reform than those who spent most of their time caring for patients.[25] Clearly, the question 'do hospitals and healthcare organisations perform better when led by doctors?', particularly in relation to the leadership structures of modern healthcare systems, has not been settled.

Objectives

This study presents the results of a systematic review of the literature published since 2005 on medical leadership. We sought contemporary evidence on the leadership performance of executives or senior managers who were also doctors. The objective of the review was to determine whether there is an

association between whether the leader has a medical background and management performance in terms of organisational performance or patient outcomes, and was framed by the research question: Do hospitals and healthcare organisations perform better when led by doctors? To enable us to objectively answer our question, and to minimise the confounders associated with comparisons in healthcare, we sought quantitative, qualitative and mixed method empirical studies reporting on leadership performance that included medical and non-medical leaders in the same setting.

METHODS

Eligibility criteria

Types of participants

We included empirical studies on senior managers in healthcare organisations that involved participants who were both doctors and leaders, and participants who were non-medical leaders. Non-medical leaders included those who had a clinical background other than medicine (e.g., nurses, allied health professionals) and those who did not have a clinical background.

Types of outcomes

After examining the literature, we included three types of outcome measures. These were: (1) patient measures, e.g., patient outcomes, or processes of care; (2) organisational measures, e.g., staffing, finance, or hospital ratings; and (3) leadership behaviour measures, e.g., management processes, teamwork, or decision-making.

Information sources

We searched for peer-reviewed, English language studies using three academic databases; Medline, Embase and Emerald Management. The search was limited to empirical research published between 1st January 2005 and 7th June 2017.

Search

The search was designed, in collaboration with a professional research librarian, to capture both the executive leadership and the medical practitioner role. Seven terms were included for executive leadership and linked using the Boolean operator OR to maximise the sensitivity of the search: "executive", "leader", "leadership", "manager", "director", "CEO", or "board". For the role of medical practitioner, terms including "physician", "clinician", and "doctor" are used sometimes interchangeably in literature. Thus we searched for all three terms using the OR operator. The searches were combined, and refined using a proximity operator. Full search strategies are presented in Table 1.

Table 1. Medline, Embase and Emerald Management search strategies

Database	**Medline**	
Strategy	**Searches**	**Results**
#1	((executive$ or leader$ or leadership$ or manager$ or director$ or CEO$ or board$) adj3 (physician$ or doctor$ or clinician$)).ab.	4,158
#2	Limit #1 to (English language and yr="2005 - Current")	2,037
#3	*Physician Executives/	4,069
#4	Limit #3 to (English language and yr="2005 - Current")	1,461
#5	#2 or #4	3,395

Database	**Embase**	
Strategy	**Searches**	**Results**
#1	((executive$ or leader$ or leadership$ or manager$ or director$ or CEO$ or board$) adj3 (physician$ or doctor$ or clinician$)).ab.	5,766
#2	Limit #1 to (English language and yr="2005 - Current" and article)	1,913

Database	**Emerald Management**	
Strategy	**Searches**	**Results**
	((executive* or leader* or leadership* or manager* or director* or CEO* or board*) and (physician* or doctor* or clinician*)).ab. Limit publication date to January 2005 - June 2017	454

Study selection

Search results were aggregated and imported to an EndNote library, and duplicate entries were removed. Pairs of reviewers (RCW:LT; KL:ZL) cross-checked 110 (approximately 3%) citation titles and abstracts in a double review in order to establish inter-rater reliability. Articles were excluded based on the following criteria: pre-2005; language other than English; non-peer-reviewed literature; setting other than healthcare; non-primary research including systematic reviews; and does not include

participants who are both doctors or leaders. Any discrepancies between the reviewers were discussed until a consensus was reached. The remaining citations were randomly assigned to the four reviewers who independently assessed titles and abstracts against the exclusion criteria, with regular discussions held at team meetings. While we did not include literature reviews, the reference section of any review identified was searched for additional papers that might meet inclusion criteria. The selected articles were then subject to a full-text review where further criteria were added to the exclusion criteria: full-text unavailable; neither medical background/training or leadership is assessed as a variable in the data analysis; does not include organisational and/or patient outcomes.

Data collection process and data items

Data from the included studies were extracted into a locally developed form for analysis. Elements extracted were: a) the full reference, b) location, c) language, d) period of data collection, e) study type, f) study primary and secondary aims, g) exclusion criteria, h) data: total number of organisations, type of organisations, data types and sources used to performance and/or outcomes, methodological/statistical approach to identify performance and/or outcomes, i) methods: methods used to study contextual/success factors associated with medical leaders (e.g., interview, survey, observation), participants, and data analysis methods, j) findings: quantitative results and qualitative results or contextual factors most important for explaining relationship between medical background of leader and performance, and k) implications.

Risk of bias

Risk of bias within studies was assessed using criteria developed by Hawker, et al.[26] Ratings were assigned (poor, fair, good) across nine different categories: 1) abstract and title, 2) introduction and aims, 3) method and data, 4) sampling, 5) data analysis, 6) ethics and bias, 7) results, 8) transferability or generalisability, 9) implications and usefulness. Risk of bias potentially affecting the cumulative evidence

across studies was determined by examining study methods, ethics committee approvals, study funding, and authors' conflicts of interest.

Synthesis of results

Results were analysed through a narrative synthesis of extracted data. Extracted data were coded and organised to explore connections between data elements and to develop sets of concepts. Segments of data were then linked in a formal fashion, to determine relationships that may exist between different data elements and allow themes to emerge.

RESULTS

Study selection

The search results and review process are presented in Figure 1 using the Preferred Reporting Items for Systematic Review and Meta-analyses (PRISMA) flow chart. The search performed on Medline (n=3,395), Embase (n=1,913) and Emerald Management (n=454) yielded a total of 3,926 articles after the removal of 1,849 duplicates. During the 3% double-review, the reviewing pairs (KL and ZL pair 1, RCW and LT pair 2) reviewed 110 citations each. To test inter-rater reliability, we used Cohen's Kappa and found high levels of agreement between the paired reviewers, K=.78 (p<.0001) for pair 1 and K=.88 (p<.0001) for pair 2. The remaining screening of title and abstract resulted in 113 studies eligible for full-text review. The full-text review stage lead to the inclusion of 24 quantitative, qualitative or mixed method studies in the penultimate pool. After the additional exclusion criterion was added, allowing for a comparison of medical and non-medical leadership, ten more studies were eliminated. The literature search identified five literature reviews on topics associated with medical leadership.[8 14 27-29] The references of these five reviews were searched for additional studies that met inclusion criteria. Two additional studies were identified as a result of this process, resulting in a final inclusion of 16 studies.

Study characteristics

The characteristics of the 16 studies that met inclusion criteria are presented in Supplementary Table 1. Fourteen studies conducted quantitative analysis: ten studies analysed questionnaire survey data;[7 30-38] one study (Jiang et al.[32]) also provided processes of care data, and another provided hospital performance data (Saleh et al.[37]). Two studies analysed US Statewide Health Planning and Development data from California,[39 40] one study analysed data from the AMADEUS database and hospital and insurance documents,[41] and one study analysed UK hospital trust data.[42] One study conducted a qualitative analysis of interview and observation data,[43] and another study conducted a mixed method analysis,[44] which combined findings from a review of hospital documents with qualitative analysis of interviews with hospital CEOs and board members. Seven studies were from the USA; the remainder were from Finland (2), Germany (2), the UK (1) Ireland (1), Norway (1), Lebanon (1) and Australia (1).

Results of individual studies

Six studies reported on the performance of hospital boards.[32 39-42 44] Veronesi et al.[42] examined the impact of clinicians appointed to the boards of 102 English NHS hospital trusts on quality of hospital care provided from 2006 to 2009. Composition of boards was determined from hospital trust annual reports. Compliance with health and well-being, clinical effectiveness, safety and patient focus, and ease and equity of access care standards was obtained from the UK Healthcare Commission and Dr Foster (a commercial provider of healthcare benchmarking). A greater percentage of doctors on boards was associated with a better-quality rating of service providers. Trusts achieving a four rating had an average of 15.01% of directors with a medical background, whereas in trusts achieving only a one rating, 11.09% board directors were physicians. This finding was confirmed in relation to lower morbidity rates and tests to exclude the possibility of reverse causality, whereby doctors joined the boards of better performing trusts. No equivalent association was found for clinical professions such as nurses and other allied health professions.

De Andrade[40] investigated whether having board members with medical expertise in 281 USA hospitals affected the levels of uncompensated care provided. A quantitative analysis of data from the California

Office of Statewide Health Planning and Development between 1997 and 2010 found that physician board membership was not related to provision of uncompensated care, except when the hospital's ownership status was taken into account. Relative to non-profit and public hospitals, for-profit hospitals provided more uncompensated care the higher the percentage of physicians on the board. For an average for-profit board size, which has ten members, substituting one member by a physician increased the amount of uncompensated care provided by 19%.

On this theme of boards, Prybil[44] sought to determine whether high-performing and mid-range hospitals differ in board structures, processes, and practices. High performance hospitals included at least three of the Solucient Center for Healthcare Improvement's '100 Top Hospitals' in 1999-2003. A mixed method analysis of hospital documents and interviews with hospital CEOs and board members was conducted for seven matched pairs of USA hospitals, and found that physicians form a larger component of the boards of high performing hospitals (30.3%) than of midrange hospitals (20.8%). Doctors comprised 25% or more of the boards' voting members in five of the seven high performing hospitals, but only one midrange hospital.

Jiang et al.[32] examined whether differences exist in quality performance of 490 USA hospitals in relation to adoption of particular practices in board oversight of quality. Data consisted of 1) a survey of 562 hospital CEOs on board practices, (2) process of care measures for three clinical conditions (heart attack, heart failure, pneumonia), and (3) outcomes measures, consisting of risk adjusted mortality rates, for the same three conditions. Sixty percent of participating hospitals had a Chief Medical Officer or Vice President of Medical Affairs on the committee; this resulted in significantly higher process of care scores (85.3% vs 81.0%, $p<0.05$) and lower risk adjusted mortality rates (5.6% vs 7.3%, $p<0.05$) than hospitals that did not have a Chief Medical Officer or Vice President of Medical Affairs as a committee member. Eighty three percent of participating hospitals had medical staff on the committee; this resulted in significantly higher process of care scores (84.2% vs 80.9%, $p<0.05$) but no difference in risk adjusted mortality rates. Sixty three percent of participating hospitals had a clinical board member on the

committee; this resulted in no difference in process of care scores but significantly lower risk-adjusted mortality rates (5.7% vs 7.2%, p<0.05).

Bai and Krishnan[39] examined whether hospitals without physician participation on their boards of directors delivered lower quality of care in 142 non-profit hospitals in the USA. Quantitative data were obtained from the US Hospital Quality Alliance and the California Office of Statewide Health Planning and Development. The study found that boards without physician members were associated with a decrease of three to five percentage points in quality of care for heart failure, pneumonia, and surgery infection prevention.

