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Review

Effectiveness of nurse-led heart failure clinic: A systematic review

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ABSTRACT

Objectives: Heart failure is a stage of various cardiovascular diseases and constitutes a growing major public health problem worldwide. Nurse-led heart failure clinics play an important role in managing heart failure. All nurse-led heart failure clinic services are clinic-based. We conducted a systematic review to describe the contents and impact of nurse-led heart failure clinics.

Methods: A review of nurse-led heart failure clinic research was undertaken in PubMed, Embase, Web of Science, and Cochrane Library. The search was initially conducted on October 23, 2022 and updated on November 21, 2023. Articles were appraised using the Joanna Briggs Institute Appraisal criteria by two independent reviewers. This review was registered on PROSPERO (CRD42022352209).

Results: Twelve articles were included in this systematic review. The nurse-led heart failure clinic contents were: medication uptitration, educational counselling, evidence-based transitional care, psychosocial support, physical examination and mental well-being assessment, therapy monitoring and adjustment, follow-up, and phone consultations. Most studies reported largely positive clinical outcomes in nurse-led heart failure clinics. Four studies examined the quality of life and reported conflicting results; four studies examined medication titration efficacy, and the results were generally positive. Only two studies examined cost-effectiveness.

Conclusions: Nurse-led heart failure clinics have shown a largely positive impact on patient outcomes, quality of life, and medication titration efficacy. More randomised controlled trials and other studies are needed to obtain more robust conclusions.

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What is known?

- Nurses play a pivotal role in the heart failure management.
- Nurse-led heart failure clinics constitute a modality to improve patient self-care skills.

relevant studies are needed to verify the effect on patient quality of life and cost-effectiveness.

What is new?

- This review describes the intervention characteristics in nurse-led heart failure clinics, such as format/delivery mode, clinic attendance frequency, equipment, and services provided.
- Nurse-led heart failure clinics mainly had a positive effect on patient outcomes and medication titration efficacy. More

1. Introduction

Structural and functional cardiac abnormalities lead to heart failure (HF), which is a stage of various cardiovascular diseases. HF, a condition that poses a significant and escalating global public health concern, is a clinical syndrome characterised by symptoms including tiredness, breathing difficulties, and signs such as lower limb swelling and distended jugular veins [1,2]. Globally, approximately 64.3 million individuals are affected by HF, and this number is increasing rapidly owing to the growing elderly population and advancements in medical treatment [2–4]. Despite the progress made in the treatment and control of HF, mortality and hospitalization rates continue to increase, and the quality of life remains poor [2,5,6]. The main reason for frequent hospital readmissions is

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symptom deterioration, mostly caused by preventable factors, such as inadequate medical treatment or failure to follow medication and dietary guidelines. HF readmissions impose a significant healthcare burden on patients and their families, and studies have indicated that approximately 54.2% of readmissions may be avoided [7,8]. A lack of proper utilisation of evidence-based therapy contributes to unfavourable results, suggesting that many patients are not receiving optimal treatment with medications such as angiotensin-converting enzyme (ACE) inhibitors and beta-blockers [9]. Guidelines have recommended the target doses of HF medications; for example, the initial daily dose of captopril is 6.25 mg three times daily, and the target dose is 50 mg three times daily [10]. Nurses play an important role in the HF management. By implementing educational programs in their practices and within the community, nurse practitioners can bridge the gap between evidence-based recommendations and clinical practice [11].

In the context of a healthcare system that prioritises integrated care and the merging of hospital and primary services, nurse-led clinics have arisen [12]. These clinics are dedicated to the management and healthcare coordination of patients with specific illnesses, the nurses are supervised and supported by specialist nurses [13]. Nurse-led clinics are managed by nurses, and the services provided to patients are clinic-based. According to Wong and Chung [12], a nurse-led clinic distinguishes itself from a physician-led clinic by placing less emphasis on medication usage and instead adopting a comprehensive approach to meeting the requirements of patients and their families. In the clinics, nurses are responsible for patient evaluation, admission, health education delivery, treatment administration and monitoring, discharge facilitation, transfer to other health care providers, and psychological support [14]. Nurse-led HF clinics constitute a significant approach to improve the self-care skills of patients with HF, while simultaneously improving the professional value of nurses.

According to Ortiz-Bautista et al. [15], nurse-led clinics are beneficial to patients with HF, resulting in quality of life improvements and HF-related readmission reduction. Nevertheless, the outcomes of nurse-led HF clinics in terms of patient results, cost-effectiveness, quality of life, and medication titration effectiveness remain unclear [16–26]. Phillips et al. [27] reported an HF disease management evaluation program, which involved the integration of HF clinics led by specialist nurses. However, the program encompassed various components, including discharge planning, home visits, telephone follow-ups, and HF clinics. Until now, limited comprehensive assessment specifically focused on nurse-led HF clinics. Hence, this study presents a comprehensive analysis of the literature discussing the materials utilised in nurse-led HF clinics; moreover, the study explores the cost-effectiveness, outcomes, quality of life, and medication titration efficacy in patients followed up in nurse-led HF clinics.

2. Methods

This systematic review adhered to the protocol registered on PROSPERO (CRD42022352209). The study was reported following the Preferred Reporting Items for Systematic Review and Meta-analysis guideline [28].

2.1. Review question

What are the content and effectiveness of nurse-led HF clinics?

2.2. Inclusion criteria

This review included patients aged >18 years, who had been diagnosed with HF. The intervention for this review was any care

provided by a nurse with any qualification (e.g., registered nurse, nurse practitioner, or advanced practice nurse) in a nurse-led HF clinic. Interventions were compared against usual care or no clinic attendance. Comparison with other interventions was also considered (e.g., medical practitioner follow-up). Primary outcomes included patient outcomes, such as readmission and mortality, cost-effectiveness, quality of life, and medication titration efficacy. The nurse-led HF clinic interventional studies were selected based on specific inclusion criteria. Our study encompassed randomised controlled trials (RCTs), quasi-experimental studies, cohort studies, case-control studies, and pre-post studies without a control group. Qualitative studies, reviews, editorials, conference abstracts, study protocols, correspondences, comments, articles lacking full-text availability or data accessibility, quality improvement reports, and non-English studies were excluded.

