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Online training to improve evidence-based leadership competencies among nurse leaders in China: a feasibility randomised controlled trial

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ABSTRACT

Objective To evaluate the feasibility of an online evidence-based leadership training programme for nurse leaders and its potential effectiveness in improving nurse leaders' evidence-based leadership competencies.

Design This is a two-arm, parallel, feasibility randomised controlled trial.

Methods We screened all 160 nurse leaders from two Chinese hospitals. Eligible participants who gave their informed consent were randomly assigned to either an evidence-based leadership training group or a conventional online training group at each site and received a 7-month intervention. Pre-test and post-test assessments gauged feasibility and potential effectiveness. Descriptive and inferential statistics were employed for data analysis.

Results Of the 160 screened participants, 119 (74%) were assigned to the intervention group (n=59, 50%) or active control group (n=60, 50%). In the intervention group, the number of participant logins in the modules ranged from 21 (36%) to 58 (98%), while in the control group, it ranged from 20 (33%) to 57 (95%). Participants in the intervention group (n=59) completed 42% of the 531 assigned tasks, while the control group (n=60) completed 41% of their 540 assigned tasks. Regarding course task adherence, participants in the intervention group returned 3.8 (SD=3.2) tasks (out of 9 tasks), while the control group returned 3.7 (SD=3.5) tasks (out of 9 tasks). A total of 22 (18%) out of 119 participants dropped out of the study, with 9 (15%) out of 59 from the intervention group and 13 (22%) out of 60 from the control group.

Conclusions While the intervention demonstrated a degree of feasibility, measures can still be taken to improve intervention acceptability, course adherence and course task adherence. A full and powered randomised controlled trial is needed to test the intervention's effectiveness and to ensure the feasibility of the study in clinical settings.

Trail registration number ClinicalTrials.gov, numbers NCT05244499.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ We designed and evaluated an evidence-based leadership training course, representing a pioneering intervention in nursing evidence-based leadership training globally.
⇒ The study followed a preregistered and published protocol to ensure transparency and minimise bias during the research process.
⇒ The voluntary participation of participants driven by intrinsic motivation, without the use of incentives, enhances the reliability and authenticity of our study's findings.
⇒ We are not sure how much contamination happened between the groups, although we reminded nurse leaders not to share information about the course content between groups.
⇒ Due to the nature of the intervention, blinding of participants and researchers was not possible, potentially introducing an element of bias into the study results.

INTRODUCTION

Incorporating evidence into leadership practices is critically important in healthcare settings globally.[1 2] Nurse leaders play a key role in driving these efforts.[3] By embedding evidence into their leadership, nurse leaders have the potential to foster staff growth, promote organisational development and improve patient care quality.[4] However, studies have found that nurses rarely use research evidence in their practice, instead primarily relying on information from their own observations, colleagues and other collaborators.[5 6] Nurse leaders have been found to resist evidence-based practice, which not only limits their own use of evidence but also hinders its adoption by their staff. Their leadership practices, especially decision-making, may be guided more by the perceived best interests of patients or the personal views of other leaders.[7] Given the significance and complexity of the nurse leaders' role and the existing gaps in using evidence in leadership

practice, there is a growing focus on implementing interventions to improve evidence-based leadership competencies among nurse leaders.[8 9] Therefore, well-designed interventions specifically aimed at improving evidence-based leadership among nurse leaders are needed.

We searched an electronic database to determine if any feasibility or pilot studies had been published relating to the development, testing or assessing the feasibility or effectiveness of an evidence-based leadership intervention. We systematically searched studies published in the PubMed database in the English language, up to 11 April 2023, using the MeSH Terms search strategy ("evidence-based leadership" AND "nurs*" AND "feasibility" OR "pilot"); no feasibility or pilot studies related to the topic were found. We also searched systematic reviews, meta-analyses and randomised controlled trials (RCTs) published in English, using the MeSH Terms search strategy ("evidence-based leadership" AND "nurs*" AND "systematic review" OR "meta-analysis" OR "random* control* trail*" OR "RCT"); but, again, no systematic reviews or meta-analyses were found. One RCT study was conducted in the USA[10] aiming to build evidence-based practice attributes, such as evidence-based practice knowledge, beliefs, organisational culture and readiness for evidence-based practice among nurse leaders. However, this study did not focus on evidence-based leadership.