Moving to Germany, Kuntz et al.[41] examined differences in the financial performance of hospitals with regard to ownership by studying the size and composition of supervisory boards in 175 hospital companies operating 246 hospitals (14% of all German acute care hospitals in 2009). The study reported on a quantitative analysis of hospital financial performance data (from the AMADEUS database) and information on hospital and board characteristics (from business and quality reports, hospital websites and health insurers). Data were obtained from all participants in 2009, and from a subsample of 163 hospital companies in 2010. Financial performance was based on four measures: return on assets (ROA), earnings before interest and tax (EBIT) margin, total profit margin, and net income. Physicians comprised, on average, 11.7% board members. Financial performance, and board size and composition depended on ownership ($p < .01$ for ROA and $p < .001$ for the other four performance measures). An increase in board size and greater political participation were negatively associated with all five tested measures of financial performance, an increase in nurse and economist participation was negatively associated with financial performance, and no associations were found for clerical participation. An increase in physician participation, however, was positively associated with a 5% increase in ROA ($p = .061$).

Two studies reported on physicians' involvement in strategic decision making.[36 37] Parayitam et al.[36] examined the self-reported outcomes of decisions when physician executives were involved in strategic

decision-making (SDM) processes in 109 USA hospitals. Hypotheses were that increased numbers of physicians involved in strategic decision-making teams would be associated with better decisions, greater understanding of the rationale of decisions, and more commitment to decisions. 114 CEOs and 254 strategic decision makers (executive officers, director of human resources, chief technical offices, chiefs of staff, personnel involved in facilities, maintenance) completed a survey reporting their decision quality, understanding, and commitment. Structural equation modelling of the data suggested that the ratio of physicians was positively correlated with decision understanding, commitment and quality.

Saleh et al.[37] explored the use of strategic planning processes in 79 (56.4%) Lebanese hospitals, and investigated its association with financial performance. Hypotheses included that the level of physician involvement in the strategic planning process is positively associated with hospital performance. Quantitative analysis of survey data on hospital-reported participation in strategic planning processes, and hospital performance data from the Lebanese Ministry of Public Health (occupancy rate and revenue-per-bed) found that there was no association between the level of physician involvement in the strategic planning process and hospital outcomes; generally, physician involvement was low (4.1 out of a possible score of 7).

Two studies reported on medical leadership of organisations.[7 31] In the USA, Colla et al.[7] measured how doctor-led organisations compared with other Accountable Care Organisations (ACOs) in terms of structure, size and care provided, and explored the degree of doctor engagement in managing ACOs. ACOs are groups of providers that are jointly responsible for caring for a nominated population of patients. Fifty one percent of the 173 ACOs in the study self-identified as physician-led, 33% as jointly led by hospital and physician, and the remainder were led by hospitals or other entities. Doctor-led ACOs were found to be more likely to have advanced IT capabilities and better outpatient care than non-doctor-led ACOs, and were more likely to measure and report financial performance at practice and clinicians levels; however this finding was confounded by the fact that physician-led ACOs are less likely to include hospitals and more likely to include physician groups. Performance of ACOs was not assessed,

therefore it was not possible to determine whether performance was related to whether leaders were doctors or non-medical managers.

Goodall[31] examined the relationship between hospital performance and whether the Chief Executive Officer (CEO) was a doctor or a non-medical manager. Hospital performance was determined by media-generated league tables, produced by US News and World Report's (USNWR) 'Best Hospitals' in 2009. Three hundred healthcare executives from three specialties (cancer, digestive disorders, heart and heart surgery) were surveyed in the top 100 USA hospitals. Positive association was found between physician CEOs and hospital performance for all three hospital specialties ($p<0.001$). While higher performing hospitals were associated with physician CEOs, causation was not able to be determined (e.g., higher performing hospitals may just prefer to have physicians as leaders).

Five studies reported on physician leadership within organisations.[30 33 34 38 43] Konu and Viitanen[33] investigated the incidence of shared leadership among 433 middle-level managers (e.g., chief physicians, nursing directors) in social service and healthcare in Finland. Quantitative analysis of survey data on leadership practices found that shared leadership practices were more common among managers without a medical background.

Another study sought to determine whether evaluations on the impact of knowledge sources affecting their decision-making differ depending on the manager's professional background, activity sector, gender, management experience, or age, among 404 middle-level social and healthcare managers in a Finnish hospital (Simonen et al[38]). Quantitative analysis of survey data revealed that doctor managers more strongly perceived that their decision-making was influenced by their own professional experience, journals and scientific research within their own professional field, and nationwide interaction within their own profession. Differences were found between doctor managers and nurse managers with respect to organization documents and publications, which carried more weight in nurse managers' decision-making. No differences were found between managers of different professional backgrounds regarding other knowledge sources.

In other work, Agarwal et al.[30] sought to determine whether there is a positive association between Management Practices Score (MPS) and the level of clinical education of managers in 42 Australian acute care public hospitals. The MPS for each hospital was calculated from interview responses of 116 managers to a survey of 21 hospital management practices across multiple dimensions. The study found no association between the number of doctors in each hospital and the MPS (p=0.779). The coefficient on the level of skills and education within hospitals, however, was positive and significant (p=0.06), indicating that hospitals with a higher proportion of clinically qualified and skilled managers perform significantly better in management practices.

Spehar et al.[43] investigated how clinicians' professional background influences their transition into the managerial role and identity as clinical managers in four public hospitals and two health trusts in Norway. Interviews were conducted with 30 clinician managers (13 doctors), 20 of these were also observed in management and staff meetings during the day. Qualitative analysis of interview and observation data revealed that doctors experienced difficulties in reconciling the clinical and management role and used clinical work to gain legitimacy and respect from medical colleagues. In contrast, nurses experienced a faster and more positive transition into the manager role, and were more fully engaged in the managerial aspects of the role.

Moving countries again, Kuntz et al.[34] assessed the relationship between the amount of medical involvement in leadership and staff-to-patient ratios. The study was conducted in Germany, where hospitals are managed by an executive leadership team consisting of a commercial director, medical director and nursing director. The study was controlled for the size and case mix of the 604 participating hospitals, whether they were public or private, the degree to which they were rural, and whether the doctors were salaried or contracted. High staff-to-patient ratios for both nurses and doctors are associated with better hospital performance.[45 46] The study found a relationship between full-time Medical Director (MD) or heavily involved part-time MD and a higher staff-to-patient ratio. Full time MDs significantly improved the staff-to-patient ratios for both doctors and nurses (physicians 1.96, p<0.01; nurses: 4.44, p<0.01), whereas part-time MDs only improved the staff-to-patient ratios for

doctors (e.g., an increase of part-time involvement from 15 to 25%, resulted in an increase of 2.49 physicians per thousand inpatients).

Staying in Europe, O'Keefe[35] measured and compared risk aversion in 788 Irish clinicians, clinical managers, non-clinical managers, and non-clinical public representatives, in terms of willingness to discharge a patient from the Emergency Department (ED). The study found no significant difference between clinicians and clinician managers, but found significant differences between clinicians and non-clinicians (including between clinical and non-clinical managers), with the non-clinical participants being more risk averse. Limitations included: (1) there was a large variation in risk tolerance, even between clinicians, (2) it was a single study in a single country, and (3) clinicians are likely to be more familiar both with actual events depicted in the scenarios, and also with the process of making treatment choices that may result in death. The study did not provide indication of an objectively appropriate level of risk, but the authors suggested that the clinicians had a more pragmatic approach to decision-making.

Risk of bias

While studies were generally well-designed and executed, generalisability and implications, and usefulness of the findings was low (Table 2).[26] There is a moderate risk of bias across studies. The majority (12) studies collected self-reported data on aspects of medical management, e.g., surveys or interviews, rather than objective data. Ethics approval was not reported for the studies, and publications did not report study funding or authors' conflicts of interests.

Table 2. Methodology rigour and risk of bias

Study	Abstract and title	Introduction and aims	Method and data	Sampling	Data analysis	Ethics and bias	Findings	Generalisability	Implications and usefulness
Agarwal et al. (2016)[30]	Good	Good	Good	Fair	Fair	Good	Good	Fair	Good
Bai and Krishnan (2015)[39]	Fair	Good	Good	Good	Good	Fair	Good	Fair	Good

Colla et al. (2014)[7]	Fair	Fair	Good	Good	Poor	Poor	Good	Good	Fair
De Andrade (2014)[40]	Fair	Good	Good	Good	Good	Fair	Good	Fair	Good
Goodall (2011)[31]	Fair	Fair	Fair	Poor	Fair	Poor	Fair	Poor	Poor
Jiang et al. (2009)[32]	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair
Konu and Viitanen (2008)[33]	Good	Good	Good	Good	Good	Very poor	Good	Fair	Fair
Kuntz et al. (2013)[34]	Fair	Good	Good	Good	Good	Good	Good	Fair	Fair
Kuntz et al. (2016)[41]	Good	Good	Good	Good	Good	Fair	Good	Fair	Fair
O'Keefe (2015)[35]	Good	Fair	Fair	Good	Good	Good	Fair	Fair	Poor
Parayitam et al. (2007)[36]	Good	Good	Good	Good	Good	Fair	Good	Fair	Good
Prybil (2006)[44]	Fair	Good	Fair	Fair	Fair	Fair	Fair	Fair	Fair
Saleh et al. (2013)[37]	Good	Fair	Good	Good	Good	Fair	Good	Fair	Fair
Simonen et al. (2009)[38]	Good	Good	Good	Good	Good	Fair	Good	Fair	Fair
Spehar et al. (2015)[43]	Fair	Fair	Good	Good	Good	Good	Good	Good	Fair
Veronesi et al. (2013)[42]	Fair	Good	Good	Good	Very Good	Good	Good	Good	Good

Study Synthesis

Extracted data were cross-checked for accuracy and coded by four researchers (ZL, KL LT, RC-W). One researcher (RC-W) completed a narrative synthesis of the coded data, by linking the data to form five interrelated themes: impact of medical leadership on outcomes; physicians on boards; contribution of qualifications and experience; the leader as an individual or part of a team; and doctors transitioning into the medical leadership role. Four broad categories of articles were found in the literature search: (1) individual perspectives on medical leadership (the majority of excluded articles), frequently based on

personal experience; (2) empirical research based on self-reported data about medical leadership (surveys, interviews, focus groups); (3) objective empirical research on the role or characteristics of healthcare leaders (observations, other data); and (4) objective empirical research on the relationship between medical leaders and outcomes (hospital performance data, patient outcomes).

DISCUSSION

Summary of evidence

Themes

Impact of medical leadership on outcomes. Given the complexity encountered within modern healthcare organisations,[47] it is difficult to demonstrate the impact of leadership on outcomes -- even when assessing medical and non-medical leadership in the same setting. Four of the sixteen studies showed either no difference or a negative difference between medical and non-medical leadership in the aspects of performance that they investigated.[33 37 38 43] The remaining 12 studies found that there were differences between medical and non-medical managers, and eight of these studies[7 31 32 39-42 44] correlated findings with hospital performance or patient outcomes. The studies did not provide sufficient information that would allow us to determine *why* medical leadership might make a difference. Other than board composition (discussed below), there were few common areas of investigation, with studies examining varied topics: risk aversion, IT adoption, patient care arrangements, financial reporting, staff-to-patient ratios, and so on.

