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Thai Health Sciences Frontiers (THSF)

Thai Health Sciences Frontiers is published to disseminate research and innovations in the health sciences that link knowledge to real practice at the clinical level, in community hospitals, and in primary health care systems, and to serve as a forum for learning exchange and academic networking among health professionals in all fields in Thailand.

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Instructions for Manuscript Submission

Thai Health Sciences Frontiers (THSF) welcomes academic articles and research articles in the health sciences from all professions, including nursing, medicine, pharmacy, physical therapy, community public health, and primary health care, that have not been published elsewhere and are not under consideration by another journal. The editorial board reserves the right to edit manuscripts and to consider them for publication in order of receipt. The criteria and guidelines are as follows:

1. Articles Submitted for Publication

Original research article is a report of the author's study, exploration, or research, including research and development (R&D) and the development of patient-care models, that has not been published in any other journal. It should contain the following sections in order: title; author name(s); abstract in Thai and English; introduction; research objectives; hypothesis (if any); research conceptual framework (if any); research methodology; research instruments and instrument quality; results; conclusion and discussion; recommendations; and references. Acknowledgments may be placed between the recommendations and the references. The total number of authors must not exceed **8.**

Academic article is an article presenting knowledge, concepts, or academic experience in the health sciences, with analysis, synthesis, and references to reliable empirical evidence. It consists of an introduction, content, conclusion, and references. The total number of authors must not exceed **5.**

Review article is an article written by compiling knowledge on a particular subject from journals or books, both domestic and international. It consists of an introduction, background knowledge on the topic, literature search methods, the content reviewed, critique, and references.

Case report is a report of an interesting patient or case study that provides insights or guidance useful for clinical practice. It consists of an introduction, case report, discussion, conclusion, and references. Patient-identifying information must not be disclosed, and consent must be obtained from the patient or the legal representative.

All article types must not exceed 15 A4 pages, including tables, figures, and references.

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Title should be short and concise yet comprehensive, consistent with the objectives and content. The title must be given in both Thai and English, without abbreviations.

Author names (article owners) must be given in both Thai and English (without abbreviations), together with position, affiliation, and full address in both Thai and English. Identify the corresponding author and provide an e-mail address at which he or she can be contacted.

Abstract is a condensed summary of the essential content, including only what is necessary and only the key statistics. Use concise, complete sentences in prose form, not itemized points. Each abstract must not exceed **300** words and should cover the objectives, materials and methods, results and discussion, or brief recommendations. Do not include reference citations in the abstract. The abstract must be written in both Thai and English.

Keywords in both Thai and English, **3–5** terms, placed at the end of the abstract in each language and separated by commas (,).

Introduction explains the background and significance of the problem that necessitates the research, related studies by others, and the knowledge gap that this research will fill.

Research objectives, hypothesis, and research conceptual framework State the objectives clearly and measurably. State the hypothesis and conceptual framework where applicable.

Research methodology describes the research design, population and sample, sample size calculation and sampling methods, data collection methods, and data analysis methods or statistics used, as well as protection of participants' rights, stating the name of the human research ethics committee, the certificate number, and the date of approval.

Research instruments and instrument quality describes the characteristics of the instruments, how they were developed or their sources, and the results of quality testing, such as content validity (CVI/IOC) and reliability.

Results describe the findings in the order of the objectives, presenting the evidence systematically. If there are many figures or variables, use tables, and do not repeat in the text the numbers shown in the tables except for key data. Table titles are placed above the table, together with the sample size (n), while figure or chart titles are placed below the figure. An article should contain no more than **3–5** tables.

Conclusion and discussion should discuss the results in comparison with the stated objectives and hypotheses—whether they agree or differ, to what extent, and why—and should refer to relevant theories or the findings of other researchers.

Recommendations are suggestions on how the research results may be used in practice, administration, or policy, as well as suggestions for future research.

Acknowledgments (if any) acknowledge significant assistance or support received, including research funding sources, in a single paragraph.

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Heading arrangement Main headings are typed flush with the left margin; subheadings are indented **3–5** characters.

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The format is as follows:

Number. Author name(s). Title. Journal title. Year of publication;Volume(Issue):First page-last page.

English-language journals

Use the surname first, followed by the initials of the given name(s). Abbreviate journal titles according to the Index Medicus system.

Thai-language journals

Translate the entire reference entry into English, following the same format as for English-language journals. Use the Gregorian (C.E.) year and append (in Thai) at the end.

If there are more than 6 authors, list only the first 6, separated by commas (,), followed by et al.

Page numbers: give the first page in full and omit the repeated digits from the last page; for example, 131-156 is written as 131-56. Do not leave a space around the ; and : when giving the year of publication, volume(issue), and page numbers.

1. Muangsapaya W, Winichagoon P, Fucharoen S, Pootrakul P, Wasi P. Improved technique for detecting intraerythrocytic inclusion bodies in thalassemic trait. J Med Assoc Thai. 1985;68:43-5.

2. Jaidee S, Meesuk S. Effects of a diabetes care program. Thai Journal of Nursing. 2023;15(2):45-58. (in Thai)

3.2 Citing Books or Textbooks

Format for a book or textbook written entirely by the author(s)

Number. Author name(s). Book title. Edition. Place of publication: Publisher; Year of publication. (Give the edition only for the second edition onward.)

1. Gilstrap LC, Cunningham FG. Operative obstetrics. 2nd ed. New York: McGraw-Hill; 2002.

2. Chaturanon W. Critical care nursing. Bangkok: Chulalongkorn University Press; 2022. (in Thai)

Format for a chapter in a book or textbook

Number. Author name(s). Chapter title. In: Editor name(s), editor. Book title. Edition. Place of publication: Publisher; Year of publication. p. First page-last page.