Due to the lack of educational interventions to develop evidence-based leadership among nurse leaders, we designed an online training intervention based on an evidence-informed model.[11] However, before a full RCT can be conducted, an early-phase feasibility assessment prior to a definitive trial is critical for the development and evaluation of a complex intervention.[12] A feasibility study answers the question of whether something can be done, whether the researchers should proceed with it and, if so, how.[13] Therefore, in this study, we explored the feasibility and potential effect of the online training intervention to understand how the intervention works in China. Specifically, we aimed to examine the feasibility of the online evidence-based leadership intervention (Objective 1), to evaluate the feasibility of the RCT design (Objective 2) and to describe a potential estimate of the effectiveness of the intervention, as compared with conventional online interventions (Objective 3).

METHODS

Trial design

In this feasibility study, we used an individually randomised, two-arm parallel-group controlled trial design. The CONSORT 2010 statement extension was used to report the study.[14] The SPIRIT checklist[15] guided the methodology of the study, while the intervention description was based on the template for intervention description and replication (TIDieR) checklist.[16] The study was simultaneously conducted in Finland; the trials are registered (ClinicalTrials.gov, numbers NCT05244512 and NCT05244499), and the protocol has been published.[17] This paper reports the Chinese results only.

Participants

Eligibility criteria for participants

To be included in the study in China, nurse leaders had to have a license to work as a nurse, they had to be in an official managerial role at a hospital (ie, nurse director, charge nurse, head nurse), they could be any gender, and they had to be working at one of the study sites at the time of recruitment (full time or part time). They also needed to be able to speak, read and write in Chinese and give voluntary informed consent.

Nurse leaders on leave at the time were excluded (family leave, long-term sick leave, study leave or any other reason).

Settings

For the study in China, nurse leaders were recruited from two tertiary hospitals in one province. Here, tertiary hospitals refer to general hospitals that have more than 500 beds. Each bed is equipped with at least four nurses, and the hospital offers education for nursing students and conducts scientific research. At the end of 2020, there were a total of 2996 tertiary hospitals in China, and over 4 million registered Chinese nurses provided care for 1.4 billion people.[18] During the time of the study, our two tertiary hospitals had a total of 160 nurse leaders, 4990 beds and about 4 million outpatients and emergency visits annually.

Identification and consent of participants

Potential participants were screened with the eligibility criteria by the Chief Executive Officer of Nursing in the human resource dataset of both hospitals. Eligible nurses received an invitation letter and a link to the survey via WeChat (generated by Sojump, www.sojump.com). If the participants were willing to join in the study, they clicked the button labelled 'Informed and Agree' to access the baseline survey.

Interventions

Evidence-based leadership training group (experimental group)

The goal of the intervention was to increase evidence-based leadership competencies among nurse leaders in hospital settings. The structure and content of the intervention are described in table 1.

Conventional online training (active control group)

The number of modules, the topics and the total length of the online training were identical in the active control group and the intervention group. However, the course was organised as a 'standalone' course, that is, the participants studied independently, and no assistance was provided by tutors or peers.

Outcomes

Primary outcomes

The primary outcomes were as follows:

Table 1 Structure and content of the online training intervention.