Physicians on boards. We found that evidence supporting the relationship between physician board participation and organisational performance is accumulating, with empirical studies from the UK,[42] Europe[41] and the USA[32 39 40 44] all reporting positive associations. This finding is consistent with pre-2005 data,[48 49] and supported by a recent literature review on the topic.[29]

Contribution of qualifications and experience. None of the studies provided data on the characteristics of medical leaders that were associated with higher performance. We know that doctors who receive leadership or management training may perform well in leadership roles. Xirasagar et al.[50 51] for

example, when examining the relationship between leadership styles, training, and effectiveness of doctors who are managers, concluded that doctors who completed managerial training such as MBAs, MHAs, MPHs, or more than 30 days of in-service training were likely to be more effective leaders. In the included studies there was no demographic information on the leaders who participated in the study to enable us to disentangle the contribution to the findings of medical qualifications, medical experience or management experience. While our included studies found both positive[42] and negative[33 38 43] differences between a leader's medical and nursing background in relation to leadership outcomes, much of the literature conflates doctors and nurses into a single group of 'clinicians'.[28]

Medical leader as an individual or part of a team. Only two studies[7 31] explored the performance of the doctor as the CEO or primary organisation leader, and both found that there was an association between medical leadership and organisational performance. Instead, the remaining studies explored outcomes when a doctor was included as part of the leadership team. While not providing direct evidence supporting the doctor as *the* leader, they emphasise current thinking about the need to engage doctors in healthcare leadership to improve organisational culture and patient outcomes.[52 53] In a comparison of six high and low performing UK trusts, for example, Mannion et al. found that poor performing organisations were characterised by cultures where a few senior consultants exerted a disproportional influence over organisational priorities.[54] Doctors who are engaged as part of a leadership team are often hybrid managers, who retain a clinical role, and studies elsewhere have found these managers less likely to be effective in their non-clinical leadership role.[55] Kippist and Fitzgerald,[12] for example, found that hybrid managers would prioritise clinical work over management, leading to additional burden on their managerial colleagues, thereby questioning the effectiveness of the hybrid clinician manager. Spehar et al.[24] explored influences and strategies employed by 30 hybrid leaders in four hospitals in Norway and concluded that doctors who were managers could not influence other doctors without drawing on professional power, and that doctors felt they had to maintain their clinical skills to retain credibility among peers. This emphasis on professional skill constrained doctors from drawing effectively on positional power. This expert power was not retained and had to be continuously

regenerated. In addition, rather than collaborating, doctors saw clinician managers of other departments as competitors, and saw themselves as representatives of their own professional group.

Doctors transitioning into the medical leadership role. The five studies reporting on medical leadership within organisations touched on some of the barriers or enablers[56] for doctors seeking to enter management, including difficulties reconciling the clinical and management role. Professional and organisational culture strongly influences the roles that practitioner leaders can take up and the influence they can wield.[57] Ham et al.[58] investigated, via 22 qualitative interviews, the experiences of doctors who become Chief Executives of UK National Health Service organisations and found that medical managers tended to be "keen amateurs" rather than trained managerial professionals. Kisa and Ersoy,[59] via a 31 item time management questionnaire, found that medical managers have poor time management skills. Medical managers are not usually trained in leadership,[11 58] which may explain both these findings and some of the negative perceptions of doctors as managers. There are also some indications within our included studies that doctors should adopt a more multidisciplinary approach to be effective leaders.[33 38 43] West and Barron[60] found that medical managers consult or network mostly with other medical managers, and that it is the non-medical managers who act as brokers between professional groups. This finding is supported by other work in the field.[61]

Limitations

Our review was limited in date range and language (English only), and we found insufficient studies meeting inclusion criteria to enable our research question to be robustly answered. Most studies examined only one or two aspects of leadership; because these aspects were different across studies, it was not possible to generalise the findings. Due to the diversity of keywords and publication venues used by authors of studies on medical leadership, it was difficult to ensure that all relevant literature has been captured by our search strategy.

Conclusions

There is a modest body of evidence supporting the importance of including physicians in the composition of hospital or organisational governing boards. Despite a large volume of published literature on the topic of whether hospitals and healthcare organisations perform better when led by doctors, however, there are few studies that have examined this topic in a robust way or directly compared the performance of medical and non-medical managers. While we found sixteen studies that provided empirical data in respect of this question, only two studies explored the role of organisational leader or CEO. This is an under researched area that requires further funding and focus.

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COMPETING INTERESTS

The authors have read and understood the *BMJ* policy on declaration of interests and declare that we have no competing interests.

DATA SHARING

The full dataset is available from the corresponding author on request.

AUTHORS' CONTRIBUTIONS

RC-W and JB conceptualised the study, KL, ZL and LT conducted the database searches. RC-W, KL, ZL and LT conducted the search and review strategy, RC-W drafted the manuscript, all authors reviewed the manuscript for critical content.

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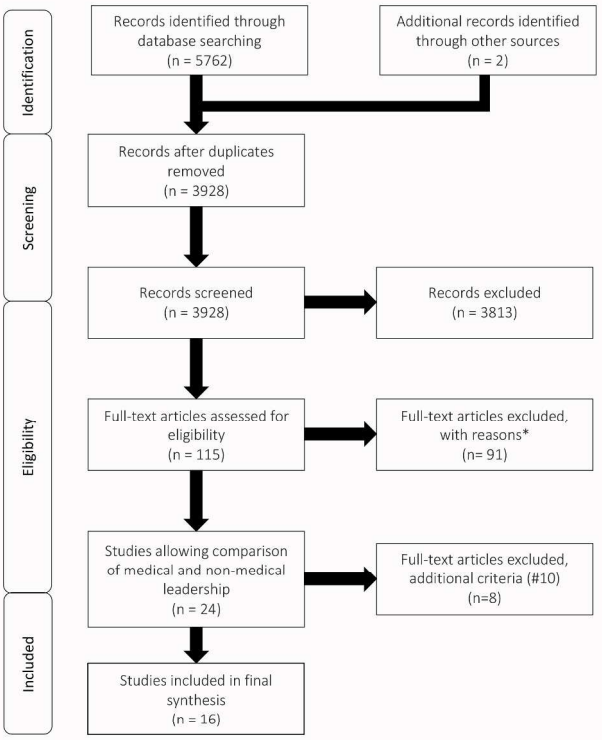
LIST OF FIGURES

Figure 1. Search and review strategy (PRISMA flow diagram)



*Legend

Reason for exclusion		Number of studies*
1	Pre-2005	0
2	Other languages	0
3	Not peer-reviewed literature	0
4	Setting other than healthcare	0
5	Full-text not available	8
6	Not primary research (including systematic reviews)	4
7	Does not include participants who are both doctors or leaders	20
8	Neither medical background/training or leadership is assessed as a variable in the data analysis	18
9	Does not include organisational and/or patient outcomes	64
10	Does not include medical and non-medical leaders in the study	8

*The numbers do not add up to the total number of studies excluded because a proportion of studies were excluded based on multiple criteria.

Figure 1. Search and review strategy (PRISMA flow diagram)

179x317mm (300 x 300 DPI)

Study	Country	Primary aim	Secondary aim	Participants; Organisation	Method	Performance measures	Key findings
Agarwal et al. (2016)[1]	Australia	To investigate the elements of best management practices in an Australian state-run healthcare system.	To determine whether there is a positive association between management practices score (MPS) and the level of clinical education of a managers in public hospitals.	42 acute care public hospitals	Quantitative analysis of survey data	Management Practices Score (MPS), consisting of 21 hospital management practices across multiple dimensions	The coefficient on the level of skills and education within hospitals was positive and significant (p=0.06). Therefore, the authors supported the hypothesis that hospitals with a higher proportion of clinically qualified and skilled managers perform significantly better in management practices.
Bai and Krishnan (2015)[2]	USA	To examine whether hospitals without physician participation on their boards of directors deliver lower quality of care.	N/A	142 non-profit hospitals	Quantitative analysis of US Hospital Quality Alliance and California Office of Statewide Health Planning and Development data	Process of care quality encompassing four categories (heart attack, heart failure, pneumonia, and surgery infection prevention)	The absence of physicians on the board was associated with a decrease of 3-5% points in three of four measures of care quality (heart failure, pneumonia, and surgery infection prevention).
Colla et al. (2014)[3]	USA	To explore the extent to which physicians are engaged in the leadership of emerging Accountable Care Organisations (ACOs), including whether ACOs identify themselves as physician-led, have boards that are run by physicians, and are physician owned.	To examine how physician-led ACOs compare to other ACOs in terms of structure, size, and services provided. To examine the implications of leadership types for ACO capabilities and the future of the ACO model.	173 accountable care organisations	Quantitative analysis of survey data	Care management and technology capabilities	Physician-led organisations had fewer patients per contract than other ACOs. Physician-led ACOs had similar care management and health IT capabilities to those of other ACOs, despite having different leadership structures and offering fewer services. Physician-led ACOs were leading in outpatient care management and health IT. However, they were falling behind in their ability to manage care across settings. Physician-led organisations may face greater challenges than other ACOs in managing transitions between settings of care and managing hospital-based care, as they were less likely to include hospitals or post-acute care facilities. Physician-led ACOs were less likely than other ACOs to offer services that are traditionally separate from medical care, such as pharmacy.
De Andrade (2014)[4]	USA	To investigate whether having board members with medical expertise affects the levels of uncompensated care provided by hospitals.	To verify how the relationship between board member medical expertise and uncompensated care is affected by the hospital's ownership type.	281 hospitals	Quantitative analysis of data from the California Office of Statewide Health Planning and Development for 1997-2010	Uncompensated care provision	Physician board membership was not related to uncompensated care provision, except when hospital's ownership status was taken into account. When hospital ownership type was considered, the percentage of physicians on the board did affect the provision of uncompensated care. Relative to non-profit and public hospitals, for-profit hospitals provided more uncompensated care the higher the percentage of physicians on the board. For an average for-profit board size, which has 10 members, substituting one member by a physician increased the amount of uncompensated care provided by 19%.
Goodall (2011)[5]	USA	To determine if there is an association between physician leaders and hospital performance.	N/A	300 healthcare executives; 100 hospitals	Quantitative analysis of survey data	Index of Hospital Quality	Positive association was found between physician CEO and hospital performance for all three hospital specialties (p<0.001).
Jiang et al. (2009)[6]	USA	To examine whether differences exist in hospitals' quality performance in relation to adoption of particular practices in board oversight of quality.	N/A	562 healthcare executives; 490 hospitals	Quantitative analysis of survey data	Process of care performance and risk-adjusted mortality relating to three conditions (heart attack, heart failure, and pneumonia)	Hospitals that had representatives with clinical expertise serving on the quality board had significantly better performance in process of care and/or mortality. Sixty percent of participating hospitals had a Chief Medical Officer or Vice President of Medical Affairs on the committee; this resulted in significantly (p<0.05) higher process of care scores (85.3% vs 81%) and lower risk adjusted mortality rates (5.6% vs 7.3%) than hospitals that did not have a Chief Medical Officer or Vice President of Medical Affairs as committee member. Eighty-three percent of participating hospitals had medical staff on the committee; this resulted in significantly (p<0.05) higher process of care scores (84.2% vs 80.9%) but no difference in risk adjusted mortality rates. Sixty-three percent of participating hospitals had a clinical board member on the committee; this resulted in no difference in process of care scores but significantly (p<0.05) lower risk adjusted mortality rates (5.7% vs. 7.2%).