1. Wood WG. Hemoglobin analysis. In: Weatherall DJ, editor. The thalassemias. New York: Churchill Livingstone; 1983. p. 31-53.

3.3 Electronic Media

Electronic books (E-books)

Number. Author name(s). Title [Type of medium/material]. Year of publication [cited Year Month Day]. Available from: URL address

Journal articles published on the Internet

Number. Author name(s). Article title. Journal title [Internet]. Year of publication [cited Year Month Day];Volume(Issue):Pages. Available from: URL address

1. Annas GJ. Resurrection of a stem-cell funding barrier--Dickey-Wicker in court. N Engl J Med [Internet]. 2010 [cited 2010 Jun 15];363:1687-9. Available from: http://www.nejm.org/doi/pdf/10.1056/NEJMp1010466

Articles with a digital object identifier (DOI)

1. Degenhardt L, Bohnert KM, Anthony JC. Assessment of cocaine and other drug dependence in the general population: "gated" vs. "ungated" approaches. Drug Alcohol Depend [Internet]. 2008 Mar [cited 2010 Apr 15];93(3):227-32. Available from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2756072/ doi:10.1016/j.drugalcdep.2007.09.024

3.4 Other References

Conference or seminar proceedings

Number. Author name(s). Title. In: Editor name(s), editor. Name of conference; Day Month Year of conference; Venue. Place of publication: Publisher; Year of publication. p. First page-last page.

1. Bengtsson S, Solheim BG. Enforcement of data protection, privacy and security in medical informatics. In: Lun KC, Degoulet P, Piemme TE, Rienhoff O, editors. MEDINFO 92. Proceedings of the 7th World Congress on Medical Informatics; 1992 Sep 6-10; Geneva, Switzerland. Amsterdam: North-Holland; 1992. p. 1561-5.

Theses and dissertations

Number. Author name(s). Title [Type/degree level]. Place of publication: University; Year of degree conferral.

1. Srichairattanakool A. Comparison of the quality of life of patients with chronic myeloid leukemia in the chronic and blastic phases [master's thesis]. Bangkok: Chulalongkorn University; 2000. (in Thai)

Newspaper articles

Number. Author name(s). Title. Newspaper name. Year Month Day; Section: Page number (Column number).

4. Manuscript Submission

4.1 Prepare the manuscript in Microsoft Word, single-sided on A4 paper, using TH SarabunPSK 16 pt, with 2.54 cm margins on all sides and no two-column layout. The length must not exceed 15 pages including references, and the format must follow the journal's template.

4.2 Illustrations: line drawings must be drawn in black ink on white paper; photographs should be .jpg files with a resolution of no less than 600×800 pixels. Write captions separately rather than within the image, and number each illustration so that the layout can be typeset correctly.

4.3 Submit the manuscript (Word file) together with the academic article/research article submission form, giving the author's name, address, telephone number, and a convenient e-mail address, to the Editor of Thai Health Sciences Frontiers by e-mail: keydatacorp@gmail.com, tel. 064-314-6622. Once the editor has determined that the article is consistent with the aims and scope of the journal, the author then submits the article through the ThaiJO system.

4.4 For research articles involving human participants, attach a copy of the certificate of approval (COA) from the human research ethics committee for the project submitted for publication.

4.5 For research articles that are part of a thesis or dissertation, attach a certificate from the principal advisor and, if available, evidence of a plagiarism check (e.g., Akkharawisut).

5. Receipt of Manuscripts

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5.2 Every manuscript will be reviewed by at least 3 experts through double-blind peer review.

5.3 For manuscripts not accepted for publication, the editorial board will notify the authors but will not return the manuscripts.

5.4 If an author does not revise the article as required by the editorial board, or the editorial board receives no communication, the journal reserves the right to decline that author's submissions in the future.

6. Publication Fees

The journal charges a publication fee only after an article has been accepted for publication, at the rate of 4,500 baht for Thai-language articles and 6,500 baht for English-language articles. Payment is made by bank transfer to the following account: account name Key Data Company Limited; bank: Siam Commercial Bank (SCB), Gateway Ekamai Branch, Bangkok; account number 416-013-9078. Then send the publication fee invoice and proof of transfer to e-mail: keydatacorp@gmail.com

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Editorial

Thai Health Sciences Frontiers (THSF), Volume 1 Issue 2 (May – August 2026), is the inaugural issue, which the editorial board is immensely proud to present to readers. The journal was founded with the aim of serving as an academic forum for health professionals in all disciplines to disseminate research and innovations that link knowledge to real practice at the clinical level, in community hospitals, and in primary health care systems.

In this issue, readers will find a diverse range of research articles and academic articles covering nursing, medicine, pharmacy, community public health, and the development of patient-care models. Every article has been reviewed by at least 3 experts through double-blind peer review to ensure academic quality and credibility. The editorial board sincerely hopes that the knowledge in these articles will benefit the development of health services and can be applied concretely in readers' work settings.

The editorial board thanks all authors who entrusted us with their work for publication; the reviewers who gave their valuable time to evaluate the manuscripts and provide helpful suggestions; and all advisors and committee members who helped bring this issue to completion. The journal welcomes articles from academics and health personnel everywhere and is ready to listen to suggestions for improving its quality further.