Item no.	Item	Content
1	Brief name	Online evidence-based leadership training.
2	Why	Rationale: Kirkpatrick's Model[11] guides the pedagogical approach of the training (reaction, learning, behaviour).
What		
3	Materials	Power points with recordings and reading material (links, scientific articles).
4	Procedures	Topics: (1) orientation and leadership problem identification; (2) leadership problems and competencies; (3) collecting and analysing organisational information; (4) evidence from the scientific literature to support problem-solving; (5) considering stakeholders' views; (6) implementation of evidence-based change; (7) evaluation of evidence-based change. ► Online lectures with power points (voice recording). ► Peer-group discussions (Modules 3 and 5). ► Assignment for each module.
5	Who provided	Five tutors (one professor, one assistant professor, two PhD students, one Master's student in nursing).
6	How	Small groups (10–15 participants in each group). Each group was supported by one tutor. Reading, assignment submission and interaction with tutors. Tutors followed up on students' assignments and learning progress.
7	Where	Online training platform (Xiaoe-Tech, https://admin.xiaoe-tech.com). Participants accessed the training platform via a mobile phone or computer and studied at work or home.
8	When and how much	When: 7-month intervention period (29 August 2022–19 March 2023) How much: each module took 1–5 weeks depending on the learning goals and specific activities. Tutors provided feedback at the end of each module.
9	Tailoring	N/A
10	Modifications	NA
How well		
11	Planned	One tutor coordinated the training programme to maintain fidelity. Tutor training was organised before each module to ensure consistency and fidelity of the intervention. Three reminders were sent during each module to remind participants to join and finalise their assignments.
12	Actual	N/A

- *Acceptability of the intervention*: the number of logins for each module and all participants.
- *Adherence to the course*: the number of returned tasks out of possible tasks.
- *Adherence to the course tasks*: the number of returned tasks by each participant.
- *Drop-out rate*: the number of participants who left the study early (no follow-up data).

Secondary outcomes

The secondary outcomes were as follows:

- *Acceptability in recruitment*: the number of participants who accepted the invitation to participate in the study.
- *Feasibility of the eligibility criteria*: the number of participants who fulfilled the eligibility criteria.
- *Feasibility of the outcome instruments for measuring the potential effectiveness of the online course:* the number of missing variables of each returned instrument.

The potential effectiveness of the intervention was measured with six instruments; for more detailed information, see the protocol[17]:

1. Leadership styles were measured with the 45-item Multifactor Leadership Questionnaire.[19] A higher score indicates that an individual displays a specific leadership style more frequently (pre- and post-intervention).
2. The Evidence-Based Practice Questionnaire[20] measures evidence-based practice, knowledge and attitudes with 24 items. A higher score indicates a more positive attitude towards evidence-based practice, knowledge or attitudes (pre- and post-intervention).
3. Self-efficacy was measured with The Generalized Self-Efficacy Scale.[21] This unidimensional scale evaluates the strength of an individual's belief in their own abilities to respond to difficult situations and to deal with obstacles. Participants were asked to answer 10 items,

with a high score indicating a higher level of self-efficacy (pre- and post-intervention).
4. Self-esteem was measured with the Rosenberg Self-Esteem Scale.[22] This instrument is a unidimensional 10-item scale, with a higher score indicating a higher level of self-esteem (pre- and post-intervention).
5. Intention to leave was measured with three self-designed questions measuring (1) intention to leave the ward, (2) intention to leave the hospital and (3) intention to leave the profession (pre- and post-intervention).
6. Course feedback was collected with eight questions (course appeal, happiness to participate, course effort required, value of participation, value of the course, meeting requirements of the course, fitting the course into personal values, recommendation of the course to others) (post-intervention).

Characteristics of the participants

Specialty, age, gender, degrees, position, time working as a nurse leader (in years) and total time working in a healthcare setting (in years) were collected.

Sample size

Since this was a feasibility study, a sample size calculation was not calculated.[14] We, therefore, invited all the nurse leaders (n=160) in two hospitals to participate in the study; the number would be large enough to inform us about the feasibility[23] of our online training for nurse leaders. For future studies aiming to estimate the required sample size with 80% statistical power and a two-sided significance level of 0.05, considering the variation in 'evidence-based practice, knowledge and attitudes' (SD=21.1), a sample size of 71 per group would be necessary to detect a 10-point difference[24] in mean values.