Study	Country	Primary aim	Secondary aim	Participants; Organisation	Method	Performance measures	Key findings
Konu and Viitanen (2008)[7]	Finland	To investigate the incidence of shared leadership among middle-level managers in social service and health care.	N/A	433 middle-level managers in social and healthcare	Quantitative analysis of survey data	Shared leadership practices	Shared leadership practices were more common among managers without a medical background.
Kuntz et al. (2013)[8]	Germany	To assess the influence of the extent to which physicians are involved in hospital leadership on staff- to-patient ratios.	To investigate the significance of employing a full-time Medical Director (MD) and, for hospitals with a part-time MD, the impact that the amount of time spent in this role has on physician-to- patient-ratio and nurse-to-patient ratio.	604 hospitals, with a subsample of 442 hospitals	Quantitative analysis of survey data	Staff-to-patient ratios	There were significant differences in staff-to-patient ratios between the low level part-time category and the high-level part-time category (physicians: $p < 0.001$, nurses: $p < 0.001$), as well as for the difference between the high level part-time category and the full-time involvement (physicians: $p < 0.001$, nurses: $p < 0.01$). Regression analysis demonstrated a positive association between full-time MDs and staff-to-patient ratios for both physicians and nurses. With the exception of part-time involvement and nurse- to-patient ratio, this association remained strong after controlling for a range of confounding variables (case-mix, size, ownership).
Kuntz et al. (2016)[9]	Germany	To explain differences in the financial performance of hospitals with regard to ownership by studying the size and composition of supervisory boards.	To examine three hypotheses: H1: Hospital financial performance depends on ownership. H2: Hospital supervisory board size and composition depend on ownership. H3: The influence of hospital ownership on financial performance is mediated by the size and composition of the supervisory board.	175 hospital companies operating 246 hospitals	Quantitative analysis of hospital financial performance data (from the AMADEUS database) and information on hospital and board characteristics (from business and quality reports, hospital websites and health insurers)	Financial performance, based on four measures (return on assets (ROA), earnings before interest and tax (EBIT) margin, total profit margin, and net income)	Financial performance, and board size and composition depended on ownership ($p < .01$ for ROA and $p < .001$ for the other four performance measures). An increase in board size and greater political participation were negatively associated with all five tested measures of financial performance. An increase in physician participation was positively associated with one dimension of financial performance, ROA (0.05, $p = .061$). An increase in nurse and economist participation was negatively associated with financial performance; no associations were found for clerical participation.
O'Keefe (2015)[10]	Ireland	To examine the hypothesis that there would be an increasing gradient of risk aversion from physicians through clinicians in management and managers to public representatives regarding an acceptable level of risk when considering discharging a patient from the emergency department.	N/A	180 consultant physicians, 47 clinicians involved in management, 143 senior healthcare managers and 418 public representatives; acute care hospitals	Quantitative analysis of survey data	Level of acceptable risk	Post hoc pairwise comparisons (Bonferroni corrected significance level of $P < 0.008$) showed no significant differences between physicians and clinician managers or between managers and public representatives in acceptability of risk; however, all pairwise comparisons between doctors and managers or public representatives were significant. There were significant differences in the acceptability of risk and a reducing tolerance of a preventable death following discharge from the emergency department between doctors, healthcare managers and public representatives; clinicians with a managerial role did not differ in risk tolerance from their purely clinical counterparts.
Parayitam et al. (2007)[11]	USA	To analyse the outcomes of decisions when physician executives are involved in strategic decision-making processes in healthcare organisations.	To examine three hypotheses: H1: The greater the presence of physician executives in shared decision-making teams (SDMTs) the greater will be the decision quality. H2: The greater the presence of physician executives in SDMTs the greater will be the understanding of the rationale of decisions. H3: The greater the presence of physician executives in SDMTs the greater will be the commitment to decisions.	109 hospitals, 114 CEOs, 254 strategic decision makers (executive officers, director of human resources, chief technical offices, chiefs of staff, personnel involved in facilities, maintenance)	Quantitative analysis of survey data	Decision outcomes (decision quality, understanding, and commitment)	The ratio of physicians was positively correlated with decision understanding, commitment and quality.
Prybil (2006)[12]	USA	To determine whether board structures, processes, and practices in high-performing hospitals differ from similar hospitals where performance is midrange and, if so, in what ways.	N/A	7 matched hospital pairs	Mixed method analysis of hospital documents and interviews with hospital CEOs and board members	High performance hospitals (from the Solucient Center for Healthcare Improvement's '100 Top Hospitals' listings from 1999-2003) matched with midrange performance hospitals.	Medical staff members formed a larger component of the boards of high performing hospitals (30.3%) as compared with the boards of midrange hospitals (20.8%). In five of the seven high performing hospitals, medical staff members comprised 25% or more of the boards' voting members. This was true in only one mid-range hospital.
Saleh et al. (2013)[13]	Lebanon	To explore the use of strategic planning processes in Lebanese hospitals and to investigate its association with financial performance.	To examine six hypotheses: H1: The existence of a strategic plan is favorably associated with hospital performance. H2: A more developed strategic plan is	79 hospitals (56.4%)	Quantitative analysis of survey data and hospital performance data from the Lebanese Ministry of Public Health	Occupancy rate (OR) and revenue-per-bed (RPB)	There was no association between having a strategic plan and either of the two performance measures. The extent of strategic plan implementation was adversely related to OR, that is, the more a hospital implemented its

Study	Country	Primary aim	Secondary aim	Participants; Organisation	Method	Performance measures	Key findings
			positively associated with hospital performance. H3: Implementation of the strategic plan is positively associated with hospital performance. H4: CEO control of the strategic planning process is positively associated with hospital performance. H5: Strategic planning process is positively associated with hospital performance. H6: The level of physician involvement in the strategic planning process is positively associated with hospital performance.				strategic plan, the lower its OR ($p< 0.05$). A similar trend was observed with level of governing board involvement in strategic plan development. There was no association between the level of physician involvement in the strategic planning process and hospital outcomes; generally, physician involvement was low (4.1 out of a possible score of 7).
Simonen et al. (2009)[14]	Finland	To determine how social and health care managers evaluate the impact of knowledge sources as affecting their decision-making.	To determine whether evaluations differ depending on the manager's professional background, activity sector, gender, management experience, or age.	404 middle-level social and healthcare managers in a hospital	Quantitative analysis of survey data	Impact of various knowledge sources on decision-making	Doctor managers more strongly perceived that their decision-making was influenced by their own professional experience, journals and scientific research within their own professional field, and nationwide interaction within their own profession. Differences were found between doctor managers and nurse managers with respect to organization documents and publications, which clearly seemed to carry more weight in nurse managers' decision-making. Regarding other knowledge sources, i.e., knowledge obtained from one's own subordinates, examples from other corresponding units, patient demands and needs, media statements, municipality/city resident opinions, contracts between municipalities and municipal federations, or one's own professional education, no differences were found between managers of different professional backgrounds.
Spehar et al. (2015)[15]	Norway	To investigate how clinicians' professional background influences their transition into the managerial role and identity as clinical managers.	N/A	Four public hospitals, two health trusts; 30 clinician managers (doctors, nurses, allied health) interviewed, 20 of these were observed in management and staff meetings during the day	Qualitative analysis of interview and observation data	Managerial role transition and clinical manager identity	Doctors experienced difficulties in reconciling the clinical and management role and used clinical work to gain legitimacy and respect from medical colleagues. Nurses experienced a faster and more positive transition into the manager role, and were more fully engaged in the managerial aspects of the role.
Veronesi et al. (2013)[16]	UK	To determine how much difference managers will make to performance outcomes.	To determine whether the positive outcomes of clinical leadership derive from the participation of all clinicians in boards (including nurses and allied health. professions) or only doctors.	102 NHS hospital trusts in England (60% total)	Quantitative analysis of data from hospital trust annual reports, publicly available performance measures from the Healthcare Commission, and data gathered by Dr Foster over a three-year period (2006-2009)	Quality of the service provided (compliance with core standards concentrating on four main areas: health and well-being, clinical effectiveness, safety and patient focus, and ease and equity of access)	Significant and positive association was found between a higher percentage of clinicians on boards and the quality ratings of service providers (confirmed in relation to lower morbidity rates and tests to exclude the possibility of reverse causality). No equivalent association was found for clinical professions such as nurses and other allied health professions.

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	3-5
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	5-6
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	N/A
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	6
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	6
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	6-7
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	7-8
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	8
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	8
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	8
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	N/A
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	8-9

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	8
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	N/A
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	9
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	9-10
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	16-17
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	10-16
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	17
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	16-17
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	N/A
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	17-20
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	20
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	20-21
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	21

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

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BMJ Open

Medical leadership - a systematic narrative review: Do hospitals and healthcare organisations perform better when led by doctors?

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Title: Medical leadership - a systematic narrative review: Do hospitals and healthcare organisations perform better when led by doctors?

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Leadership, management, physician executive, clinician-manager, organisational performance, board director, patient outcomes

ABSTRACT

Introduction: Despite common assumptions that doctors are well placed to lead hospitals and healthcare organisations, the peer-reviewed literature contains little evidence on the performance of doctors in leadership roles in comparison with that of non-medical managers.

Objectives: To determine whether there is an association between the leader's medical background and management performance in terms of organisational performance or patient outcomes.

Methods: We searched for peer-reviewed, English language studies using Medline, Embase and Emerald Management between 2005 and 2017. We included quantitative, qualitative, and mixed method empirical studies on the performance of senior healthcare managers where participants were described as doctors or leaders, and where comparative performance data were provided on non-medical leaders. Studies without full-text available, or no organisational, leadership behaviour or patient measures, were excluded.

Results: The search, conducted in Medline (n=3,395), Embase (n=1,913) and Emerald Management (n=454) databases, yielded 3,926 entries. After application of inclusion and exclusion criteria, sixteen studies remained. Twelve studies found that there were positive differences between medical and non-medical leaders, and eight studies correlated those findings with hospital performance or patient outcomes. Six studies examined the composition of boards of directors; otherwise there were few common areas of investigation. Five interrelated themes emerged from a narrative analysis: the impact of medical leadership on outcomes; doctors on boards; contribution of qualifications and experience; the medical leader as an individual or part of a team; and doctors transitioning into the medical leadership role.

Discussion and conclusion: A modest body of evidence supports the importance of including doctors on organisational governing boards. Despite many published articles on the topic of whether hospitals and healthcare organisations perform better when led by doctors, there were few empirical studies that directly compared the performance of medical and non-medical managers. This is an under-researched area that requires further funding and focus.

Strengths and limitations of this study

- To the best of our knowledge, this is the first systematic review of the literature published over the last decade to determine whether healthcare leaders who are doctors perform better than those with non-medical backgrounds in terms of organisational performance or patient outcomes
- We developed robust search strategies and a rigorous reviewing process aiming to minimise bias and ensure the objectiveness and transparency of the systematic review
- A modest body of evidence supports the importance of including doctors in the composition of governing boards to improve organisational performance
- There were insufficient studies meeting inclusion criteria to enable our research question to be fully answered

INTRODUCTION

Rationale

Prior to the 1970s, doctors very often ran hospitals[1 2] and administrators played a subordinate, coordination, rather than a leadership, role. As healthcare moved towards a more business-bureaucratic[3] model of practice, administrators were engaged to manage general organisational-operational business performance, but doctors continued to expend substantial resources and manage the major decisions affecting patient care. In 1983, the Griffiths Report[4] was released in the UK, paving the way for the introduction of a new purchaser-provider model of healthcare. In the USA, the idea which became known as clinical directorates was established.[5] The Medical Director role and clinical directorates became more widely established, and over time enabled more senior managers to have greater control over resources. Doctors did not always consider such roles attractive,[5] but felt that they needed to take up these part-time appointments in order to continue to partake in decisions affecting

their work. In the 1990s, when managed care was established in the USA,[6] new drivers emerged as doctors moved from part-time advisory roles into full-time management in order to contribute to running healthcare organisations, secure greater control over resource allocation and participate in senior decision-making.