Dr. Chontira Choommanee

Editor-in-Chief

Thai Health Sciences Frontiers

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Thai Health Sciences Frontiers
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THSF

RESEARCH ARTICLE

Development of Competence of Village Health Volunteers in Caring for Tuberculosis Patients in the Community, Don Chan District, Kalasin Province

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Abstract

This participatory action research (PAR), combined with a non-randomized two-group pretest–posttest quasi-experimental evaluation, aimed to 1) explore the situation, problems, and needs for developing the competence of village health volunteers (VHVs) in caring for tuberculosis (TB) patients in the community, 2) develop a participatory competence-enhancement approach, and 3) compare VHVs' knowledge, skills, and competence levels before and after the intervention and between groups. The study was conducted in Don Chan District, Kalasin Province, from October 2025 to August 2026. Co-researchers were 38 health personnel, and the sample comprised 60 VHVs allocated by subdistrict to an experimental or a control group (30 each). Instruments included an 8-week competence-enhancement program, a knowledge test, a skills assessment, a satisfaction questionnaire, and qualitative interview guides. Data were analyzed using descriptive statistics, paired and independent t-tests, ANCOVA, the chi-square test, and content analysis.

VHVs lacked in-depth knowledge of treatment observation and adverse drug reactions, lacked confidence in home visits, and feared infection. The developed approach comprised four components: participatory workshops, mentored field practice, a community of practice with digital patient follow-up, and supervision with reflection. After the intervention, the experimental group had higher knowledge (17.20±1.73) and skill scores (52.83±4.15) than before and than the control group (mean differences 5.07, 95% CI 3.97–6.17, and 12.76, 95% CI 10.14–15.38; $p<.001$). More VHVs in the experimental group reached a high competence level (80.00% vs. 36.67%; $\chi^2=11.59$, df=1, $p<.001$). Co-researchers' satisfaction was very high (4.52±0.48). **Conclusion:** The participatory approach improved VHVs' short-term competence. It should be extended to all subdistrict health promoting hospitals and evaluated for long-term patient outcomes in a cluster randomized trial.

Keywords: Competence, Village health volunteers, Tuberculosis

Introduction

Tuberculosis (TB) remains a major global public health problem. The World Health Organization (WHO) reported approximately 10.80 million new TB cases and 1.25 million deaths in 2023.[1] Thailand is on the WHO lists of countries with a high TB burden and a high TB/HIV burden (2021–2025), with an estimated 107,000 new and relapse TB cases in 2023, or 149 per 100,000 population.[1] The Thai government has therefore established a national strategic plan to end TB by 2035, emphasizing primary health care system development and community participation, in line with Sustainable Development Goal (SDG) target 3.3.[2] Meanwhile, the 2021 National Tuberculosis Control Programme Guideline of Thailand emphasizes building the capacity of health personnel at all levels, including village health volunteers (VHVs), to have the knowledge and skills needed to care for TB patients correctly.[3]

Kalasin Province continues to face TB problems. In 2024, approximately 1,516 new TB cases were found, exceeding the provincial estimate. The treatment success rate was 82.90%, below the national target (88.00%); the loss-to-follow-up rate was 1.70%, and the death rate was 8.60%.[4] In Don Chan District, during fiscal years 2020–2024, 34–41 new patients were registered for treatment each year (184 in total); 12 patients missed appointments or interrupted treatment, and 24 died during treatment, with deaths decreasing from 6 in 2020 to 2 in 2024.[5] Although mortality has declined, deaths and treatment interruptions still occur almost every year, increasing the risk of drug-resistant TB. The TB clinic at Don Chan Hospital operates only once a week, and staff are limited because they also carry other responsibilities, so patients experiencing adverse drug reactions cannot notify staff promptly. In addition, VHVs caring for patients in the community still lack knowledge and confidence in TB care.

VHVs are a key mechanism of the primary health care system, acting as change agents for health behavior and as the front line in identifying at-risk groups and conducting disease surveillance in the community.[6] However, previous studies have found that VHVs and caregivers of TB patients have only moderate knowledge of TB prevention and control and lack the in-depth knowledge needed to apply it in real situations.[7] Caregivers' confidence has also been associated with treatment success among pulmonary TB patients.[8] VHV development should therefore cover knowledge, practical skills, attitudes, and communication,[9] together with treatment observation by non-family community members (non-family DOT), which improves treatment success.[10]

This study applied the supportive-educative nursing system of Orem[11] through the role of mentor nurses who teach, guide, support, and provide an environment that enables VHVs to care for TB patients independently, together with the self-efficacy concept of Bandura,[12] which is built through mastery experiences from real

practice, modeling, verbal persuasion, and reduction of anxiety. Most previous studies in Thailand have been surveys of VHVs' knowledge and behavior.[7] Few studies have developed VHVs' TB competence through a community participatory process that integrates mentoring and digital technology and is evaluated against a comparison group, and none has been conducted in the context of Don Chan District. Participatory action research is therefore appropriate, as it yields an approach suited to the local context and fosters ownership among practitioners.

In light of these problems, the researcher developed the competence of VHVs in caring for TB patients in the community in Don Chan District, Kalasin Province, through participatory action research with nurses, network partners, and the community. The aims were to strengthen VHVs' knowledge, skills, and confidence in treatment observation, monitoring of adverse drug reactions, contact screening, and psychosocial support for patients and families, and to evaluate the effects on VHVs' knowledge, skills, and competence levels compared with a control group. The study is expected to yield a VHV competence development approach that can be extended to other areas and serve as a basis for studying long-term clinical outcomes of patients.

Research Objectives

1) To study the situation, problems, and needs for developing the competence of village health volunteers (VHVs) in caring for TB patients in the community, Don Chan District, Kalasin Province
2) To develop a participatory approach for enhancing VHVs' competence in caring for TB patients in the community
3) To compare VHVs' knowledge, skills, and competence levels in caring for TB patients in the community before and after the intervention and between the experimental and control groups, and to assess co-researchers' satisfaction with the developed approach

Research Hypotheses

1) After the intervention, the experimental group has higher mean knowledge and skill scores in TB patient care than before the intervention.
2) After the intervention, the experimental group has higher mean knowledge and skill scores in TB patient care than the control group.
3) After the intervention, the proportion of VHVs with a high competence level is greater in the experimental group than in the control group.