2.3. Search strategy

We searched PubMed, Embase, Web of Science, and Cochrane Library online databases. The search was initially conducted on October 23, 2022 and updated on November 21, 2023. To enhance the recall level, truncation searching was employed along with the utilisation of Boolean operators (“AND” and/or “OR”) to combine search strings. Strategies for conducting literature searches were created by utilising MeSH terms such as HF, practice patterns, and nurse practitioner, as well as keywords including nurse-led clinic, nurse practitioner-led clinic, nurse-managed center, and specialist nurse (Table 1). Initially, the search strategy underwent testing in PubMed and was subsequently modified for the other databases. Only studies published in English were included.

2.4. Assessment of risk of bias

To assess the risk of bias, Joanna Briggs Institute (JBI) Critical Appraisal Checklists for RCTs, Quasi-Experimental Studies, Studies Reporting Prevalence Data, and Case-Control Studies were employed to appraise the methodological rigour of studies that were included in this systematic review [29] (Appendix A. Tables S1–S4).

The research team (XW, ZL and QT) initially held online meetings to discuss the items within the critical appraisal checklists and processes for assessing the methodological quality of the included studies. Two reviewers (ZL and QT) performed the quality appraisals independently. A third researcher (XW) resolved the disagreement.

2.5. Data extraction, analysis, and synthesis

Two independent reviewers performed eligibility screening of titles and abstracts of articles resulting from the search and independently screened full-text articles to determine their eligibility. All differences regarding the ultimate inclusion were deliberated with a third evaluator until a unanimous agreement was achieved. Subsequently, 89 articles were assessed based on the inclusion and exclusion criteria. Fig. 1 outlines the search procedure [28]. Some studies reporting the effectiveness of nurse-led HF clinics together with other interventions were not included [30–32].

The following data were extracted: the first author, country, the year of publication, study design, study setting, study objectives, study conclusions, clinic staff, format/delivery mode, equipment, and nurse-led HF clinic services (Table 2). Table 3 presents the study findings.

Table 1
Search strategy.

Pubmed
S1 (“Heart Failure”[MeSH] OR (((((((((((Heart Failure[Title/Abstract]) OR (Cardiac Failure[Title/Abstract]) OR (Heart Decompensation[Title/Abstract])) OR (Decompensation, Heart[Title/Abstract]) OR (Heart Failure, Right-Sided[Title/Abstract]) OR (Heart Failure, Right Sided[Title/Abstract]) OR (Right-Sided Heart Failure [Title/Abstract]) OR (Right Sided Heart Failure[Title/Abstract]) OR (Myocardial Failure[Title/Abstract]) OR (Congestive Heart Failure[Title/Abstract]) OR (Heart Failure, Congestive[Title/Abstract]) OR (Heart Failure, Left-Sided[Title/Abstract]) OR (Heart Failure, Left Sided[Title/Abstract]) OR (Left-Sided Heart Failure[Title/Abstract]) OR (Left Sided Heart Failure[Title/Abstract]))))))))))))
S2 (((“Practice Patterns, Nurses”[MeSH] OR (“Nurse Practitioners”[MeSH]) OR (((((((((((Practice Patterns, Nurs*[Title/Abstract]) OR (Nurse Practition*[Title/Abstract]) OR (Nurse Led Clinic*[Title/Abstract]) OR (Nurse-led clinic*[Title/Abstract]) OR (Clinic*, Nurse-Led[Title/Abstract]) OR (Nurse practitioner-led clinic*[Title/Abstract]) OR (Nurse Managed cent*[Title/Abstract]) OR (Nurse-Managed cent*[Title/Abstract]) OR (Nurse specialist*[Title/Abstract]) OR (Specialist nurs*[Title/Abstract]) OR (Practice Patterns, Nurs*[Title/Abstract]))))))))))))
S1 AND S2
Filter English only

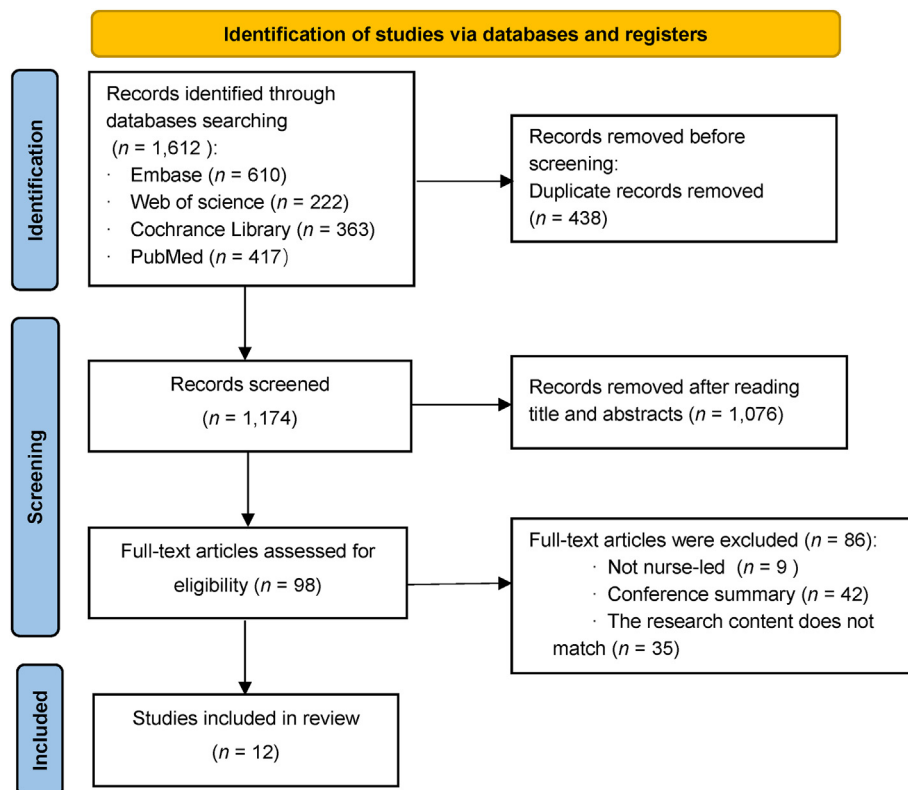


Fig. 1. PRISMA flow diagram of study selection.