Today, doctors are well-established in management roles, with the first survey of Accountable Care Organisations (ACOs) in the USA finding that by 2014, 51% were led by doctors.[7] Within hospitals and other healthcare organisations, medical departments are normally led by doctors, and report to the Medical Director (or equivalent) who is typically a member of the executive team (see Dwyer[8] for a literature-based review on the roles of medical managers). By the turn of the 21st century in the USA, 50% of physician executives no longer practiced medicine,[6] and physician executives began to gain acceptance as administrators of managed care institutions.[9 10] In the UK[2 11] (and elsewhere[11 12]), where the culture was historically less well disposed to accepting doctors who relinquish their clinical work,[13] the majority of medical executives today act as 'hybrid managers', who continue to manage a clinical workload alongside their management responsibilities. In the UK National Health Service (NHS), where doctors hold positions of power within healthcare organisations that enable them to participate in managerial decisions, enhancing medical engagement in leadership is seen as a factor that may contribute to improved organisational performance.[11] Benefits to employing doctors in healthcare management roles may include bottom-up leadership, greater political influence, and improved communications between doctors and senior management.[14] Current focus on engaging doctors in leadership centres on efforts to link clinical decisions with those of strategic management, and has broadened to include key accountabilities for quality of care in addition to resource management.[15] Today's leaders in healthcare perform many tasks. For this review, we have adopted the UK's King's Fund description of the healthcare leadership task: "to ensure direction, alignment and commitment within teams and organisations".[16, p2] This task may incorporate elements of leadership, management and administration.

Despite the prevalence of such physician executives (to use the US term) occupying leadership roles in health systems, we do not know to what extent prior medical training or experience as a doctor affects the performance of healthcare executives. Research questions include: Do healthcare executives who are doctors perform better than those who are not; and, if so, in what ways do they perform better? What is it about a doctor that might enhance their leadership ability: medical training, experience in the medical role, or something else? Is it important for organisational performance to have doctors as members of the executive leadership team, and if so, why?

Previous research has found no difference in performance between medical and non-medical managers;[17-19] however, opinion on the topic of 'which profession should manage hospitals' is prevalent and polarised. There appears to be a view that the doctor's mindset is different to that of the general healthcare manager.[20 21]Arguing against the benefits of medical leadership, papers cite doctors' over-identification with their professional clinical role, tendency to be conservative individualists rather than team players, lack of formal management training, and their purported weaknesses in financial management and organisational strategy.[12 22-24]

However, doctors prefer to be led by doctors,[11] and articles in favour of medical leadership cite doctors' strengths in addressing patient outcomes, quality and safety issues, and decision-making, and point to their ability to specialise, and intelligence. A recent study surveying doctors' reactions to hospital reform found that doctors who were also leaders reacted more positively to hospital reform than those who spent most of their time caring for patients.[25] Clearly, the question 'do hospitals and healthcare organisations perform better when led by doctors?', particularly in relation to the leadership structures of modern healthcare systems, has not been settled.

Objectives

This study presents the results of a systematic review of the literature published since 2005 on medical leadership. We sought contemporary evidence on the leadership performance of executives or senior managers who were also doctors. The objective of the review was to determine if there is an association

between leaders having a medical background and management performance, in terms of organisational performance or patient outcomes. This objective was framed by the research question: Do hospitals and healthcare organisations perform better when led by doctors?

To enable us to objectively answer our question, and to minimise the confounders associated with comparisons in healthcare, we sought quantitative, qualitative and mixed method empirical studies reporting on leadership performance that included medical and non-medical leaders in the same setting.

METHODS

Eligibility criteria

Types of participants

We included empirical studies on senior managers in healthcare organisations that involved participants who were both doctors and leaders, and participants who were non-medical leaders. Non-medical leaders included those who had a clinical background other than medicine (e.g., nurses, allied health professionals) and those who did not have a clinical background.

Types of outcomes

After examining the literature, we included three types of outcome measures. These were: (1) patient measures, e.g., patient outcomes, or processes of care; (2) organisational measures, e.g., staffing, finance, or hospital ratings; and (3) leadership behaviour measures, e.g., management processes, teamwork, or decision-making.

Information sources

We searched for peer-reviewed, English language studies using three academic databases; Medline, Embase and Emerald Management. The search was limited to empirical research published between 1st January 2005 and 7th June 2017.

Search

The search was designed, in collaboration with a professional research librarian, to capture both the executive leadership and the medical practitioner role. Seven terms were included for executive leadership and linked using the Boolean operator OR to maximise the sensitivity of the search: "executive", "leader", "leadership", "manager", "director", "CEO", or "board". For the role of medical practitioner, terms including "physician", "clinician", and "doctor" are used sometimes interchangeably in the literature. Thus we searched for all three terms using the OR operator. The searches were combined, and refined using a proximity operator. Full search strategies are presented in Table 1.

Table 1. Medline, Embase and Emerald Management search strategies

Database	**Medline**	
Strategy	**Searches**	**Results**
#1	((executive$ or leader$ or leadership$ or manager$ or director$ or CEO$ or board$) adj3 (physician$ or doctor$ or clinician$)).ab.	4,158
#2	Limit #1 to (English language and yr="2005 - Current")	2,037
#3	*Physician Executives/	4,069
#4	Limit #3 to (English language and yr="2005 - Current")	1,461
#5	#2 or #4	3,395

Database	**Embase**	
Strategy	**Searches**	**Results**
#1	((executive$ or leader$ or leadership$ or manager$ or director$ or CEO$ or board$) adj3 (physician$ or doctor$ or clinician$)).ab.	5,766
#2	Limit #1 to (English language and yr="2005 - Current" and article)	1,913

Database	**Emerald Management**	
Strategy	**Searches**	**Results**
	((executive* or leader* or leadership* or manager* or director* or CEO* or board*) and (physician* or doctor* or clinician*)).ab. Limit publication date to January 2005 - June 2017	454

Study selection

Search results were aggregated and imported to an EndNote library, and duplicate entries were removed. Pairs of reviewers (RCW:LT; KL:ZL) cross-checked 110 (approximately 3%) of the citation titles and abstracts in a double review in order to establish inter-rater reliability. Articles were excluded based on the following criteria: pre-2005; language other than English; non-peer-reviewed literature; setting

other than healthcare; non-primary research including systematic reviews; and does not include participants who are both doctors and leaders. Any discrepancies between the reviewers were discussed until a consensus was reached. The remaining citations were randomly assigned to the four reviewers who independently assessed titles and abstracts against the exclusion criteria, with regular discussions held at team meetings. While we did not include literature reviews, we snowballed the reference section of any review identified, searching for additional papers that might meet inclusion criteria. The selected articles were then subject to a full-text review where further criteria were added to the exclusion criteria: full-text unavailable; neither medical background/training or leadership is assessed as a variable in the data analysis; does not include organisational and/or patient outcomes.

Data collection process and data items

Data from the included studies were extracted into a locally developed form for analysis. Elements extracted were: a) the full reference, b) location, c) language, d) period of data collection, e) study type, f) study primary and secondary aims, g) exclusion criteria, h) data: total number of organisations, type of organisations, data types and sources used to performance and/or outcomes, methodological/statistical approach to identify performance and/or outcomes, i) methods: methods used to study contextual/success factors associated with medical leaders (e.g., interview, survey, observation), participants, and data analysis methods, j) findings: quantitative results and qualitative results or contextual factors most important for explaining relationship between medical background of leader and performance, and k) implications.

Risk of bias

Risk of bias within studies was assessed using criteria developed by Hawker, et al.[26] Ratings were assigned (poor, fair, good) across nine different categories: 1) abstract and title, 2) introduction and aims, 3) method and data, 4) sampling, 5) data analysis, 6) ethics and bias, 7) results, 8) transferability or generalisability, 9) implications and usefulness. Risk of bias potentially affecting the cumulative evidence

across studies was determined by examining study methods, ethics committee approvals, study funding, and authors' conflicts of interest.

Synthesis of results

Results were analysed through a narrative synthesis of extracted data.[27] Extracted data were coded and organised to explore connections between data elements and to develop sets of concepts. Segments of data were then linked in a formal fashion, to determine relationships that may exist between different data elements and allow themes to emerge.

RESULTS

Study selection

The search results and review process are presented in Figure 1, using the Preferred Reporting Items for Systematic Review and Meta-analyses (PRISMA) flow chart. The search performed on Medline (n=3,395), Embase (n=1,913) and Emerald Management (n=454) yielded a total of 3,926 articles after the removal of 1,849 duplicates. To test inter-rater reliability, we used Cohen's Kappa and found high levels of agreement between the paired reviewers for the 3% double-review, K=.78 (p<.0001) for pair 1 and K=.88 (p<.0001) for pair 2. The remaining screening of title and abstract resulted in 113 studies eligible for full-text review. The full-text review stage lead to the inclusion of 22 quantitative, qualitative or mixed method studies in the penultimate pool. After an additional exclusion criterion was added, requiring that included studies provide data to allow a comparison of medical and non-medical leadership, eight more studies were eliminated. The literature search identified five literature reviews on topics associated with medical leadership.[8 14 28-30] The references of these five reviews were searched for additional studies that met inclusion criteria. Two additional studies were identified as a result of this process, resulting in a final inclusion of 16 studies.

Study characteristics

The characteristics of the 16 studies that met inclusion criteria are presented in Supplementary Table 1. Fourteen studies conducted quantitative analysis: ten studies analysed questionnaire survey data;[7 31-39] one study (Jiang et al.[33]) also provided processes of care data, and another provided hospital performance data (Saleh et al.[38]). Two studies analysed US Statewide Health Planning and Development data from California,[40 41] one study analysed data from the AMADEUS database and hospital and insurance documents,[42] and another study analysed UK hospital trust data.[43] One study conducted a qualitative analysis of interview and observation data,[44] and another conducted a mixed method analysis,[45] which combined findings from a review of hospital documents with qualitative analysis of interviews with hospital CEOs and board members. Seven studies were from the USA; the remainder were from Finland (2), Germany (2), the UK (1) Ireland (1), Norway (1), Lebanon (1) and Australia (1).

Results of individual studies

Six studies reported on the performance of hospital boards.[33 40-43 45] Veronesi et al.[43] examined the impact of clinicians appointed to the boards of 102 English NHS hospital trusts on quality of hospital care provided from 2006 to 2009. Composition of boards was determined from hospital trust annual reports. Compliance with health and well-being, clinical effectiveness, safety and patient focus, and ease and equity of access care standards was obtained from the UK Healthcare Commission and Dr Foster (a commercial provider of healthcare benchmarking data). A greater percentage of doctors on boards was associated with a better-quality rating of service providers. Trusts achieving a four rating had an average of 15.01% of directors with a medical background, whereas in trusts achieving only a one rating, 11.09% board directors were doctors. This finding was confirmed in relation to lower morbidity rates and tests to exclude the possibility of reverse causality, whereby doctors joined the boards of better performing trusts. No equivalent association was found for clinical professions such as nurses and other allied health professions.