Randomisation

Participants were randomised into a 1:1 ratio using a block randomisation design with block sizes of six, into two groups: (1) evidence-based leadership training group and (2) conventional online training. A statistician at the University of Turku (Department of Biostatistics) sets up the computer-based randomisation process to assign participants to the intervention or active control group through remote allocation. Allocation was implemented by a research assistant who did not participate in the study. Another research assistant enrolled participants and assigned them to interventions on the online platform.

Blinding

Participants and researchers could not be blinded to intervention allocation because of the intervention type. Only the statistician was blinded to intervention allocation. The statistician had no interaction with the participants or the research assistant who enrolled and assigned the participants to groups.

Analytical methods

The analysis was on intention to treat based on our objectives. SPSS (V.27.0) was used for data analysis. Normal distribution assumption was evaluated visually as well as by using skewness and kurtosis measures. Descriptive data were used (mean, deviations, frequencies, percentages) to evaluate the intervention feasibility (Objective 1), while a *t*-test, χ^2, χ^2 test with continuity correction and Fisher's exact test were used to compare the two groups after the intervention. Course feedback was compared between the groups with a Cochran-Armitage trend test. To describe Objective 2 (trial feasibility), frequencies and percentages were used to present the data. The potential effectiveness of the intervention (Objective 3) was assessed using a *t*-test (normally distributed data) or Mann-Whitney U-test to indicate postintervention differences between groups. There were no missing data in this study. P values less than 0.05 (two-tailed) were considered statistically significant.

Patient or public involvement

Eleven nurse leaders were engaged in and contributed to the development of the intervention.

RESULTS

Participant flow

Between 29 June and 12 July 2022, all 160 nurse leaders at the two hospitals were screened for eligibility. One-fourth (26%) of the eligible participants refused to join the study. Of the remaining 119 (74% of potential participants), 59 (50%) were randomly assigned to the intervention group, and 60 (50%) were assigned to the active control group. Due to COVID-19, the course had a short break between 23 January and 12 February 2023, which extended the length of the intervention up to 9 months; the follow-up data were collected from 16 to 30 May 2023 (figure 1).

Baseline data

Out of all 119 participants at baseline, 96% were females. The median age of the participants was 42 years. No relevant differences were identified in the characteristics between the two groups. Table 2 summarises the demographic characteristics of the participants. The datasets generated and analysed during the current study are available in the Open Science Framework repository.[25]

Outcomes

Objective 1: intervention feasibility

Intervention feasibility was measured by acceptability of the intervention, adherence to the course, adherence to the course tasks and drop-out rate. First, for acceptability of the intervention, the number of participants' logins to the modules for the intervention group ranged from 21 (36%) to 58 (98%) out of a total of 59, while for the control group, the number ranged from 20 (33%) to 57 (95%) out of 60. In both groups, the number of logins for each module decreased steadily during the course lifetime, and there were