3. Results

3.1. Study characteristics

The primary focus of this systematic review was the effectiveness of nurse-led HF clinics, with specific emphasis on cost-effectiveness, patient outcomes, quality of life, and medication titration efficacy. The final examination comprised 12 studies [15–26]: one from China, two from Denmark, one from Norway, one from Spain, one from Australia, three from Sweden, and three from the United States of America, respectively. The studies were conducted in various environments, such as community hospitals ($n = 1$), hospital outpatient clinics ($n = 9$), primary care settings ($n = 1$), and a combination of hospital and primary care settings ($n = 1$). The HF clinic was staffed by nurses, with or without additional personnel, such as cardiologists, clinical pharmacists, dietitians, social workers, behavioural health coordinators, public health professionals, exercise physiologists, health professionals,

and certified medical assistants. Studies evaluating the nurse-led HF clinic described the following nursing roles: half-time nurses ($n = 1$), nurse case managers ($n = 1$), nurse practitioners ($n = 2$), clinical registered nurses ($n = 7$), and cardiac rehabilitation nurses ($n = 1$).

3.2. Intervention characteristics and outcome

The format/delivery mode was face to face, telephone call, or text message. The clinic attendance frequency was mostly planned individually, based on the clinical situation; the frequency was sometimes fixed.

The nurse-led HF clinic offered various equipment, including a blood pressure monitor, scales for daily weight measurement, pill box, educational materials for writing, digital video discs, checklists for daily HF monitoring, lists for reporting early symptoms, wallet cards with medication lists and emergency telephone numbers, printed lists of current medications, adaptive servo-ventilation, and

Table 2
Characteristics of included studies.

Author, year, country	Study types	Aim of the study	Setting	Number of patients	Clinic staff	Format/delivery mode	Nurse-led heart failure clinic intervention content	Equipment provided by the clinic
Andersen et al., 2005 [17] Denmark	Prospective, observational study, pre-post design	To evaluate the effect of a nurse-led heart failure clinic on drug therapy and hospitalization in a community hospital setting	Community hospital setting	138	Two half-time nurses with special training in heart failure management. Two cardiologists serve as consultants and outline a general treatment plan and target doses for each patient.	Face to face, telephone counselling.	Uptitration of ACE inhibitors and beta-blockers and introduction of spironolactone according to ESC guidelines. All patients, and if possible their relatives, underwent an individualised heart failure education program with an emphasis on coping with chronic disease and understanding simple aspects of the drug treatment to optimise compliance. In case of clinical deterioration, patients enrolled in the program were advised to contact the clinic directly (i.e., without a referral from their general practitioner) either by telephone or by an unscheduled visit. Patients facing an imminent admission were treated with intravenous diuretics in the clinic during the daytime.	Not mentioned
Ortiz-Bautista et al., 2018 [15] Spain	RCT	To develop a simple nurse-led clinic intervention program for patients with HF and assess whether this intervention positively affects the prognosis of patients, their care costs, and perceived QoL	Hospital outpatient clinic	127 intervention group, 87; Control group, 40	Study principal investigator, nurse case manager	Face to face	The initial nurse visit was made after study enrolment; thereafter, the nurse moved to each patient's primary care centre to continue follow-up visits with the support of their general practitioners. Educational counselling was performed during the first visit and comprised of dietary guideline provision, daily weight and blood pressure monitoring, HF warning clinical symptom recognition, flexible diuretic dosing regimens, and HF treatment adherence. During the follow-up visits, the nurse reviewed and reinforced educational counselling with the patients and, when possible,	Not mentioned

Table 2 (continued)

Author, year, country	Study types	Aim of the study	Setting	Number of patients	Clinic staff	Format/delivery mode	Nurse-led heart failure clinic intervention content	Equipment provided by the clinic
Paul et al., 2000 [18] USA	Pre-post design	To evaluate the effects of a multidisciplinary outpatient heart failure clinic on the clinical and economic management of patients with congestive heart failure.	Hospital outpatient clinic	15	Nurse practitioner, clinical pharmacist, and physician. A dietician was available on site to consult and offer nutritional education, and a social worker was on call to assist with financial or psychosocial issues.	Face to face and telephone.	accomplished HF evidence-based drug uptitration. The number and regularity of visits were planned individually, relying on the clinical situation. When patients were referred to the clinic, they are first evaluated by an attending cardiologist, focusing on heart failure evaluation. The nurse practitioner also evaluated each patient and initiated patient and patient family education about living with CHF. A clinical pharmacist assessed the patient's medication regimen and provided patient education. The nurse practitioner provided follow-up via telephone and clinic visits, reinforcing the education provided, reassessing the patient's clinical status, and adjusting medications as needed. The nurse practitioner maintained telephone contact with the patients to monitor their progress, make any necessary medication adjustments, and determine potential problems.	Not mentioned
White-Williams et al., 2021 [19] USA	Comparative study	To compare the differences in readmission days and patient-incurred costs followed by an inter-professional collaborative practice clinic (both engaged and not engaged) and those who did not establish care with the clinic.	Hospital outpatient clinic	730 intervention group, 619; Control group, 111	Nursing (NPs-Acute from 2017 to 2020 with Psychiatric-Mental Health from 2017 to 2019); clinical nurse leader, registered nurse; medicine (cardiology, psychiatry), social work (general, behavioral health), behavioural health coordinator, public health; exercise physiology (replaced with physical therapy in 2018); pharmacy; health professions; and certified medical assistance.	Face to face/ telephone and automated text message reminding patients for clinic appointments.	Evidence-based transitional care. During the initial clinic visit, medication reconciliation, adherence to hospital-prescribed guideline-directed medical therapy, and initiation of appropriate medication titration were addressed. Additional extensive heart failure self-management education was provided.	Blood pressure monitor, scale for daily weight measurement, and pill box. Education was provided both verbally and in writing, based on patient literacy levels.