De Andrade[41] investigated whether having board members with medical expertise in 281 USA hospitals affected the levels of uncompensated care provided. A quantitative analysis of data from the California

Office of Statewide Health Planning and Development between 1997 and 2010 found that doctors' board membership was not related to provision of uncompensated care, except when the hospital's ownership status was taken into account. Relative to non-profit and public hospitals, for-profit hospitals provided more uncompensated care the higher the percentage of doctors on the board. For an average for-profit board size of ten members, substituting one member by a doctor increased the amount of uncompensated care provided by 19%.

On the theme of boards, Prybil[45] sought to determine whether high-performing and mid-range hospitals differ in board structures, processes, and practices. High performance hospitals included at least three of the Solucient Center for Healthcare Improvement's '100 Top Hospitals' in 1999-2003. A mixed method analysis of hospital documents and interviews with hospital CEOs and board members was conducted for seven matched pairs of USA hospitals, finding that doctors form a larger component of the boards of high performing hospitals (30.3%) than of midrange hospitals (20.8%). Doctors comprised 25% or more of the boards' voting members in five of the seven high performing hospitals, but only one midrange hospital.

Jiang et al.[33] examined whether differences exist in quality performance of 490 USA hospitals in relation to adoption of particular practices in board oversight of quality. Data consisted of 1) a survey of 562 hospital CEOs on board practices, (2) process of care measures for three clinical conditions (heart attack, heart failure, pneumonia), and (3) outcomes measures, consisting of risk adjusted mortality rates, for the same three conditions. Sixty percent of participating hospitals had a Chief Medical Officer or Vice President of Medical Affairs on the committee; this resulted in significantly higher process of care scores (85.3% vs 81.0%, $p<0.05$) and lower risk adjusted mortality rates (5.6% vs 7.3%, $p<0.05$) than hospitals that did not have a Chief Medical Officer or Vice President of Medical Affairs as a committee member. Eighty three percent of participating hospitals had medical staff on the committee; this resulted in significantly higher process of care scores (84.2% vs 80.9%, $p<0.05$) but no difference in risk adjusted mortality rates. Sixty three percent of participating hospitals had a clinical board member on the

committee; this resulted in no difference in process of care scores but significantly lower risk-adjusted mortality rates (5.7% vs 7.2%, p<0.05).

Bai and Krishnan[40] examined whether hospitals without medical participation on their boards of directors delivered lower quality of care in 142 non-profit hospitals in the USA. Quantitative data were obtained from the US Hospital Quality Alliance and the California Office of Statewide Health Planning and Development. The study found that boards without medical members were associated with a decrease of three to five percentage points in quality of care for heart failure, pneumonia, and surgery infection prevention.

Moving to Germany, Kuntz et al.[42] examined differences in the financial performance of hospitals with regard to ownership by studying the size and composition of supervisory boards in 175 hospital companies operating 246 hospitals (14% of all German acute care hospitals in 2009). The study reported on a quantitative analysis of hospital financial performance data (from the AMADEUS database) and information on hospital and board characteristics (from business and quality reports, hospital websites and health insurers). Data were obtained from all participants in 2009, and from a subsample of 163 hospital companies in 2010. Financial performance was based on four measures: return on assets (ROA), earnings before interest and tax (EBIT) margin, total profit margin, and net income. Doctors comprised, on average, 11.7% board members. Financial performance, and board size and composition depended on ownership ($p < .01$ for ROA and $p < .001$ for the other four performance measures). An increase in board size and greater political participation were negatively associated with all five tested measures of financial performance, an increase in nurse and economist participation was negatively associated with financial performance, and no associations were found for clerical participation. An increase in physician participation, however, was positively associated with a 5% increase in ROA ($p = .061$).

Two studies reported on doctors' involvement in strategic decision making.[37 38] Parayitam et al.[37] examined the self-reported outcomes of decisions when physician executives were involved in strategic decision-making (SDM) processes in 109 USA hospitals. Hypotheses were that increased numbers of

doctors involved in strategic decision-making teams would be associated with better decisions, greater understanding of the rationale of decisions, and more commitment to decisions. The sample of 114 CEOs and 254 strategic decision makers (executive officers, director of human resources, chief technical offices, chiefs of staff, personnel involved in facilities, maintenance) completed a survey reporting their decision quality, understanding, and commitment. Structural equation modelling of the data suggested that the ratio of doctors was positively correlated with decision understanding, commitment and quality.

Saleh et al.[38] explored the use of strategic planning processes in 79 (56.4%) Lebanese hospitals, and investigated its association with financial performance. Hypotheses included that the level of physician involvement in the strategic planning process is positively associated with hospital performance. Quantitative analysis of survey data on hospital-reported participation in strategic planning processes, and hospital performance data from the Lebanese Ministry of Public Health (occupancy rate and revenue-per-bed) found that there was no association between the level of physician involvement in the strategic planning process and hospital outcomes; generally, physician involvement was low (4.1 out of a possible score of 7).

Two studies reported on medical leadership of organisations.[7 32] In the USA, Colla et al.[7] measured how doctor-led organisations compared with other Accountable Care Organisations (ACOs) in terms of structure, size and care provided, and explored the degree of doctor engagement in managing ACOs. ACOs are groups of providers that are jointly responsible for caring for a nominated population of patients. Fifty one percent of the 173 ACOs in the study self-identified as doctor-led, 33% as jointly led by hospital and doctor, and the remainder were led by hospitals or other entities. Doctor-led ACOs were found to be more likely to have advanced IT capabilities and better outpatient care than non-doctor-led ACOs, and were more likely to measure and report financial performance at practice and clinicians levels; however this finding was confounded by the fact that doctor-led ACOs are less likely to include hospitals and more likely to include physician groups. Performance of ACOs was not assessed, therefore

it was not possible to determine whether performance was related to whether leaders were doctors or non-medical managers.

Goodall[32] examined the relationship between hospital performance and whether the Chief Executive Officer (CEO) was a doctor or a non-medical manager. Hospital performance was determined by media-generated league tables, produced by US News and World Report's (USNWR) 'Best Hospitals' in 2009. Three hundred healthcare executives from three specialties (cancer, digestive disorders, heart and heart surgery) were surveyed in the top 100 USA hospitals. Positive association was found between physician CEOs and hospital performance for all three hospital specialties ($p<0.001$). While higher performing hospitals were associated with physician CEOs, causation was not able to be determined (e.g., higher performing hospitals may just prefer to have doctors as leaders).

Five studies reported on medical leadership within organisations.[31 34 35 39 44] Konu and Viitanen[34] investigated the incidence of shared leadership among 433 middle-level managers (e.g., chief doctors, nursing directors) in social service and healthcare in Finland. Quantitative analysis of survey data on leadership practices found that shared leadership practices were more common among managers without a medical background.

Another study sought to determine whether evaluations on the impact of knowledge sources affecting their decision-making differ depending on the manager's professional background, activity sector, gender, management experience, or age, among 404 middle-level social and healthcare managers in a Finnish hospital (Simonen et al[39]). Quantitative analysis of survey data revealed that managers who were also doctors more strongly perceived that their decision-making was influenced by their own professional experience, journals and scientific research within their own professional field, and nationwide interaction within their own profession. Differences were found between doctor managers and nurse managers with respect to organization documents and publications, which carried more weight in nurse managers' decision-making. No differences were found between managers of different professional backgrounds regarding other knowledge sources.

In other work, Agarwal et al.[31] sought to determine whether there is a positive association between Management Practices Score (MPS) and the level of clinical education of managers in 42 Australian acute care public hospitals. The MPS for each hospital was calculated from interview responses of 116 managers to a survey of 21 hospital management practices across multiple dimensions. The study found no association between the number of doctors in each hospital and the MPS (p=0.779). The coefficient on the level of skills and education within hospitals, however, was positive and significant (p=0.06), indicating that hospitals with a higher proportion of clinically qualified and skilled managers perform significantly better in management practices.

Spehar et al.[44] investigated how clinicians' professional background influences their transition into the managerial role and identity as clinical managers in four public hospitals and two health trusts in Norway. Interviews were conducted with 30 clinician managers (13 doctors), 20 of these were also observed in management and staff meetings during the day. Qualitative analysis of interview and observation data revealed that doctors experienced difficulties in reconciling the clinical and management role and used clinical work to gain legitimacy and respect from medical colleagues. In contrast, nurses experienced a faster and more positive transition into the manager role, and were more fully engaged in the managerial aspects of the role.

Moving countries again, Kuntz et al.[35] assessed the relationship between the amount of medical involvement in leadership and staff-to-patient ratios. The study was conducted in Germany, where hospitals are managed by an executive leadership team consisting of a commercial director, medical director and nursing director. The study was controlled for the size and case mix of the 604 participating hospitals, whether they were public or private, the degree to which they were rural, and whether the doctors were salaried or contracted. High staff-to-patient ratios for both nurses and doctors are associated with better hospital performance.[46 47] The study found a relationship between full-time Medical Director (MD) or heavily involved part-time MD and a higher staff-to-patient ratio. Full time MDs significantly improved the staff-to-patient ratios for both doctors and nurses (doctors 1.96, p<0.01; nurses: 4.44, p<0.01), whereas part-time MDs only improved the staff-to-patient ratios for doctors (e.g.,

an increase of part-time involvement from 15 to 25%, resulted in an increase of 2.49 doctors per thousand inpatients).

Staying in Europe, O'Keefe[36] measured and compared risk aversion in 788 Irish clinicians, clinical managers, non-clinical managers, and non-clinical public representatives, in terms of willingness to discharge a patient from the Emergency Department (ED). The study found no significant difference between clinicians and clinician managers, but found significant differences between clinicians and non-clinicians (including between clinical and non-clinical managers), with the non-clinical participants being more risk averse. Limitations included: (1) there was a large variation in risk tolerance, even between clinicians, (2) it was a single study in a single country, and (3) clinicians are likely to be more familiar both with actual events depicted in the scenarios, and also with the process of making treatment choices that may result in death. The study did not provide indication of an objectively appropriate level of risk, but the authors suggested that the clinicians had a more pragmatic approach to decision-making.

Risk of bias

While studies were generally well-designed and executed, generalisability and implications, and usefulness of the findings, was low (Table 2).[26] There was a risk of bias across studies, in that the majority (12) studies collected self-reported data on aspects of medical management, e.g., surveys or interviews, rather than objective data. Many of the studies did not report ethics approval, study funding or authors' conflicts of interests.