Methods

This study was participatory action research (PAR) based on the concept of Kemmis and McTaggart,[13] comprising three cycles of planning, acting, observing, and reflecting,

conducted from October 2025 to August 2026: Cycle 1, situation analysis and planning (October–December 2025); Cycle 2, program development and implementation (January–May 2026), in which the program was evaluated using a non-randomized two-group pretest–posttest quasi-experimental design, with the 8-week program delivered during February–March 2026; and Cycle 3, refinement and evaluation (June–August 2026). The experimental group received the same version of the program throughout the intervention period, and refinements arising from reflection were applied after the posttest (researcher to confirm the timeline). Success indicators were predefined: at least 80% of co-researchers would understand how to use the approach, implement it in practice, and be satisfied at a high level or above.

Conceptual Framework and Research Variables

Conceptual framework. This study used a three-part framework: 1) the supportive-educative nursing system of Orem,[11] which defines the mentor nurse's role in teaching, guiding, supporting, and providing an environment that enables VHVs to care for TB patients independently; 2) the self-efficacy concept of Bandura,[12] which is built through mastery experiences from real practice, modeling, verbal persuasion, and reduction of anxiety; and 3) the participatory action research process of Kemmis and McTaggart,[13] to obtain an approach suited to the local context and foster ownership among practitioners.

Study variables. The independent variable was participation in the 8-week program for enhancing VHVs' competence in caring for TB patients in the community (experimental group), compared with routine practice (control group). The dependent variables were TB knowledge scores (maximum 20 points), community TB patient care skill scores (maximum 60 points), competence level determined from the combined knowledge and skill score (maximum 80 points), and co-researchers' satisfaction with the developed approach.

Population and Sample

Population. The population comprised two groups: 1) co-researchers, i.e., all 38 registered nurses and public health officers responsible for TB work at Don Chan Hospital, the Don Chan District Public Health Office, and all subdistrict health promoting hospitals (SHPHs), all of whom participated; and 2) approximately 980 VHVs working in Don Chan District in fiscal year 2026. Key informants for the qualitative study were VHVs, TB patients, family members, community leaders, and health personnel, purposively selected for their direct experience in providing or receiving TB care in the area.

Sample. The sample size was calculated using G*Power[14] for a two-tailed independent t-test with an effect size of 0.80, which is lower than that found in a similar VHV capacity development program study[15] and is classified as large by Cohen's criteria,[16] a significance level of .05, and a power of 0.80, yielding 26 per group. The sample was increased by 15% to allow for attrition (26 × 1.15 = 29.90), giving 30 per group, or 60 in total. Groups were allocated non-randomly by subdistrict, selecting subdistricts with similar numbers of registered TB patients, numbers of VHVs, and distances to the hospital:

Don Chan and Muang Na subdistricts formed the experimental group, and Sa-at Chai Si and Dong Phayung subdistricts formed the control group. VHVs were then purposively selected according to the inclusion criteria, 15 per subdistrict. To minimize contamination, the control group did not join the LINE group or receive the program manual, and mentor nurses did not work in the control subdistricts.

Inclusion criteria: 1) registered VHVs with at least 1 year of service; 2) aged 18–45 years, because the program used the LINE application and video calls as the main channels for patient follow-up, and the area planned to develop this group as a new generation of TB VHV leaders; 3) able to read, write, and communicate in Thai; 4) owning a smartphone and able to use the LINE application; 5) responsible for households with TB patients or at-risk persons; and 6) willing to participate in the study.

Exclusion criteria: 1) illness that would impede participation in activities; and 2) plans to relocate during the study period.

Discontinuation criteria: 1) request to withdraw from the study; and 2) illness or relocation during the study that prevented posttest measurement. Participants who attended less than 80% of the program still underwent posttest measurement and were analyzed according to their allocated group (intention-to-treat).

Research Instruments

Instruments. The instruments comprised 1) the intervention instrument, namely the 8-week program for enhancing VHVs' competence in caring for TB patients in the community, developed in Cycle 1, together with a community TB care manual for VHVs; and 2) data collection instruments, namely a general information questionnaire, a TB knowledge test, a community TB patient care skills assessment, a satisfaction questionnaire, focus group discussion guides, in-depth interview guides, and an observation record form, developed by the researcher based on the 2021 National Tuberculosis Control Programme Guideline of Thailand[3] and related literature.

The TB knowledge test had 20 items (1 point for a correct answer, 0 for an incorrect one), interpreted using the criteria of Bloom[17] as follows: ≥80% (16–20 points), high; 60–79% (12–15 points), moderate; and <60% (0–11 points), low. The community TB patient care skills assessment had 20 items rated on a 3-point scale (1–3 points), with total scores of 20–60, and was assessed by observing actual practice during home visits and simulations by two registered nurses who were not mentor nurses and were blinded to group allocation. Competence level was determined from the combined knowledge and skill score (80 points) using the 80% cut-off of Bloom,[17] with ≥64 points indicating high competence and <64 points indicating moderate-to-low competence. The satisfaction questionnaire used a 5-point rating scale, with mean scores interpreted using the criteria of Best[18] as follows: 4.51–5.00, very high; 3.51–4.50, high; 2.51–3.50, moderate; 1.51–2.50, low; and 1.00–1.50, very low.

Instrument quality testing. Content validity was examined by three experts (a physician specializing in TB, a community nursing instructor, and a public health officer specializing

in disease control), yielding IOC values of 0.67–1.00. The instruments were then piloted with 30 VHVs with characteristics similar to the sample in a neighboring district. The knowledge test had difficulty indices of 0.25–0.78, discrimination indices of 0.22–0.65, and a reliability (KR-20) of 0.82. The skills assessment had a Cronbach's alpha coefficient of 0.87 and an inter-rater reliability (intraclass correlation coefficient) of 0.86, and the satisfaction questionnaire had a Cronbach's alpha coefficient of 0.91.