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Table 2 (continued)

Author, year, country	Study types	Aim of the study	Setting	Number of patients	Clinic staff	Format/delivery mode	Nurse-led heart failure clinic intervention content	Equipment provided by the clinic
Liljeroos et al., 2018 [20] Sweden	Pre-post design	To evaluate the effects of systematically implementing nurse-led HF clinics in primary care settings with regard to hospital health care utilisation and evidence-based HF treatment, and to explore patients' experiences of HF clinics in primary care setting	Primary care settings	The total number of inhabitants in Sörmland was 270,738 and 291,341 in 2010 and 2017, respectively. The number of patients who visited nurse-led heart failure clinics was not mentioned.	At least one nurse, a general practitioner, and a physiotherapist. The HF clinic also had access to dietitians, occupational therapists, and social workers when needed. The team members could also consult cardiologists and nurses at the HF clinics at the hospitals if and when necessary.	Face to face.	Evidence-based HF care, nurse-led HF model for follow-up after hospitalization in primary care centers.	Not mentioned
Savarese et al., 2019 [21] Sweden	Observational study, clinic as an exposure factor	To assess independent predictors of and prognosis associated with planned referral to nurse-led HF clinics	Hospital and primary care setting	40,992 Number followed-up in a nurse-led HF clinic 16,180; Number followed-up in a nurse-led HF clinic, 24,812	Nurses, physicians	Face to face.	Nurses provided education on self-care and psychosocial support to patients and their family members, and they independently performed physical examinations and mental well-being assessments. Medication up-titration was performed to optimise doses and new treatments were occasionally prescribed with co-signatures by the attending physician. The number of follow-up visits was individualised for each patient.	Not mentioned
Strömberg et al., 2003 [22] Sweden	RCT	To prospectively evaluate the effect of follow-up at a nurse-led heart failure clinic on mortality, morbidity and self-care behavior in patients hospitalised due to heart failure for 12 months after discharge.	One university hospital and two county hospitals	106 intervention group, 52; Control group, 54	Specially educated and experienced cardiac nurses, were delegated the responsibility for making protocol-led changes in medications	Face to face/ telephone	The first visit was scheduled 2–3 weeks after discharge. All visits lasted for 1 h, and the nurse evaluated the patient's status. If the heart failure treatment was optimised, the nurse provided education about heart failure and social support to the patients and their family members. If treatment needed to be optimised, the cardiologist with medical responsibility for the heart failure clinic was consulted, and the treatment was changed in accordance with current clinical guidelines.	The education was individualised, including both written and verbal guideline-based information.
Smith et al., 2015 [16] USA	RCT	To describe key approaches for self-management and care of heart failure through group clinic	Hospital	198 intervention group, 92; Control group, 106	NP with HF outpatient care background, mental health clinical nurse specialist, social	Face to face	Each patient randomised to the intervention group was invited to a total of five 2 h group	DVDs, daily HF monitoring checklist, and early symptom reporting list; list of common signs and

Table 2 (continued)

Author, year, country	Study types	Aim of the study	Setting	Number of patients	Clinic staff	Format/delivery mode	Nurse-led heart failure clinic intervention content	Equipment provided by the clinic
		interactive learning strategies, describe resources and materials used in group clinic appointments, and present results supporting this patient-centered group intervention.			work case manager, and dietitian. Other professionals, such as physical therapists (to guide exercise) and pharmacists (for medication-related discussion), could be invited to group sessions. However, to maintain standardisation of the self-management and care of heart failure through group clinics trial intervention and lower health care costs, only these four professionals were included.		clinic appointments with 4–8 other patients. The first four appointments occurred weekly post-hospital discharge for HF exacerbation, and the fifth appointment occurred approximately 6 months later as a reinforcing booster. During group clinics, patients practised HF symptom assessments, discouragement management, and HF self-care skill establishment. Moreover, patients listed questions and information to discuss with their primary care providers.	symptoms associated with worsening HF and intolerance to HF medication; wallet cards. A weekly pill-sorter box, medication side effect list, low-sodium food list and recipe book, stress reduction and smoking cessation guides/referrals.
Driscoll et al., 2014 [23] Australia	RCT	To determine the effectiveness of a nurse-led titration clinic in improving the time required for patients to reach optimal doses of beta-adrenergic receptor blocking agents.	Outpatient heart failure clinic	25 intervention group, 12; Control group, 13	Although the titration clinic was run by a heart failure nurse, a cardiologist was available to briefly examine each patient and, especially in patients who had significant co-morbidities and uptitration difficulties, guide the nurse during the uptitration process.	Face to face	During each visit the heart failure nurse clinically examined the patient; determined appropriate medication changes, tests, and referrals; and educated the patient concerning medication changes. Patients in the intervention group were reviewed by the heart failure nurse in the clinic weekly, fortnightly, or monthly until they reached the maximum optimal dose of beta-adrenergic receptor blockers over for 6 month intervention period.	Each patient received a printed list of current medications, including the newly titrated medication doses.
Olseng et al., 2016 [24] Norway	RCT	To investigate if the quality of life improved in chronic heart failure patients with Cheyne-Stokes respiration treated with adaptive servo-ventilation in nurse-led heart failure clinics	A nurse-led heart failure clinic at a central hospital in Norway, between October 2007 and January 2011	51 intervention group, 27; Control group, 24	Nurses and other staff are not mentioned.	Face to face/ telephone	Nurse-led education and therapy monitoring and adjustment. In addition to a regular clinical assessment, the nurse provided health education and psychosocial support and titrated medication doses according to the doctor's prescription. The patients met the same nurse during each consultation.	The intervention group received adapted servo-ventilation using AutoSetCS2 (ResMed AS, Norway) and a full face mask because patients with CHF primarily breathe with an open mouth.
Gustafsson et al., 2007	Retrospective data analysis, pre-post design	To assess the proportion of patients with HF due to left ventricular	Hospital-based outpatient clinics	1,533	In daily practice, these clinics were run by nurses with	Face to face/ telephone	Generally, an HF physician performs an initial clinical evaluation of the	During each clinic visit, a drug dispensing sheet was printed from the

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Table 2 (continued)

Author, year, country	Study types	Aim of the study	Setting	Number of patients	Clinic staff	Format/delivery mode	Nurse-led heart failure clinic intervention content	Equipment provided by the clinic
[25] Denmark		systolic dysfunction on beta-blocker treatment 3 months after referral to a nurse-led HF clinic, and to identify baseline predictors of treatment failure.			special training in HF management.		patient and ordered a treatment plan. Subsequently, a specialised HF nurse uptitrated ACE inhibitor and BB doses and adjusted diuretic doses guided by clinical and laboratory monitoring. The physician was consulted in case of doubt or clinical deterioration of the patient. Clinic appointments were scheduled at variable intervals depending on individual needs.	system and given to the patient to ensure the accordance between the medication data in the system and the drugs and doses actually (or supposedly) taken by the patient until the next clinic visit.
Cheng et al., 2016 [26] China	Retrospective data analysis; clinic services used as an intervention	To evaluate the effects of a nurse-led HF clinic on hospital readmission and mortality rates among older HF patients in Hong Kong, China	Local public hospital nurse-led HF clinic	78 attended the clinic, 38; not attended the clinic, 40	The clinic was led by trained cardiac rehabilitation nurses. All nurses received 12-week in-service training, which was conducted at a specialist outpatient clinic of the hospital.	Face to face/ phone consultations	For the first clinic appointment, the patient's physical status was monitored by a cardiac rehabilitation nurse. Nurses educated patients on self-monitoring. Nurses could also adjust the diuretic dose based on the patient's condition. Intensive clinic follow-up and daily phone consultations were arranged for the patients until their conditions, such as shortness of breath and limb edema, became stable. Follow-up schedules for the patients ranged from weekly to bi-monthly.	Not mentioned