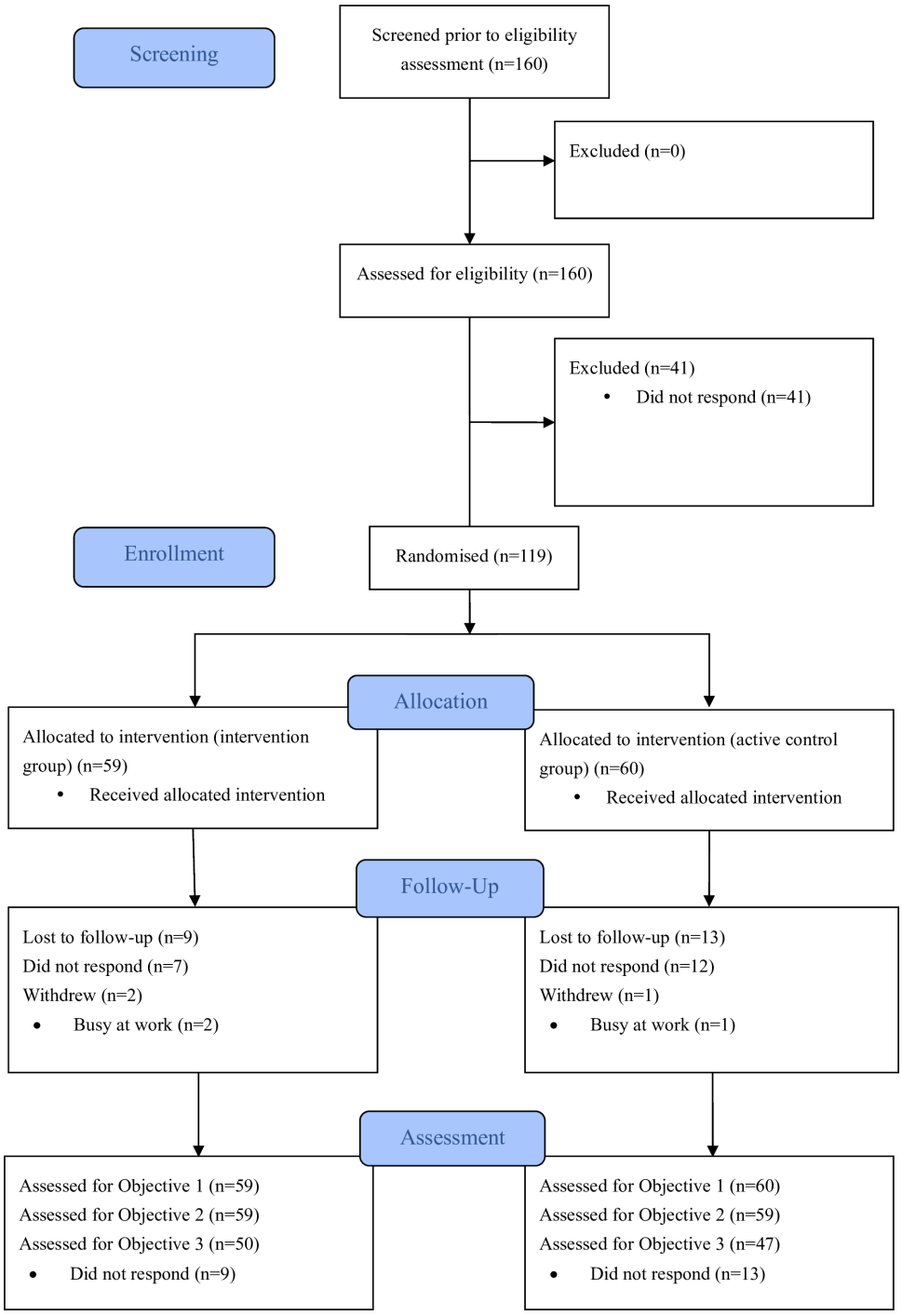

Figure 1 Flow diagram of a feasibility randomised controlled trial on online training to improve evidence-based leadership competencies among nurse leaders.[14]

more participants logged into Module 2 in the experimental group compared with the control group (p=0.003) (table 3). Second, regarding adherence to the course, participants in the intervention group (n=59) completed 42% of the 531 assigned tasks, while those in the control group (n=60) completed 41% of their 540 assigned tasks. Third, regarding adherence to the course tasks (each participant in both groups needed to complete nine tasks), participants in the intervention group completed 3.8 (SD=3.2) tasks, while those in the control group completed 3.7 (SD=3.5) tasks. And last, a total of 22 (18%) out of 119 participants dropped out of the study, with 9 (15%) out of 59 from the intervention group and 13 (22%) out of 60 from the control group. No statistically significant differences were found between the groups regarding any of the four outcomes (table 3).