Data Collection

The researcher and research assistants, who were registered nurses briefed on data collection procedures, collected data according to the research cycles. Qualitative data were collected through four focus groups (two groups of VHVs with 8 members each, one group of health personnel with 10 members, and one group of community leaders with 8 members), each lasting 60–90 minutes, and through in-depth interviews with 12 key informants (4 TB patients, 4 family members, 2 VHVs, and 2 health personnel). Data were collected until saturation, audio-recorded with permission, and transcribed verbatim. Quantitative data were collected from the experimental and control groups twice: before the intervention (week 1) and at the end of the intervention (week 8). The control group received routine practice, namely monthly VHV meetings at the SHPH and home visits within their usual roles, without TB-specific training or mentor nurses, and received the program after the study ended.

Data Analysis

Quantitative data were analyzed using SPSS version 13. General data were analyzed using descriptive statistics, namely frequency, percentage, mean, and standard deviation. General characteristics were compared between groups using the chi-square test (or Fisher's exact test when expected counts were less than 5) and the independent t-test. Normality was examined using the Shapiro-Wilk test before analysis; if data were not normally distributed, the Wilcoxon signed-rank test and the Mann-Whitney U test were used instead. Within-group mean scores before and after the intervention were compared using the paired t-test, and between-group comparisons used the independent t-test and ANCOVA with pretest scores as the covariate. Mean differences with 95% confidence intervals (95% CI) and effect sizes (Cohen's d) were reported.[16] Proportions of competence levels were compared using the chi-square test, with the difference in proportions and the odds ratio reported. Statistical significance was set at .05 (two-tailed). Qualitative data were analyzed by content analysis following the steps of Elo and Kyngäs,[19] namely reading for understanding, coding, categorizing, and developing main themes. Trustworthiness was established according to Lincoln and Guba[20] through data source and method triangulation and member checking.

Research Ethics

This study adhered to the ethical principles of research involving human subjects. The researcher explained the objectives, procedures, benefits, and risks of the research to

all participant groups, including TB patients and family members who served as informants. Participants signed informed consent forms before participating. All data were kept confidential and presented in aggregate without identifying individuals. For patient follow-up via the LINE group and video calls, codes were used instead of patient names, no images or identifying information were shared in the group, and group membership was limited to relevant persons to prevent stigma. VHVs received training and infection-prevention equipment (N95 masks) before home-visit practice, and participants could withdraw at any time without any effect on their work or the services they received.

Results

1. Situation, problems, and needs for developing VHVs' competence in caring for TB patients in the community

1.1 General characteristics of co-researchers and the sample. The 38 co-researchers comprised 24 registered nurses and 14 public health officers. Most VHVs in the experimental and control groups were female (83.33% and 80.00%), with mean ages of 39.47±4.82 and 40.13±4.56 years, respectively. General characteristics did not differ significantly between the two groups (p>.05 for all variables), as shown in Table 1. No VHVs withdrew or were lost to follow-up during the study; therefore, all 30 participants in each group were analyzed, and mean attendance in the experimental group was 100%.

Table 1 **General characteristics of VHVs by group (n = 30 per group)**

Characteristic	Experimental group	Control group	Test statistic	p-value
Female	25 (83.33)	24 (80.00)	χ^2=0.11[a]	.739
Age (years)	39.47±4.82	40.13±4.56	t=−0.55[b]	.588
Years as a VHV	8.23±4.15	8.60±4.37	t=−0.34[b]	.738
Upper secondary education	17 (56.67)	16 (53.33)	χ^2=0.07[a]	.795
Previous TB training	11 (36.67)	10 (33.33)	χ^2=0.07[a]	.787

Note: Data are presented as n (%) or mean±standard deviation; [a]Chi-square test (df = 1), [b]Independent t-test (df = 58)

1.2 Situation, problems, and needs. Analysis of the focus group and in-depth interview data in Cycle 1 yielded four main themes, as follows.

Theme 1: Insufficiently in-depth knowledge for treatment observation. VHVs knew that patients must take medication continuously but were not confident in observing adverse drug reactions such as jaundice, itchy rash, and nausea and vomiting. "I know they have to take the drugs every day, but if the patient says they're itchy or their eyes are yellow, I don't

know whether to stop the drugs or refer them right away." (VHV 03, focus group 1)

Theme 2: Lack of confidence in home visits and fear of infection. VHVs worried about becoming infected and bringing the infection home to their families, so they avoided entering patients' homes. "When I visit, I just stand and talk in front of the house. I'm afraid of catching it and passing it to my grandchildren." (VHV 11, focus group 2)

Theme 3: Social stigma. Some patients and families concealed the illness for fear of rejection by the community. "I don't want anyone to know I have TB. I'm afraid the neighbors won't associate with me." (Patient 02, in-depth interview)

Theme 4: Discontinuous information referral. Communication among VHVs, SHPHs, and the hospital was not yet systematic because the TB clinic operated only once a week. "If a patient has symptoms on Saturday, they have to wait until clinic day. They don't know who to call." (Staff 01, in-depth interview)

Development needs included practice-focused training, mentor nurses, a rapid consultation channel via the LINE application, and an easy-to-understand manual. The mean pre-development knowledge score of all 60 VHVs was 11.52 points, or 57.58% of the maximum score, which was at a low level.