Note: DMPs = disease management programs. HF = heart failure. QOL = quality of life. CHF = chronic heart failure. NP = nurse practitioner. ACE = angiotensin-converting enzyme. ARB = angiotensin receptor blocker. HFrEF = heart failure with reduced ejection fraction. ESC = European Society of Cardiology. RCT = randomised controlled trial. DVD = digital video disc.

a drug dispensing sheet.

The nurse-led HF clinic provided services such as medication uptitration, educational counselling on dietary guidelines, daily weight and blood pressure monitoring, HF clinical symptom recognition, diuretic dose adjustment, HF treatment adherence promotion, edema examination, lifestyle modification promotion, evidence-based transitional care, psychosocial support, physical examination and mental well-being assessment, therapy monitoring and adjustment, follow-up, and phone consultations.

The patient sample sizes varied considerably among the studies, ranging from 15 to 25,892. Of the included studies, 2, 10, 4, and 4 studies examined cost-effectiveness, patient outcomes, quality of life, and medication titration efficacy, respectively (Table 3).

3.2.1. Medication titration efficacy

Ninety-four percent of patients used an ACE inhibitor for three months. There was a significant improvement in the relative mean

dose of ACE inhibitor/angiotensin receptor blocker compared with the target dose after three months [17]. However, Strömberg et al. [22] reported no disparity in the initial and 12-month ACE inhibitor doses. Additionally, the intervention group exhibited a greater target dose achievement rate compared with the control group after three months.

There was a significant variation in the beta-blocker use rate across different studies. Andersen et al. [17] reported a 91% beta-blocker prescription rate after three months, whereas Gustafsson et al. [25] reported a beta-blocker prescription rate of only 63%. The average beta-blocker dose relative to the target dose significantly improved after three months compared with the initial measurement [17].

Driscoll et al. [23] reported that patients in the intervention group achieved the optimal beta-adrenergic receptor blocker dose almost half the time this dose was achieved in the control group. Additionally, the beta-adrenergic receptor blocker doses were

Table 3
The effectiveness of nurse-led heart failure clinic.

Author, year, country	Cost-effectiveness	Clinical outcomes	Quality of life	Medication titration efficacy	Main findings
Andersen et al., 2005 [17] Denmark	Not measured	HF admissions: HF admissions decreased by 45% after the clinic was established. Hospital days for HF: Number of days spent in hospital for HF decreased by 58% after the clinic was established.	Not measured	ACE inhibitor/ARB: After 3 months, 94% of patients were taking an ACE inhibitor, and beta-blockade was prescribed for 91% of patients. The mean ACE inhibitor/ARB dose relative to the target dose after 3 months was 77% ± 30% and 53% ± 36% at baseline ($P < 0.001$). Beta-blocker: The mean beta-blocker dose relative to the target dose after 3 months was 53% ± 31% of the target dose, which was 34% ± 30% at baseline ($P < 0.001$).	Community hospital-based HF clinics may promote the utilisation of evidence-based drug therapy, substantially decreasing HF admissions, thereby producing results comparable to those obtained in studies of university hospital-based HF management programs
Ortiz-Bautista et al., 2018 [15] Spain	Not measured	HF admissions: In the intervention group, readmissions for HF were significantly reduced (35% vs. 18%; $P = 0.04$) All-cause mortality: There were no between-group differences. The all-cause mortality rate was 25% in the intervention group and 28% in the control group ($RR = 0.92$, 95% CI 0.49–1.71; $P = 0.79$) All-cause readmission: There were no between-group differences. The all-cause readmission rate was 49% in the intervention group and 55% in the control group ($RR = 0.90$, 95% CI 0.63–1.28; $P = 0.55$). All-cause mortality and all-cause readmission: There were no between-group differences. Moreover, 73 of 127 patients (57%) reached the primary endpoint of all-cause mortality and all-cause readmission: 50 patients in the intervention group (57%) and 23 patients in the control group (58%) ($RR = 1.0$, 95% CI 0.72–1.38; $P = 0.99$).	QoL significantly improved (2.29 ± 14 vs. 10.9 ± 14.75 ; $P = 0.04$, the measurement: MLHFQ)	Not measured	The primary findings of this randomized study support the use of nurse-led clinic DMPs in clinical practice, since they significantly decrease hospital readmission for HF and improve QoL.
Paul et al., 2000 [18] USA	Mean inpatient hospital charges: There were no differences between preclinical and postclinical findings. Mean inpatient hospital charges decreased from \$10,624 per patient admission to \$5,893.	All-cause readmissions: The patients had a total of 38 hospital admissions (mean, 2.4 admissions per patient) before beginning treatment at the clinic and 19 admissions (mean, 1.3 admissions per patient) afterward ($P = 0.04$). HF admissions: There was no significant difference between pre- and postclinical findings. CHF accounted for 24 (63%) of the 38 preclinical admissions and 9 (47%) of the 19 postclinical admissions ($P = 0.25$); Total number of hospital days: The total number of hospital days was reduced from 151 in the 6-month period before treatment at the clinic to 72 in the 6-month period after	Not measured	Not measured	Patients seemed to benefit from participation in the HF clinic. The availability of a health care provider to manage early signs and symptoms of worsening HF, hospital readmissions may be decreased and patient outcomes may be improved.