Objective 2: trial feasibility

For recruitment acceptability, 119 (119/160) participants were enrolled (74%), and 41 (26%) refused. All nurse leaders (100%) fulfilled the eligibility criteria of

Table 2 Baseline characteristics of the participants by group (n=119)

Variable	Categories	Total (n=119)	Intervention group (n=59)	Active control group (n=60)
Specialty	Nursing	118 (99%)	58 (98%)	60 (100%)
	Midwifery	1 (1%)	1 (2%)	0 (0%)
Age		42 (37, 46)	41 (37, 46)	42 (36, 45)
Gender	Male	5 (4%)	1 (2%)	4 (7%)
	Female	114 (96%)	58 (98%)	56 (93%)
Degree	Bachelor	41 (35%)	22 (37%)	19 (32%)
	Postgraduate	78 (65%)	37 (63%)	41 (68%)
Position	Nurse director/associate nurse director/sector nurse manager	13 (11%)	8 (14%)	5 (8%)
	Head nurse/associate head nurse	106 (89%)	51 (86%)	55 (92%)
Time working as a nurse leader (years)	≤5	58 (49%)	30 (51%)	28 (47%)
	6–10	24 (20%)	9 (15%)	15 (25%)
	≥11	37 (31%)	20 (34%)	17 (28%)
Total time working in a healthcare setting (years)	6–10	5 (4%)	2 (3%)	3 (5%)
	11–15	33 (28%)	15 (25%)	18 (3%)
	16–20	18 (15%)	9 (15%)	9 (15%)
	≥21	63 (53%)	33 (56%)	30 (50%)

For categorical variables, n (%) was reported. For continuous variables, the median (Q1, Q3) was reported.

our study. No missing values were found in the returned instruments (figure 1).

Objective 3: potential effectiveness of the intervention

A positive effect of the intervention was found regarding one subscale (Avoidant Leadership) in the Multifactor Leadership Questionnaire (median 4/mean 5.2 vs median 5/mean 7.4, p=0.039/0.048). No statistically significant differences were found in other scores (table 4).

The course feedback was overwhelmingly positive as 75% of the items in both groups scored over 4 (max. value 5). However, a statistically significant difference between the groups was only observed in the first item (See online supplemental table 1).

DISCUSSION

To our knowledge, this training programme aimed at nurse leaders stands as a pioneering effort to evaluate the feasibility and potential effectiveness of online training in enhancing evidence-based leadership competencies in the Chinese context. The inclusion criteria for the course aligned very well with the target population (100%).

Table 3 Intervention acceptability

Intervention feasibility	Total (n=119)	Experimental group (n=59)	Active control group (n=60)	P value
Intervention acceptability (the number of login subjects)				
Module 1	115 (97%)	58 (98%)	57 (95%)	0.623
Module 2	104 (87%)	57 (97%)	47 (78%)	0.003
Module 3	82 (69%)	45 (76%)	37 (62%)	0.085
Module 4	64 (54%)	35 (59%)	29 (48%)	0.229
Module 5	47 (40%)	24 (41%)	23 (38%)	0.794
Module 6	50 (42%)	26 (44%)	24 (40%)	0.653
Module 7	41 (34%)	21 (36%)	20 (33%)	0.795
Course adherence	1071 (42%)	223 (42%)	223 (41%)	0.816
Course task adherence	3.8 (3.4)	3.8 (3.2)	3.7 (3.5)	0.919
Drop-out rate	22 (18%)	9 (15%)	13 (22%)	0.368

For categorical variables, the χ^2 or χ^2 test with continuity correction or Fisher's exact test was used, and n (%) was reported. For course task adherence, the *t*-test[a] was used, and the mean (SD) was reported.