2. Participatory approach for enhancing VHVs' competence in caring for TB patients in the community

2.1 Components of the approach and the competence-enhancement program. Co-researchers jointly designed the approach in three workshops using the Appreciation-Influence-Control (AIC) participatory meeting technique, yielding an approach with four components: 1) workshops using participatory learning; 2) field practice supervised by mentor nurses; 3) establishment of a community of practice using digital technology for learning and patient follow-up; and 4) supervision, follow-up, and reflection with network partners. These were organized into an 8-week competence-enhancement program delivered by the researcher and mentor nurses at a ratio of one mentor nurse to five VHVs, as shown in Table 2.

Table 2 **Program for enhancing VHVs' competence in caring for TB patients in the community, Don Chan District, Kalasin Province**

Week	Activities/content	Tools	Duration	Academic rationale
1	Orientation, relationship building, pretest, and participatory lecture on basic TB knowledge: causes, symptoms, transmission, and treatment	Knowledge test, presentation media, VHV manual	180 minutes	Participatory learning and the 2021 National TB Control Programme Guideline of Thailand[3]
2	Mentored directly observed treatment (DOT), monitoring of adverse drug reactions, and referral	Mock drugs, DOT record form, demonstration and return demonstration	180 minutes	DOTS concept and the supportive-educative nursing system of Orem[11]

3	Household contact screening, infection prevention, cough etiquette, and mask use	Screening form, simulations	180 minutes	Simulation-based learning to enhance practical skills
4–5	Mentored home-visit practice with TB patients	Home visit form, skills assessment form	2 sessions, 120 minutes each	Learning through mastery experience based on the self-efficacy concept[12]
6	Communication skills, stigma reduction, encouragement, and patient follow-up via video-observed therapy (VOT) and the LINE group	LINE application, role play	120 minutes	Health literacy[21] and social support
7–8	Community of practice (CoP): knowledge sharing, reflection, lessons learned, and posttest	Sharing forum, tests and assessment forms	180 minutes	Participatory action research cycle[13]

2.2 Reflection results and refinement of the approach. Among the 38 co-researchers, 89.47% (34) understood how to use the approach, 84.21% (32) implemented it in practice, and 92.11% (35) were satisfied at a high to very high level, with a mean satisfaction score of 4.52±0.48 (very high), meeting all predefined success indicators. Post-intervention reflection led to refinements in Cycle 3, namely adding short video clips on treatment observation, creating an adverse drug reaction reporting form via the LINE group, and pairing experienced VHVs with new VHVs (buddy system). In addition, all 14 new TB patients in the experimental area during the study received treatment observation by VHVs, and no treatment interruption was found; these are descriptive data not compared with the control area.

3. Effects of the approach for developing VHVs' competence in caring for TB patients in the community

3.1 Within-group comparisons before and after the intervention. The Shapiro-Wilk test showed that knowledge and skill scores before and after the intervention in both groups were normally distributed ($W = 0.94–0.98$, $p > .05$). In the experimental group, the mean knowledge score increased from 11.43±2.65 to 17.20±1.73 (mean difference 5.77, 95% CI 4.86–6.68; $t(29)=13.02$, $p<.001$), and the mean skill score increased from 38.27±6.42 to 52.83±4.15 (mean difference 14.56, 95% CI 12.37–16.75; $t(29)=13.59$, $p<.001$), whereas the control group's mean scores in both domains did not differ from before the intervention ($p=.275$ and $p=.319$), as shown in Table 3.

Table 3 **Comparison of VHVs' mean knowledge and skill scores in TB patient care before and after the intervention, by group** (Paired t-test, df = 29)

Variable	Group	Before		After		Mean difference (95% CI)	t	p-value
		$\bar{x}$	S.D.	$\bar{x}$	S.D.			
Knowledge (max 20)	Experimental	11.43	2.65	17.20	1.73	5.77 (4.86, 6.68)	13.02	<.001*
	Control	11.60	2.51	12.13	2.47	0.53 (−0.45, 1.51)	1.11	.275
Skills (max 60)	Experimental	38.27	6.42	52.83	4.15	14.56 (12.37, 16.75)	13.59	<.001*
	Control	38.90	6.18	40.07	5.86	1.17 (−1.20, 3.54)	1.01	.319

Note: *p<.05

3.2 Comparisons between the experimental and control groups. Before the intervention, mean knowledge and skill scores did not differ between the two groups (p=.800 and p=.700). After the intervention, the experimental group's mean knowledge score was 5.07 points higher than that of the control group (95% CI 3.97–6.17; t(58)=9.21, p<.001, d=2.38), and its mean skill score was 12.76 points higher (95% CI 10.14–15.38; t(58)=9.73, p<.001, d=2.51). After controlling for pretest scores using ANCOVA, the differences remained statistically significant (knowledge: adjusted mean difference 5.13 points, F(1,57)=108.99, p<.001, partial η^2=0.66; skills: adjusted mean difference 12.99 points, F(1,57)=123.08, p<.001, partial η^2=0.68), as shown in Table 4.

Table 4 Comparison of VHVs' mean knowledge and skill scores in TB patient care between the experimental and control groups (Independent t-test, df = 58)

Variable	Experimental group		Control group		Mean difference (95% CI)	t	p-value
	$\bar{x}$	S.D.	$\bar{x}$	S.D.			
Knowledge, before (max 20)	11.43	2.65	11.60	2.51	−0.17 (−1.50, 1.16)	−0.26	.800
Knowledge, after (max 20)	17.20	1.73	12.13	2.47	5.07 (3.97, 6.17)	9.21	<.001*
Skills, before (max 60)	38.27	6.42	38.90	6.18	−0.63 (−3.89, 2.63)	−0.39	.700
Skills, after (max 60)	52.83	4.15	40.07	5.86	12.76 (10.14, 15.38)	9.73	<.001*

Note: *p<.05

3.3 VHVs' competence levels after the intervention. In the experimental group, 80.00% (24) of VHVs had a high competence level, compared with 36.67% (11) in the control group, a statistically significant difference (χ^2=11.59, df=1, p<.001), corresponding to a difference in proportions of 43.33% (95% CI 20.92–65.74) and an odds ratio of 6.91 (95% CI 2.16–22.10), as shown in Table 5.