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Table 3 (continued)

Author, year, country	Cost-effectiveness	Clinical outcomes	Quality of life	Medication titration efficacy	Main findings
White-Williams et al., 2021 [19] USA	Total cost savings were significantly greater in the engaged group ($P < 0.001$). In the engaged group ($n = 42$), there was a significant decrease in direct costs between baseline (median \$7,958) and intervention periods (median \$4,742) ($S = 205.50, DF = 41, P < 0.01$)	treatment at the clinic ($P = 0.02$). The average length of stay: There was no significant difference between preclinical and postclinical findings. The average length of stay decreased from 4.3 to 3.8 days. Total number of hospitalization days: The engaged group showed significant decreases in the number of hospitalization days from baseline to the intervention periods (baseline median 7 days). Intervention median 5 days; $S = -219.00, DF = 42, P < 0.01$	Not measured	Not measured	Caring for a predominantly African-American population of underserved patients with HF in a nurse-led inter-professional clinic decreased the number of hospitalization days and the direct hospital costs during a 6-month intervention period, resulting in a total cost avoidance of \$1,987,379.
Liljeroos et al., 2018 [20] Sweden	Not measured	HF admissions: The implementation of HF clinics in primary care centers significantly reduced the number of HF-related hospital admissions by 27% ($P < 0.001$). Hospitalization days for HF: The implementation of HF clinics in primary care centers significantly reduced the HF-related hospitalization days by 27.3% ($P < 0.001$). HF emergency room visits: The implementation of HF clinics in primary care centers significantly reduced the HF-related emergency room visits by 24% ($P < 0.001$). HF readmissions within 30 days: There were significantly fewer early readmissions within 30 days after hospital discharge between 2010 and 2017 ($P = 0.01$). All-cause readmissions: There was no significant difference.	Not measured	Not measured	The implementation of HF clinics in primary care centers significantly reduced the number of hospital admissions, hospitalization days, and emergency room visits.
Savarese et al., 2019 [21] Sweden	Not measured	All-cause mortality: Planned follow-up in a nurse-led HF clinic was associated with a significant reduction in the risk of all-cause mortality ($HR = 0.90; 95\% CI = 0.86 - 0.95$) Mortality/HF-related hospitalization: Planned follow-up in a nurse-led HF clinic was associated with a significant reduction in the risk of mortality/HF-related hospitalization ($HR = 0.96; 95\% CI = 0.93 - 0.99$). HF admissions: There was no significant difference.	Not measured	Not measured	In this nationwide registry, 39% of identified HF cohort was planned to be referred to a nurse-led HF clinic. Planned referral reflected more severe HF as well as also sex- and family-related factors. Moreover, and it was independently associated with lower mortality risks, but not lower HF hospitalization risks.
Strömberg et al., 2003 [22] Sweden	Not measured	All-cause mortality and all-cause readmission: There were fewer patients with events after 12 months in the intervention group compared with the control group (29 vs. 40, $P = 0.03$)	Not measured	ACE inhibitors: Beta-blockers: At baseline and after 12 months, there was no between-group difference in beta-blocker prescription. After 3 months, there was no	Post-hospitalization follow-up at a nurse-led HF clinic can improve survival and self-care behavior in patients with HF as well as reduce the number of events, readmissions, and hospitalization days.

Table 3 (continued)

Author, year, country	Cost-effectiveness	Clinical outcomes	Quality of life	Medication titration efficacy	Main findings
		<p>All-cause mortality:</p> <p>Three months after inclusion, a total of 3 patients in the intervention group had died compared with 13 patients in the control group ($P = 0.009$); after 12 months the differences in mortality persisted, as 7 and 20 patients died in the intervention and control groups, respectively ($P = 0.005$).</p> <p>All-cause readmissions: The intervention group had fewer admissions (33 vs. 56, $P = 0.047$) during the first 3 months. After 12 months, the intervention and control groups had a total of 688 and 976 hospitalization days, respectively ($P = 0.13$).</p> <p>Total number of hospitalization days: The intervention group had fewer hospitalization days (350 vs. 592, $P = 0.045$) during the first 3 months, constituting a reduction of 41%. After 12 months, the intervention and control groups had a total of 688 and 976 hospitalization days, respectively ($P = 0.13$).</p> <p>Admissions/patient/month: After 12 months, the intervention group had a 55% decrease in admissions/patient/month (0.18 vs. 0.40, $P = 0.06$).</p> <p>Days in hospital/patient/month: After 12 months, the intervention group had fewer days in hospital/patient/month (1.4 vs. 3.9, $P = 0.02$).</p>		<p>between-group difference in beta-blocker use.</p>	
Smith et al., 2015 [16] USA	Not measured	<p>HF admissions: The Poisson model showed a 33% decrease in the rate of readmissions (incidence rate ratio, 0.67) associated with the intervention over the follow-up period when compared with controls ($\chi^2 = 3.9$, $P = 0.04$).</p>	<p>The HF-related quality of life scale data revealed a significant improvement ($P < 0.001$) from baseline to 12 months of one-half standard deviation in both groups, with no significant between-group difference. (Measurement tool: Kansas City Cardiomyopathy Questionnaire)</p>		<p>The Nurse-Led Multidisciplinary HF Group Clinic was associated with improvements in HF self-care knowledge and home care behavior skills and managing their for HF care. In turn, better self-care was associated with reductions in HF-related hospitalizations.</p>
Driscoll et al., 2014 [23] Australia	Not measured	<p>Hospital admission and/or presentation to the emergency department: There was no significant between-group difference ($P = 0.1$).</p>	<p>There was no significant between-group difference at any time point, although there was a slight trend toward fewer quality of life deteriorations over the 6-month period in the intervention group than in the control group (mean difference 6.7 ± 16.2 vs. 9.5 ± 10.8; $P = 0.6$).</p>	<p>Here was a significant between-group difference in the time to maximum dose of beta-blocker, whose value in the intervention group was nearly half the time in the control group (mean: 90 ± 14 days, 95% $CI = 63.15-118.5$ day vs. 166 ± 8 days, 95% $CI = 150.67-182.26$ days, $P < 0.001$)</p> <p>At 6 months, a significantly higher proportion of patients reached the maximal dose of</p>	<p>A nurse-led uptitration clinic improves beta-adrenergic receptor blocker optimization therapy by increasing the proportion of patients reaching the maximal dose and facilitating rapid beta-adrenergic receptor blocker uptitration in patients with chronic HFrEF.</p>

(continued on next page)

Table 3 (continued)