Table 2. Methodology rigour and risk of bias

Study	Abstract and title	Introduction and aims	Method and data	Sampling	Data analysis	Ethics and bias	Findings	Generalisability	Implications and usefulness
Agarwal et al. (2016)[31]	Good	Good	Good	Fair	Fair	Good	Good	Fair	Good
Bai and Krishnan (2015)[40]	Fair	Good	Good	Good	Good	Fair	Good	Fair	Good

Colla et al. (2014)[7]	Fair	Fair	Good	Good	Poor	Poor	Good	Good	Fair
De Andrade (2014)[41]	Fair	Good	Good	Good	Good	Fair	Good	Fair	Good
Goodall (2011)[32]	Fair	Fair	Fair	Poor	Fair	Poor	Fair	Poor	Poor
Jiang et al. (2009)[33]	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair
Konu and Viitanen (2008)[34]	Good	Good	Good	Good	Good	Very poor	Good	Fair	Fair
Kuntz et al. (2013)[35]	Fair	Good	Good	Good	Good	Good	Good	Fair	Fair
Kuntz et al. (2016)[42]	Good	Good	Good	Good	Good	Fair	Good	Fair	Fair
O'Keefe (2015)[36]	Good	Fair	Fair	Good	Good	Good	Fair	Fair	Poor
Parayitam et al. (2007)[37]	Good	Good	Good	Good	Good	Fair	Good	Fair	Good
Prybil (2006)[45]	Fair	Good	Fair	Fair	Fair	Fair	Fair	Fair	Fair
Saleh et al. (2013)[38]	Good	Fair	Good	Good	Good	Fair	Good	Fair	Fair
Simonen et al. (2009)[39]	Good	Good	Good	Good	Good	Fair	Good	Fair	Fair
Spehar et al. (2015)[44]	Fair	Fair	Good	Good	Good	Good	Good	Good	Fair
Veronesi et al. (2013)[43]	Fair	Good	Good	Good	Very Good	Good	Good	Good	Good

Scale: Very Good; Good; Fair; Poor; Very Poor. Adapted from Hawker et al.[26]

Study Synthesis

Extracted data were cross-checked for accuracy and coded by four researchers (ZL, KL LT, RC-W). One researcher (RC-W) completed a narrative synthesis of the coded data, by linking the data to form five interrelated themes: impact of medical leadership on outcomes; doctors on boards; contribution of qualifications and experience; the leader as an individual or part of a team; and doctors transitioning into the medical leadership role. Four broad categories of articles were found in the literature search: (1) individual perspectives on medical leadership (the majority of excluded articles), frequently based on

personal experience; (2) empirical research based on self-reported data about medical leadership (surveys, interviews, focus groups); (3) objective empirical research on the role or characteristics of healthcare leaders (observations, other data); and (4) objective empirical research on the relationship between medical leaders and outcomes (hospital performance data, patient outcomes).

DISCUSSION

Summary of evidence

Themes

Impact of medical leadership on outcomes. Given the complexity encountered within modern healthcare organisations,[48] it is difficult to demonstrate the impact of leadership on outcomes - even when assessing medical and non-medical leadership in the same setting. Four of the sixteen studies showed either no difference or a negative relationship between medical and non-medical leadership in the aspects of performance that they investigated.[34 38 39 44] The remaining 12 studies found that there were differences between medical and non-medical managers, and eight of these studies[7 32 33 40-43 45] correlated findings with hospital performance or patient outcomes. The studies did not provide sufficient information that would allow us to determine *why* medical leadership might make a difference. Other than board composition (discussed below), there were few common areas of investigation, with studies examining varied topics: risk aversion, IT adoption, patient care arrangements, financial reporting, staff-to-patient ratios, and so on.

Doctors on boards. We found that evidence supporting the relationship between doctors' board participation and organisational performance is accumulating, with empirical studies from the UK,[43] Europe[42] and the USA[33 40 41 45] all reporting positive associations. This finding is consistent with pre-2005 data,[49 50] and supported by a recent literature review on the topic.[30]

Contribution of qualifications and experience. None of the studies provided data on the characteristics of medical leaders that were associated with higher performance. We know that doctors who receive leadership or management training may perform well in leadership roles. Xirasagar et al.[51 52] for

example, when examining the relationship between leadership styles, training, and effectiveness of doctors who are managers, concluded that doctors who completed graduate managerial training such as Masters of Business Administration (MBA), Masters of Health Administration (MHA), or Masters of Public Health (MPH) degrees, or more than 30 days of in-service training, were likely to be more effective leaders. In the included studies there was no demographic information on the leaders who participated in the study to enable us to disentangle the contribution to the findings of medical qualifications, medical experience or management experience. While our included studies found both positive[43] and negative[34 39 44] differences between a leader's medical and nursing background in relation to leadership outcomes, much of the literature conflates doctors and nurses into a single group of 'clinicians'.[29]

Medical leader as an individual or part of a team. Only two studies[7 32] explored the performance of the doctor as the CEO or primary organisation leader, and both found that there was an association between medical leadership and organisational performance. The remaining studies explored outcomes when a doctor was included as part of the leadership team. While not providing direct evidence supporting the doctor as *the* leader, they emphasise current thinking about the need to engage doctors in healthcare leadership to improve organisational culture and patient outcomes.[53 54] In a comparison of six high and low performing UK trusts, for example, Mannion et al. found that poor performing organisations were characterised by cultures where a few senior consultants exerted a disproportional influence over organisational priorities.[55] Doctors who are engaged as part of a leadership team are often hybrid managers, who retain a clinical role, and studies elsewhere have found these managers less likely to be effective in their non-clinical leadership role.[56] Kippist and Fitzgerald,[12] for example, found that hybrid managers would prioritise clinical work over management, leading to additional burden on their managerial colleagues, thereby questioning the effectiveness of the hybrid clinician manager. Spehar et al.[24] explored influences and strategies employed by 30 hybrid leaders in four hospitals in Norway and concluded that doctors who were managers could not influence other doctors without drawing on professional power, and that doctors felt they had to maintain their clinical skills to retain

credibility among peers. This emphasis on professional skill constrained doctors from drawing effectively on positional power. This expert power was not retained and had to be continuously regenerated. In addition, rather than collaborating, doctors saw clinician managers of other departments as competitors, and saw themselves as representatives of their own professional group.

Doctors transitioning into the medical leadership role. The five studies reporting on medical leadership within organisations touched on some of the barriers or enablers[57] for doctors seeking to enter management, including difficulties reconciling the clinical and management role. Professional and organisational culture strongly influences the roles that practitioner leaders can take up and the influence they can wield.[58] Ham et al.[59] investigated, via 22 qualitative interviews, the experiences of doctors who become Chief Executives of UK National Health Service organisations and found that medical managers tended to be "keen amateurs" rather than trained managerial professionals. Kisa and Ersoy,[60] via a 31 item time management questionnaire, found that medical managers have poor time management skills. Medical managers are not usually trained in leadership,[11 59] which may explain both these findings and some of the negative perceptions of doctors as managers. There are also some indications within our included studies that doctors should adopt a more multidisciplinary approach to be effective leaders.[34 39 44] West and Barron[61] found that medical managers consult or network mostly with other medical managers, and that it is the non-medical managers who act as brokers between professional groups. This finding is supported by other work in the field.[62]

Limitations

Our review was limited in date range and language (English only), and we found insufficient studies meeting inclusion criteria to enable our research question to be robustly answered, hence the decision to craft a narrative review. Most studies examined only one or two aspects of leadership; because these aspects were different across studies, it was not possible to generalise the findings. Due to the diversity of keywords and publication venues used by authors of studies on medical leadership, it was difficult to ensure that all relevant literature has been captured by our search strategy. It is also important to

consider that risk of bias was evident across studies due to the majority of studies employing self-reported measures, and an absence of information concerning ethics approval, funding, or conflicts of interests in some studies.

Conclusions

There is a modest body of evidence supporting the importance of including doctors in the composition of hospital or organisational governing boards. Despite a large volume of published literature on the topic of whether hospitals and healthcare organisations perform better when led by doctors, however, there are few studies that have examined this topic in a robust way or directly compared the performance of medical and non-medical managers. While we found sixteen studies that provided empirical data in respect of this question, only two studies explored the role of organisational leader or CEO. This is an under researched area that requires further funding and focus.

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COMPETING INTERESTS

The authors have read and understood the *BMJ* policy on declaration of interests and declare that we have no competing interests.

DATA SHARING

The full dataset is available from the corresponding author on request.

AUTHORS' CONTRIBUTIONS

RC-W and JB conceptualised the study, KL, ZL and LT conducted the database searches. RC-W, KL, ZL and LT conducted the search and review strategy, RC-W drafted the manuscript, all authors reviewed the manuscript for critical content.

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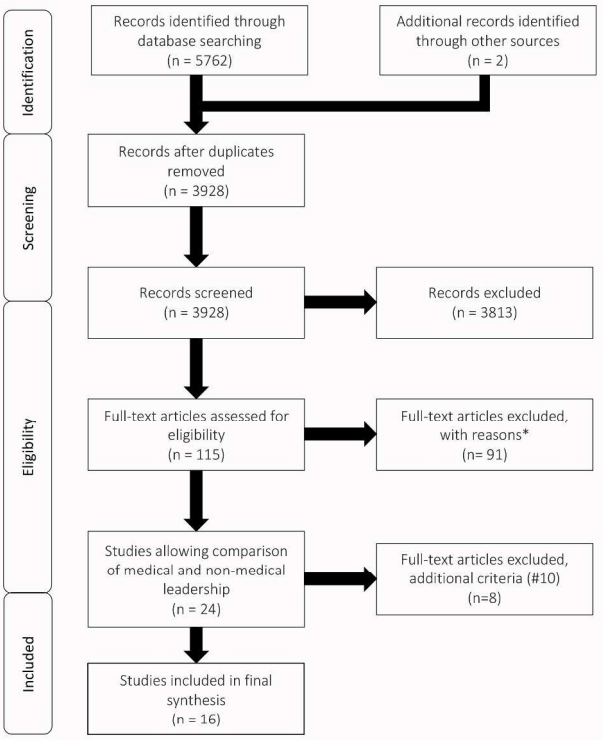
LIST OF FIGURES

Figure 1. Search and review strategy (PRISMA flow diagram)



*Legend

Reason for exclusion		Number of studies*
1	Pre-2005	0
2	Other languages	0
3	Not peer-reviewed literature	0
4	Setting other than healthcare	0
5	Full-text not available	8
6	Not primary research (including systematic reviews)	4
7	Does not include participants who are both doctors or leaders	20
8	Neither medical background/training or leadership is assessed as a variable in the data analysis	18
9	Does not include organisational and/or patient outcomes	64
10	Does not include medical and non-medical leaders in the study	8

*The numbers do not add up to the total number of studies excluded because a proportion of studies were excluded based on multiple criteria.

Figure 1. Search and review strategy (PRISMA flow diagram)

179x317mm (300 x 300 DPI)