Table 5 Comparison of VHVs' competence levels after the intervention between the experimental and control groups (Chi-square test)

Competence level	Experimental group, n (%)	Control group, n (%)	χ^2 (df = 1)	p-value
High (≥64 points)	24 (80.00)	11 (36.67)	11.59	<.001*
Moderate–low (<64 points)	6 (20.00)	19 (63.33)		

Note: *p<.05

3.4 Summary of hypothesis testing. With respect to the stated hypotheses, the results supported all three: after the intervention, the experimental group had higher mean knowledge and skill scores than before the intervention and than the control group, and a greater proportion of VHVs with a high competence level than the control group, as shown in Table 6.

Table 6 Summary of hypothesis testing

Hypothesis	Test statistic	Analysis result	Conclusion
H1: The experimental group's mean knowledge and skill scores after the intervention are higher than before the intervention	Paired t-test	Knowledge increased by 5.77 points (t(29)=13.02, p<.001); skills increased by 14.56 points (t(29)=13.59, p<.001)	Supported
H2: The experimental group's mean knowledge and skill scores after the intervention are higher than those of the control group	Independent t-test and ANCOVA	Knowledge 5.07 points higher (t(58)=9.21, p<.001; adjusted mean difference 5.13 points); skills 12.76 points higher (t(58)=9.73, p<.001; adjusted mean difference 12.99 points)	Supported
H3: The proportion of VHVs with a high competence level is greater in the experimental group than in the control group	Chi-square test	80.00% vs. 36.67% (χ^2=11.59, df=1, p<.001; OR=6.91, 95% CI 2.16–22.10)	Supported

Note: Statistical significance was set at .05 (two-tailed).

Discussion

The situation analysis found that VHVs still lacked in-depth knowledge and confidence in caring for TB patients, with a pre-development knowledge score of 57.58% of the maximum, consistent with a study finding that VHVs and caregivers of TB patients had only moderate knowledge of TB prevention and control.[7] This may be because most VHVs (65.00%) had never received TB-specific training, VHV work covers many disease groups, and the TB clinic operates only once a week, leaving VHVs without a consultation channel when problems arise. The

qualitative findings on fear of infection and social stigma also indicate that competence development must address both knowledge and confidence, not knowledge alone. Situation analysis with stakeholders therefore yielded context-specific information, an important foundation for program design.[15]

The developed approach comprised workshops, mentored field practice, a community of practice, and supervision, consistent with the proposal that VHV development should cover knowledge, practical skills, attitudes, and communication.[9] Mentored field practice builds mastery experience, the most important source of self-efficacy,[12] and directly addresses the lack of confidence in home visits identified in Cycle 1. Meanwhile, the LINE group and video calls helped overcome the limitation of a once-weekly clinic and supported treatment observation by non-family community members, which improves treatment success.[10] In addition, participation in every cycle fostered ownership among co-researchers, resulting in satisfaction and actual implementation of the approach.[13] However, the absence of treatment interruption among the 14 new patients is only a descriptive observation in the experimental area and does not permit conclusions about treatment outcomes.

After the intervention, the experimental group had higher mean knowledge and skill scores than before the intervention and than the control group, with very large effect sizes (Cohen's d = 2.38 and 2.51), and the results remained significant after controlling for pretest scores. This can be explained by the program's use of diverse, practice-focused learning methods based on the supportive-educative nursing system[11] together with health literacy enhancement,[21] consistent with a study finding that a VHV capacity development program significantly increased knowledge and practice in patient care.[15] However, effect sizes several times larger than the value used for the sample size calculation may have been influenced by measurement immediately after the program, use of the same test before and after the intervention (testing effect), and the special attention received by the experimental group (Hawthorne effect); the results should therefore be interpreted with caution.

Limitations

This study has several limitations: 1) the experimental and control groups were allocated non-randomly by subdistrict, and the intraclass correlation was not incorporated into the sample size calculation or analysis;[22] 2) all four subdistricts are in the same district and use the same TB clinic, so contamination may have occurred; 3) the 18–45 age criterion excluded older VHVs, limiting generalizability to all VHVs; 4) the follow-up period was short (8 weeks), and patients' clinical outcomes were not compared between areas; and 5) the researcher served as both developer and implementer of the program, so caution is needed when generalizing the results to areas with different contexts.

Conclusion

Developing VHVs' competence in caring for TB patients in the community in Don Chan District, Kalasin Province, through participatory action research yielded a four-component competence-enhancement approach consistent

with local problems and needs. After the intervention, VHVs in the experimental group showed significant increases in knowledge, skills, and the proportion with high competence compared with before the intervention and with the control group, and co-researchers were very highly satisfied. The approach is likely applicable in similar contexts, but long-term clinical outcomes still need to be evaluated.

Recommendations

1. Recommendations for applying the findings: Don Chan Hospital and the Don Chan District Public Health Office should adopt this approach as the guideline for VHV development and extend it to all SHPHs, with annual refresher training, support for mentor nurses and a LINE consultation channel with patient data protection measures, and coordination with local administrative organizations for budget support.

2. Recommendations for future research: A cluster randomized controlled trial with randomization at the subdistrict level should be conducted, using blinded assessors, extending the age criterion to cover VHVs of all ages, following up for at least 6–12 months, and evaluating patients' clinical outcomes, including treatment success, loss-to-follow-up, and mortality rates, as well as the cost-effectiveness of the approach.