Author, year, country	Cost-effectiveness	Clinical outcomes	Quality of life	Medication titration efficacy	Main findings
Olseng et al., 2016 [24] Norway	Not measured	Not measured	A reduction in MLHFQ scores between the time of randomization (0 month) and 3 months indicated a better QoL in the intervention group but not in the control group. In the intervention group, significant differences in QoL scores ($P < 0.01$) were noted both between the randomized patients at 0 months ($n = 27$) and the patients who completed the study after 3 months ($n = 15$) as well as between the patients who completed the study ($P < 0.001$) at 0 months ($n = 15$) and after 3 months of treatment ($n = 15$).	beta-adrenergic receptor blockers in the intervention group compared with the control group (10.91% vs. 4.31%, $P = 0.001$). At 3 months, the beta-adrenergic receptor blocker dose was optimised to higher doses in 6 (50%) patients compared with 2 (15%) in the control group ($P = 0.008$). At 6 months, 9 (82%) patients in the intervention group had high doses compared with five patients (42%) in the control group ($P = 0.04$). Not measured	The use of adaptive servo-ventilation improved quality of life in chronic heart failure patients with Cheyne-Stokes respiration.
Gustafsson et al., 2007 [25] Denmark	Not measured	Not measured	Not measured	Proportion of patients reaching the maximal beta-adrenergic receptor blocker dose: Three months after the initial HF clinic visit, 63% of the patients were treated with beta-blockers. The mean dose (relative to target dose) was 63 (± 35)%, and the target dose was reached by 21% of patients.	Beta-blocker uptitration remains a challenge even in specialised clinics dedicated to this task.
Cheng et al., 2016 [26] China	Not measured	All-cause readmission: Patients with HF who did not attend the nurse-led HF clinic demonstrated a significantly higher risk of hospital readmission (OR = 7.40; $P < 0.01$) than those who attended the clinic, after adjusting for the effect of age and blood pressure at 6 months. All-cause mortality: There was no significant difference. Patients with HF who attended the clinic had a lower mortality ($n = 4$) than those who did not attend ($n = 14$).	Not measured	Not measured	Nurse-led HF clinics significantly contribute to treatment adherence and lifestyle modification by patients via continuous education and training. The findings of this study suggest the important role of nurse-led HF clinics in reducing health care burden and improving patient outcomes among patients with HF in Hong Kong, China.

Note: DMPs = disease management programs. MLHFQ = Minnesota Living with Heart Failure Questionnaire. HF = heart failure. QOL = quality of life. CHF = chronic heart failure. ACE = angiotensin-converting enzyme. ARB = angiotensin receptor blocker. HFrEF = heart failure with reduced ejection fraction.

optimised to higher levels in the intervention group than in the control group at 3 and 6 months. Although Strömberg et al. [22] reported no discrepancies at both 3 and 12 months, a significantly

higher proportion of patients reached the maximum beta-adrenergic receptor blocker dose in the intervention group at six months. Gustafsson et al. [25] reported that only 21% of patients

achieved the target dose three months after their initial visit to a nurse-led HF clinic.

3.2.2. Clinical outcomes

The clinical outcome indicators were dispersive. Ortiz-Bautista et al. and Cheng et al. [15,26] reported no between-group differences in all-cause mortality. Savarese et al. [22] found that patients who visited the nurse-led HF clinic showed a statistically significant reduction in all-cause mortality [21], which is consistent with Strömberg et al.'s findings. Furthermore, Ortiz-Bautista et al. and Liljeroos et al. [15,20] found no between-group differences in all-cause readmission. Paul et al. [18] reported lower readmission rates after treatment at the clinic, corroborating with the results of Strömberg et al. at 3 and 12 months, as well as Cheng et al. at six months [22,26]. Regarding all-cause mortality and all-cause readmission, Ortiz-Bautista et al. [15] found no differences between groups. However, Strömberg et al. [22] reported a lower incidence rate after 12 months. Moreover, Savarese et al. [21] reported a significant reduction in mortality and HF hospitalization risks. Paul et al. and Savarese et al. [18,21] reported no significant differences in HF admission rates. Nevertheless, the other four studies found a reduction in HF admission rates [15–17,20]. Andersen et al., Liljeroos et al., and White-Williams et al. [17,19,20] reported reductions in the number of hospitalization days for HF. Paul et al. [18] reported a reduction in the total number of hospitalization days after six months from baseline. Strömberg et al. [22] reported fewer hospitalization days for patients in the intervention group during the first three months, with a reduction of 41%; however, after 12 months, there was no significant between-group difference in the number of hospitalization days. In addition, Liljeroos et al. [20] reported that the implementation of HF clinics in primary care significantly reduced HF emergency room visits by 24%. Furthermore, Liljeroos et al. [20] highlighted a notable decrease in HF readmissions within 30 days from 2010 to 2017. Strömberg et al. [22] demonstrated a reduction in both admissions/patient/month and hospital/patient/month after 12 months. There were no significant differences in the average length of stay, hospital admission, and/or presentation to the emergency department [18,23].

3.2.3. Quality of life

Three of the four studies that assessed the quality of life used the Minnesota Living with Heart Failure Questionnaire [15,23,24], whereas one study used the Kansas City Cardiomyopathy Questionnaire [16]. Ortiz-Bautista et al. and Olseng et al. [15,24] observed a significant quality of life enhancement in the intervention group. However, Smith et al. and Driscoll et al. [16,23] reported no significant between-group disparities in the quality of life.

3.2.4. Cost-effectiveness

Paul et al. [18] compared the health care costs before and after patient introduction to the nurse-led HF clinic. The study found no significant difference in healthcare costs, despite a decrease in average inpatient hospital charges from \$10,624 to \$5,893 per patient. According to a study conducted in 2021, patients who participated in a nurse-led HF clinic experienced considerably higher cost savings. During the intervention period, there was a notable reduction in direct costs from a median of \$7,958 at baseline to \$4,742 [19].

4. Discussion

The nurse-led HF clinic services were: medication uptitration, educational counselling, evidence-based transitional care, psychosocial support, physical examination and mental well-being

assessment, therapy monitoring and adjustment, follow-ups, and phone consultations. The nurse-led HF clinic mainly had a positive effect on clinical outcomes and medication titration efficacy. More relevant studies are needed to verify the effect of the clinic services on quality of life and cost-effectiveness.

In this study, we exclusively incorporated the nurse-led HF clinic service as an intervention, resulting in a significant decrease in heterogeneity. By implementing educational programs in clinical practice and the community, nurse practitioners play a crucial role in bridging the treatment gap between evidence-based recommendations and clinical practice [11]. The nurse-led HF clinic intervention is similar to other nurse-led clinic services, incorporating self-management education [33], counselling, behaviour modification promotion, patient evaluation, follow-up and psychosocial assistance [11], assessment and review, treatment and procedure administration, and case management [12]. Medicine uptitration is a crucial aspect of the distinctive nurse-led HF clinic.