Table 4 Comparison between an experimental group and an active control group

Outcome variables	Intervention group (n=50)	Active control group (n=47)	P value
Leadership styles			
Transformational leadership	56.6 (11.5)	56.4 (9.2)	0.911
Transactional leadership	20.4 (4.9)	19.8 (4.4)	0.531
Avoidant leadership	4 (2, 6)	5 (3, 9)	**0.039**[a]
Outcomes of leadership	24.8 (5.7)	24.7 (4.9)	0.944
Evidence-based practice, knowledge and attitudes	122.9 (21.1)	122.8 (18.8)	0.978
Self-efficacy	30.1 (5.2)	29.2 (4.62)	0.368
Self-esteem	24 (22, 25)	24 (22, 25)	0.613[a]
Nurse leaders' intention to leave	4 (3, 6)	3 (3, 5)	0.075[a]

For two independent samples, a *t*-test or the Mann-Whitney U test[a] was used, and the mean (SD) or median (Q1, Q3) was reported.

Three-fourths of the nurse leaders accepted the invitation, and 18% of participants dropped out of the study. In addition, instruments used to measure the outcomes were well filled in with no missing data. Despite positive course feedback, the acceptability of the intervention regarding the number of logins, returned course tasks in total and returned course tasks by participants decreased throughout the courses, about one-third of course tasks were completed at the end of the programme. Only one statistically significant difference emerged in the feasibility data between study groups: participants in the intervention group demonstrated a higher login rate in Module 2 compared with those in the control group (97% vs 78%, p=0.003).

In our study, most participants (n=58, 98%) in the intervention group were engaged in at least one module of the course, demonstrating some feasibility of the intervention. These findings partially support previous research, specifically regarding the number of logins[26] and the rate of participant drop-out as the course progressed.[27] For example, McCall *et al*[28] found that half of the medical students (n=2, 50%) in their small-scale feasibility RCT logged into the learning platform at some point during the study period. In our intervention group, the drop-out rate was 15%, which falls within a reasonable range recommended by Wisman.[29] The withdrawal of nurse leaders from the training programme may be due to the challenging content of evidence-based approaches, which could lead to frustration, reduced motivation and a higher drop-out risk.[30] It has already been shown in China that although nurse leaders' leadership competencies are at a moderate level,[31 32] their knowledge of evidence-based practice is limited and their experience in implementing evidence-based practice is poor.[33] Our pre-intervention assessment also indicated that nurse leaders' evidence-based leadership competencies need to be improved. Other reasons to withdraw may be a lack of sense of immediate benefits of the course for their daily work.[34] Looking ahead, it is important to ensure that the course addresses current learning needs and is valued by participants.

The number of returned tasks among participants decreased over the lifetime of the course. This decrease might be related to the complexity and time-consuming tasks. The drop-out was seen as related to specific topics such as root-course analysis, search of evidence-based literature in electronic databases and how to use the evidence.[35] Despite the fact that nurse leaders expressed their familiarity with the evidence-based approach before the course,[17] these specific topics might still be new and cause extra stress to them in the learning process.[36] Our hands-on tasks might also be too demanding to be finalised in the work environment.[35] Further, each module was linked to the next to support the learning process.[17] Therefore, dropping out of one module could have caused problems in the following tasks.[37]

The feasibility of our RCT design could be considered reasonable as 74% (n=160) of eligible nurse leaders participated in the study. Typically, reaching the target sample size is a challenge in RCT studies.[29] Despite the small amount of data, we noted one promising trend in it: our online training had a statistically significant positive effect on 'avoidant leadership' compared with the active control group. 'Avoidant leadership' refers to passive or avoidant behaviour during leadership activities; leaders may wait for a problem to appear before taking corrective action or refuse to shoulder the responsibilities inherent in their leadership roles.[19] The result may reflect three factors. First, the content and learning material, that is, power points with voice, may be attractive to learners, which increase their participation and understanding of the evidence-based leadership process.[38] Second, the intervention group had tutors available for discussions when needed to enhance their problem-solving skills. Consequently, learners might have been more inclined to confront their problems and proactively address and resolve them.[39] Third, peer support activities might have provided emotional support to participants and assisted them in consolidating their knowledge and skills.[40] The validity of these factors needs to be considered further in future large-scale RCT studies.