Study	Country	Primary aim	Secondary aim	Participants; Organisation	Method	Performance measures	Key findings
Agarwal et al. (2016)[1]	Australia	To investigate the elements of best management practices in an Australian state-run healthcare system.	To determine whether there is a positive association between management practices score (MPS) and the level of clinical education of a managers in public hospitals.	42 acute care public hospitals	Quantitative analysis of survey data	Management Practices Score (MPS), consisting of 21 hospital management practices across multiple dimensions	The coefficient on the level of skills and education within hospitals was positive and significant (p=0.06). Therefore, the authors supported the hypothesis that hospitals with a higher proportion of clinically qualified and skilled managers perform significantly better in management practices.
Bai and Krishnan (2015)[2]	USA	To examine whether hospitals without physician participation on their boards of directors deliver lower quality of care.	N/A	142 non-profit hospitals	Quantitative analysis of US Hospital Quality Alliance and California Office of Statewide Health Planning and Development data	Process of care quality encompassing four categories (heart attack, heart failure, pneumonia, and surgery infection prevention)	The absence of physicians on the board was associated with a decrease of 3-5% points in three of four measures of care quality (heart failure, pneumonia, and surgery infection prevention).
Colla et al. (2014)[3]	USA	To explore the extent to which physicians are engaged in the leadership of emerging Accountable Care Organisations (ACOs), including whether ACOs identify themselves as physician-led, have boards that are run by physicians, and are physician owned.	To examine how physician-led ACOs compare to other ACOs in terms of structure, size, and services provided. To examine the implications of leadership types for ACO capabilities and the future of the ACO model.	173 accountable care organisations	Quantitative analysis of survey data	Care management and technology capabilities	Physician-led organisations had fewer patients per contract than other ACOs. Physician-led ACOs had similar care management and health IT capabilities to those of other ACOs, despite having different leadership structures and offering fewer services. Physician-led ACOs were leading in outpatient care management and health IT. However, they were falling behind in their ability to manage care across settings. Physician-led organisations may face greater challenges than other ACOs in managing transitions between settings of care and managing hospital-based care, as they were less likely to include hospitals or post-acute care facilities. Physician-led ACOs were less likely than other ACOs to offer services that are traditionally separate from medical care, such as pharmacy.
De Andrade (2014)[4]	USA	To investigate whether having board members with medical expertise affects the levels of uncompensated care provided by hospitals.	To verify how the relationship between board member medical expertise and uncompensated care is affected by the hospital's ownership type.	281 hospitals	Quantitative analysis of data from the California Office of Statewide Health Planning and Development for 1997-2010	Uncompensated care provision	Physician board membership was not related to uncompensated care provision, except when hospital's ownership status was taken into account. When hospital ownership type was considered, the percentage of physicians on the board did affect the provision of uncompensated care. Relative to non-profit and public hospitals, for-profit hospitals provided more uncompensated care the higher the percentage of physicians on the board. For an average for-profit board size, which has 10 members, substituting one member by a physician increased the amount of uncompensated care provided by 19%.
Goodall (2011)[5]	USA	To determine if there is an association between physician leaders and hospital performance.	N/A	300 healthcare executives; 100 hospitals	Quantitative analysis of survey data	Index of Hospital Quality	Positive association was found between physician CEO and hospital performance for all three hospital specialties (p<0.001).
Jiang et al. (2009)[6]	USA	To examine whether differences exist in hospitals' quality performance in relation to adoption of particular practices in board oversight of quality.	N/A	562 healthcare executives; 490 hospitals	Quantitative analysis of survey data	Process of care performance and risk-adjusted mortality relating to three conditions (heart attack, heart failure, and pneumonia)	Hospitals that had representatives with clinical expertise serving on the quality board had significantly better performance in process of care and/or mortality. Sixty percent of participating hospitals had a Chief Medical Officer or Vice President of Medical Affairs on the committee; this resulted in significantly (p<0.05) higher process of care scores (85.3% vs 81%) and lower risk adjusted mortality rates (5.6% vs 7.3%) than hospitals that did not have a Chief Medical Officer or Vice President of Medical Affairs as committee member. Eighty-three percent of participating hospitals had medical staff on the committee; this resulted in significantly (p<0.05) higher process of care scores (84.2% vs 80.9%) but no difference in risk adjusted mortality rates. Sixty-three percent of participating hospitals had a clinical board member on the committee; this resulted in no difference in process of care scores but significantly (p<0.05) lower risk adjusted mortality rates (5.7% vs. 7.2%).

Study	Country	Primary aim	Secondary aim	Participants; Organisation	Method	Performance measures	Key findings
Konu and Viitanen (2008)[7]	Finland	To investigate the incidence of shared leadership among middle-level managers in social service and health care.	N/A	433 middle-level managers in social and healthcare	Quantitative analysis of survey data	Shared leadership practices	Shared leadership practices were more common among managers without a medical background.
Kuntz et al. (2013)[8]	Germany	To assess the influence of the extent to which physicians are involved in hospital leadership on staff- to-patient ratios.	To investigate the significance of employing a full-time Medical Director (MD) and, for hospitals with a part-time MD, the impact that the amount of time spent in this role has on physician-to- patient-ratio and nurse-to-patient ratio.	604 hospitals, with a subsample of 442 hospitals	Quantitative analysis of survey data	Staff-to-patient ratios	There were significant differences in staff-to-patient ratios between the low level part-time category and the high-level part-time category (physicians: $p < 0.001$, nurses: $p < 0.001$), as well as for the difference between the high level part-time category and the full-time involvement (physicians: $p < 0.001$, nurses: $p < 0.01$). Regression analysis demonstrated a positive association between full-time MDs and staff-to-patient ratios for both physicians and nurses. With the exception of part-time involvement and nurse- to-patient ratio, this association remained strong after controlling for a range of confounding variables (case-mix, size, ownership).
Kuntz et al. (2016)[9]	Germany	To explain differences in the financial performance of hospitals with regard to ownership by studying the size and composition of supervisory boards.	To examine three hypotheses: H1: Hospital financial performance depends on ownership. H2: Hospital supervisory board size and composition depend on ownership. H3: The influence of hospital ownership on financial performance is mediated by the size and composition of the supervisory board.	175 hospital companies operating 246 hospitals	Quantitative analysis of hospital financial performance data (from the AMADEUS database) and information on hospital and board characteristics (from business and quality reports, hospital websites and health insurers)	Financial performance, based on four measures (return on assets (ROA), earnings before interest and tax (EBIT) margin, total profit margin, and net income)	Financial performance, and board size and composition depended on ownership ($p < .01$ for ROA and $p < .001$ for the other four performance measures). An increase in board size and greater political participation were negatively associated with all five tested measures of financial performance. An increase in physician participation was positively associated with one dimension of financial performance, ROA (0.05, $p = .061$). An increase in nurse and economist participation was negatively associated with financial performance; no associations were found for clerical participation.
O'Keefe (2015)[10]	Ireland	To examine the hypothesis that there would be an increasing gradient of risk aversion from physicians through clinicians in management and managers to public representatives regarding an acceptable level of risk when considering discharging a patient from the emergency department.	N/A	180 consultant physicians, 47 clinicians involved in management, 143 senior healthcare managers and 418 public representatives; acute care hospitals	Quantitative analysis of survey data	Level of acceptable risk	Post hoc pairwise comparisons (Bonferroni corrected significance level of $P < 0.008$) showed no significant differences between physicians and clinician managers or between managers and public representatives in acceptability of risk; however, all pairwise comparisons between doctors and managers or public representatives were significant. There were significant differences in the acceptability of risk and a reducing tolerance of a preventable death following discharge from the emergency department between doctors, healthcare managers and public representatives; clinicians with a managerial role did not differ in risk tolerance from their purely clinical counterparts.
Parayitam et al. (2007)[11]	USA	To analyse the outcomes of decisions when physician executives are involved in strategic decision-making processes in healthcare organisations.	To examine three hypotheses: H1: The greater the presence of physician executives in shared decision-making teams (SDMTs) the greater will be the decision quality. H2: The greater the presence of physician executives in SDMTs the greater will be the understanding of the rationale of decisions. H3: The greater the presence of physician executives in SDMTs the greater will be the commitment to decisions.	109 hospitals, 114 CEOs, 254 strategic decision makers (executive officers, director of human resources, chief technical offices, chiefs of staff, personnel involved in facilities, maintenance)	Quantitative analysis of survey data	Decision outcomes (decision quality, understanding, and commitment)	The ratio of physicians was positively correlated with decision understanding, commitment and quality.
Prybil (2006)[12]	USA	To determine whether board structures, processes, and practices in high-performing hospitals differ from similar hospitals where performance is midrange and, if so, in what ways.	N/A	7 matched hospital pairs	Mixed method analysis of hospital documents and interviews with hospital CEOs and board members	High performance hospitals (from the Solucient Center for Healthcare Improvement's '100 Top Hospitals' listings from 1999-2003) matched with midrange performance hospitals.	Medical staff members formed a larger component of the boards of high performing hospitals (30.3%) as compared with the boards of midrange hospitals (20.8%). In five of the seven high performing hospitals, medical staff members comprised 25% or more of the boards' voting members. This was true in only one mid-range hospital.
Saleh et al. (2013)[13]	Lebanon	To explore the use of strategic planning processes in Lebanese hospitals and to investigate its association with financial performance.	To examine six hypotheses: H1: The existence of a strategic plan is favorably associated with hospital performance. H2: A more developed strategic plan is	79 hospitals (56.4%)	Quantitative analysis of survey data and hospital performance data from the Lebanese Ministry of Public Health	Occupancy rate (OR) and revenue-per-bed (RPB)	There was no association between having a strategic plan and either of the two performance measures. The extent of strategic plan implementation was adversely related to OR, that is, the more a hospital implemented its

Study	Country	Primary aim	Secondary aim	Participants; Organisation	Method	Performance measures	Key findings
			positively associated with hospital performance. H3: Implementation of the strategic plan is positively associated with hospital performance. H4: CEO control of the strategic planning process is positively associated with hospital performance. H5: Strategic planning process is positively associated with hospital performance. H6: The level of physician involvement in the strategic planning process is positively associated with hospital performance.				strategic plan, the lower its OR ($p< 0.05$). A similar trend was observed with level of governing board involvement in strategic plan development. There was no association between the level of physician involvement in the strategic planning process and hospital outcomes; generally, physician involvement was low (4.1 out of a possible score of 7).
Simonen et al. (2009)[14]	Finland	To determine how social and health care managers evaluate the impact of knowledge sources as affecting their decision-making.	To determine whether evaluations differ depending on the manager's professional background, activity sector, gender, management experience, or age.	404 middle-level social and healthcare managers in a hospital	Quantitative analysis of survey data	Impact of various knowledge sources on decision-making	Doctor managers more strongly perceived that their decision-making was influenced by their own professional experience, journals and scientific research within their own professional field, and nationwide interaction within their own profession. Differences were found between doctor managers and nurse managers with respect to organization documents and publications, which clearly seemed to carry more weight in nurse managers' decision-making. Regarding other knowledge sources, i.e., knowledge obtained from one's own subordinates, examples from other corresponding units, patient demands and needs, media statements, municipality/city resident opinions, contracts between municipalities and municipal federations, or one's own professional education, no differences were found between managers of different professional backgrounds.
Spehar et al. (2015)[15]	Norway	To investigate how clinicians' professional background influences their transition into the managerial role and identity as clinical managers.	N/A	Four public hospitals, two health trusts; 30 clinician managers (doctors, nurses, allied health) interviewed, 20 of these were observed in management and staff meetings during the day	Qualitative analysis of interview and observation data	Managerial role transition and clinical manager identity	Doctors experienced difficulties in reconciling the clinical and management role and used clinical work to gain legitimacy and respect from medical colleagues. Nurses experienced a faster and more positive transition into the manager role, and were more fully engaged in the managerial aspects of the role.
Veronesi et al. (2013)[16]	UK	To determine how much difference managers will make to performance outcomes.	To determine whether the positive outcomes of clinical leadership derive from the participation of all clinicians in boards (including nurses and allied health. professions) or only doctors.	102 NHS hospital trusts in England (60% total)	Quantitative analysis of data from hospital trust annual reports, publicly available performance measures from the Healthcare Commission, and data gathered by Dr Foster over a three-year period (2006-2009)	Quality of the service provided (compliance with core standards concentrating on four main areas: health and well-being, clinical effectiveness, safety and patient focus, and ease and equity of access)	Significant and positive association was found between a higher percentage of clinicians on boards and the quality ratings of service providers (confirmed in relation to lower morbidity rates and tests to exclude the possibility of reverse causality). No equivalent association was found for clinical professions such as nurses and other allied health professions.

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	3-5
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	5-6
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	N/A
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	6
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	6
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	6-7
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	7-8
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	8
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	8
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	8
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	N/A
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	8-9

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	8
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	N/A
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	9
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	9-10
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	16-17
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	10-16
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	17
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	16-17
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	N/A
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	17-20
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	20
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	20-21
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	21

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