A previous study revealed that attending nurse-led coronary heart disease clinics significantly reduced certain risk factors in the short term. However, these clinic services had no evident impact on long-term changes. Compared with standard care, the positive impact of nurse-led clinic services on the patients appeared to diminish over time [13]. Coronas-Watkins et al. [34] also reported that patients who attended nurse-led clinics after undergoing percutaneous coronary intervention experienced slight enhancements in quality of life and certain self-management practices. However, these improvements were not maintained in the long run. The findings of this study were consistent with those of another study wherein some indicators were effective at three months, but the effect disappeared at 12 months [22].

Most of the studies reported clinical outcomes. Generally, clinical outcome-related findings aligned with those of other systematic evaluations. Van Spall et al. [35] reported that transitional care services were effective in patients with HF after hospital discharge. Nurse home visits and disease management clinic services were associated with a reduction in overall mortality rates following hospitalization for HF. The transitional care services provided were education, pharmacist interventions, telemonitoring, telephone support, and disease management clinics. Feltner et al. [36] reported that programs involving home visits and specialised clinic services incorporating various disciplines decreased all-cause readmission and mortality rates in patients with HF. In 2016, Oyanguren et al. [37] confirmed that HF management programs incorporating various interventions decrease mortality and readmission rates.

Owing to the limited number of doctors available and the growing need to control expenses, the responsibility of care can be transferred from doctors to nurses. The potential substitution of doctors with nurses can directly reduce doctor workload and health care costs. However, the extent of these reductions relies on the specific care context [38]. According to Raftery et al. [39], the secondary prevention of coronary heart disease via nurse-led primary care clinics has shown more economic advantages compared with other healthcare interventions, primarily owing to the significant increase in life years saved. Raftery et al. [39] demonstrated the cost-effectiveness of nurse-led HF clinics and telemonitoring programs. Only two studies included in this review focused on cost-effectiveness analysis. Therefore, the absence of research offering economic examination necessitates more cost-effectiveness evaluations.

Guideline-recommended medical treatment should be employed for individuals with HF. If the initial dose is well tolerated, the medication should gradually be increased to a designated target dose. Despite any improvement in symptoms or other signs of response at lower doses, the medication dose would still be

increased to the target dose. If the desired dose cannot be attained or is poorly tolerated, opting for the maximum tolerated dose is advisable. The initiation and titration process should be personalised and enhanced promptly based on patient symptoms, vital signs, functional condition, tolerance, kidney function, electrolyte levels, existing health conditions, underlying reason for HF, and ability to receive follow-up care [10]. Michalsen et al. [7] reported that failure to comply with medication and dietary recommendations was the primary reason for hospital admission resulting from worsening of chronic HF. This was followed by cardiac ischemia and insufficient medical care. Four studies evaluated the medication titration efficacy and reported different results. Further research is required.

The findings on quality of life align with those in the existing literature, indicating that organised nurse-led education enhances adherence to self-care and improves mental well-being [40]. Generally, nurse-led HF clinics offer education, psychosocial assistance, and other effective methods to improve the quality of life.

This systematic review has some limitations. First, the studies analyzed in this review were conducted in various settings, including hospitals, community hospitals, and primary care facilities. Second, few studies have investigated the financial advantages of nurse-led HF clinics. Third, the diversified indicators prevented the possibility of conducting a meta-analysis; hence, a quantitative analysis was not conducted in this review. Fourth, only English papers were included. Finally, the sample size for review was comparatively limited. A total of 12 studies fulfilled the inclusion criteria for this review, highlighting the necessity for enhanced methodological rigour in research concerning nurse-led HF clinics.

5. Conclusion and implications

The systematic review outlined the contents presently utilized in nurse-led HF clinics and assessed their efficacy. Generally, the patients experienced positive outcomes, both quality of life and medication uptitration efficacy were improved. However, only a single study reported findings regarding cost savings. Further research is necessary to obtain more robust and reliable findings.

5.1. Implications for clinical practice

To develop a nurse-led HF clinic in nursing practice, nurses can have an overview of nurse-led HF clinics, including a knowledge of the content and effectiveness of the clinics providing the required services. Furthermore, this study provides strong evidence of the effectiveness of nurse-led HF clinics, which not only attaches more attention to the development of nurse-led HF clinics and nurse specialists but also improves nurse career development prospects and professional value.

5.2. Recommendations for future research

Research about innovative approaches is needed in the future. A study conducted in 2016 showed that ultrasound examinations performed by nurses could enhance diagnostic accuracy and care in patients with HF [41]. However, further research is required to ascertain the influence of these examinations on clinical outcomes. Requesting patients with HF to record their educational requirements prior to their clinic visit enhances the effect of patient education. A more innovative approach is needed based on routine interventions [42].

We observed an absence of a standardised framework for thoroughly assessing nurse-led HF clinic services. The studies examined 13 indicators of patient outcome: all-cause mortality, all-

cause readmission, all-cause mortality and all-cause readmission, HF admissions, hospitalization days for HF, mortality/HF hospitalization, total number of hospitalization days, HF emergency room visits, HF readmissions within 30 days, admissions/patient/month, days in hospital/patient/month, average length of stay, hospital admission, and/or presentation to the emergency department. It is crucial to have a uniform framework with standardised measures for evaluating nurse-led HF clinics. More RCTs are required to obtain reliable findings.

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Data availability statement

The datasets generated during and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Conflict of interest

The authors have no conflict of interest to declare.

CRediT authorship contribution statement

Xiaoxiao Wu: Conceptualization, Methodology, Validation, Formal analysis, Investigation, Writing – original draft, Writing – review & editing, Funding acquisition. **Zhen Li:** Conceptualization, Methodology, Validation, Formal analysis, Investigation, Data curation, Writing – original draft, Writing – review & editing. **Qingxiu Tian:** Conceptualization, Methodology, Validation, Formal analysis, Investigation, Data curation, Writing – original draft, Writing – review & editing. **Shiming Ji:** Conceptualization, Methodology, Validation, Formal analysis, Investigation, Writing – review & editing. **Chen Zhang:** Conceptualization, Methodology, Validation, Formal analysis, Investigation, Writing – review & editing, Project administration.

Declaration of competing interest

The authors have declared no conflict of interest.

Appendices. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ijnss.2024.04.001>.

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