Implications for future research and practice

For future research, sample sizes can be increased, for example, by using incentives.[41] A meta-analysis of RCTs[42] found that even small incentives can result in a statistically significant increase in participant consent and response rates. However, using incentives can be complex[41] and ethically questionable,[43] necessitating careful consideration in their design. Second, qualitative interviews could be useful for understanding the feasibility elements of the study.[44] Third, more effort should be put into improving the attendance of the participants. For example, tutors could send reminder messages to participants before the commencement of a new module, inquire about the reasons for their lack of progress and provide guidance to resolve any course-related issues.[39] On the other hand, with lengthy courses, the number and frequency of reminders should be restricted to prevent the participants from becoming annoyed or bored by the course. Finally, steps can be taken to reduce drop-out rates in future studies. For example, designing training courses that align with the level of evidence-based leadership competencies among nurse leaders may enhance their engagement.[30] Understanding what nurse leaders consider as highly relevant outcomes or immediate benefits of training courses is crucial for developing strategies to reduce drop-out rates.[45]

For practice, online training courses could be a feasible and promising method of supporting nurse leaders in their leadership roles in clinical settings. Nurse leaders who are seeking to enhance their evidence-based leadership competencies can benefit from participating in this kind of training programme. Furthermore, interventions to support evidence-based leadership development among nurse leaders are needed. Nurse educators can use this online training either as a standalone method or as part of a complex intervention to enhance the leadership competencies of nurse leaders. Policymakers can also contribute by developing policies encouraging nurse leaders to engage in such courses to better identify and resolve leadership problems in clinical work.

Limitations

There are potential limitations concerning this study. First, we reminded nurse leaders not to share information about the course content between groups. However, we are not sure how much contamination happened between the groups. On the other hand, the content of the learning material was the same, and the real differences were in the types of tasks: nurse leaders in the intervention group had specific hands-on tasks after each module related to their own leadership problems. The second limitation concerns a lack of blinding of participants and tutors, which might have introduced unintentional favouritism or expectations and thus influenced the outcome measurements and potentially compromised the internal validity of the study. We conducted regular training with tutors to emphasise the importance of impartiality and adherence to the study protocol. Despite these efforts, we must recognise that the absence of blinding remains a potential source of bias. Third, differences among tutors may have contributed to variations in the effectiveness of the intervention, potentially impacting the study's external validity. To mitigate this, we used structured feedback templates in each module for tutors to ensure consistency in their feedback, while consistency in intervention delivery was ensured through training and regular meetings to support tutors' adherence to designated teaching methods.

CONCLUSIONS

Studying the feasibility and effectiveness of evidence-based leadership interventions among nurse leaders is a new field, and there is a need to structurally investigate the optimal conditions of online evidence-based leadership interventions. The trial feasibility data in our study allow us to conclude that the intervention was feasible and that it has demonstrated some degree of potential effectiveness. Measures can still be taken to improve the intervention acceptability, course adherence and course task adherence. More studies are needed to reassess the feasibility and test the effectiveness of the intervention in a definitive randomised controlled trial within a clinical setting.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were involved in the design, conduct, reporting or dissemination plans of this research. Refer to the Methods section for further details.

Patient consent for publication Not applicable.

Ethics approval The study protocol was approved by the Ethics Committees of Nursing and Behavioural Medicine Research at the Xiangya School of Nursing, Central South University (E2021167); the Ethics Review Committee of Medicine of Hunan Tumour Hospital (202237); and the Ethics Review Committee of Clinical Medicine of Xiangya Hospital (202204099). Before participating, participants gave informed consent to participate in the study.

Provenance and peer review Not commissioned; externally peer reviewed.

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