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ORIGINAL ARTICLE

Improving the Efficiency of the Patient Triage System Based on the Emergency Severity Index in the Outpatient and Emergency Departments, Samdet Hospital, Kalasin Province

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Abstract

This research and development study, combined with a one-group pretest-posttest quasi-experimental design, aimed to analyze the situation, develop, and evaluate a patient triage system based on the Emergency Severity Index (ESI) in the outpatient department and emergency room of Samdet Hospital, Kalasin Province, from January 2024 to September 2025. The participants comprised 24 triage personnel and 800 triage records (400 before and 400 after the development). The research instruments were the ESI-based triage system, a knowledge test, a triage competency assessment, a triage accuracy audit form, and a satisfaction questionnaire. Data were analyzed using descriptive statistics, paired t-test, Welch's t-test (Mann-Whitney U test for non-normal data), and chi-square test by outcome with GEE logistic regression adjusted for triage personnel, Holm-adjusted p values, and mean differences with 95% CI. Before the development, triage errors, both under-triage and over-triage, occurred in both departments and were attributed to the service system, personnel, and tools. After the development, the mean knowledge score increased from 11.41 ± 2.32 to 17.38 ± 1.71 and the mean triage competency score increased from 10.88 ± 2.56 to 16.55 ± 1.96 ($p < .001$). Triage accuracy increased from 82.00% to 93.00% (difference 11.00 percentage points, 95% CI 6.47-15.58) and under-triage decreased from 13.00% to 4.50% (difference 8.50 percentage points, 95% CI 4.64-12.50), whereas over-triage did not differ significantly (5.00% to 2.50%, $p = .063$). The mean waiting time to see a physician decreased from 41.37 to 27.45 minutes (difference 13.92 minutes, 95% CI 11.93-15.91; $d = 0.97$). Triage accuracy was higher, under-triage lower, and waiting time shorter after implementation of the developed system; however, with a one-group pretest-posttest design and no comparison group, causal effects and effects on patient safety cannot be concluded.

Keywords: triage, Emergency Severity Index, emergency service hospital, patient safety

Introduction

The outpatient and emergency departments are the front line of a hospital. The triage unit plays a vital role in assessing symptoms, classifying patients, prioritizing urgency, and referring patients correctly to the appropriate departments, and it is the starting point of safe, high-quality care.[1] The Emergency Medical Committee issued the Criteria for Emergency Triage Assessment and Emergency Operation Standards B.E. 2554 (2011), recommending five-level emergency triage[2] using the Emergency Severity Index (ESI), a United States standard that focuses on identifying critically ill patients and those at risk who require urgent care. This system used ESI version 4 because it is the version disseminated by the National Institute for Emergency Medicine and used for training in Thailand. The Emergency Nurses Association published ESI version 5 in 2023 with clarified algorithm wording;[3] version 5 should therefore be adopted in the next development cycle. The ESI also emphasizes smooth workflow to reduce emergency department crowding.[4,5] A standardized triage system gives nurses a common approach, speeds patient flow, reduces treatment delays for truly emergent patients, prevents avoidable deaths, reduces triage errors, and limits unnecessary resource use.[1,5] Nationally, the 1669 hotline received 8,180,908 calls in 2023, ranging from critically ill patients to general illnesses.[6]

Emergency departments of hospitals in Kalasin Province are front-line services operating 24 hours a day and require specialists to care for large numbers of patients.[7] Samdet Hospital serves an average of 400-700 outpatients per day. It introduced triage in 2015 and adopted five-level patient classification in 2016. In 2023, 1,378 patients attended the emergency room (patients served in the emergency room throughout 2023, separate from the 400-700 general outpatients per day; of these, 513 (37.23%) were ESI levels 1-3 and 865 (62.77%) were levels 4-5), classified by ESI as resuscitation (level 1), 16; emergent (level 2), 135; and urgent (level 3), 362 patients.[8] A review of risk reports revealed deterioration while waiting for examination, long triage times, high triage error rates, and frequent complaints from patients not treated according to urgency, because the triage guideline consisted only of broad criteria.[8]

Triage errors are of two types. Under-triage (in this study, an ESI level assigned by the triage personnel that is less urgent than the expert-assigned level by one level or more; over-triage means more urgent by one level or more, defined against the expert-assigned ESI level, with results reported separately for ESI levels 1-2, which have the highest clinical importance) delays diagnosis and treatment and may lead to deterioration, disability, or death, whereas over-triage deprives other critically ill patients of timely care, wastes resources, and causes emergency room overcrowding.[9] The ESI has high validity and reliability and is easy and quick to use;[10,11] however, triage results depend on the knowledge, skills, and training of the triage personnel,[9] and triage error rates vary widely among facilities.[12] In Thailand, the ESI is applicable in hospitals ranging from community to regional hospitals,[5] and effective triage is one of the patient safety goals of the 2P Safety policy.[13] Nevertheless, research developing a triage system that simultaneously addresses staffing structure, triage personnel, tools, and indicators in both the outpatient department and

the emergency room of small hospitals remains limited. Thai studies that developed ESI-based triage systems include a triage model for the emergency room of Khaowong Hospital, Kalasin Province, which reported 96.80% triage accuracy after development,[14] and a triage system for the accident and emergency departments of community hospitals in Phra Nakhon Si Ayutthaya Province;[15] however, these studies focused mainly on the emergency room and did not include the outpatient department.

In this context, the researcher improved the efficiency of the patient triage system of Samdet Hospital based on the ESI with the participation of a multidisciplinary team and evaluated outcomes in terms of triage accuracy, patient safety, and satisfaction. The findings are expected to provide the hospital with a unified triage model for both the outpatient department and the emergency room and to serve as a guide for hospitals in similar settings.

Conceptual framework and research hypotheses The study used Donabedian's structure-process-outcome framework.[16] Hypotheses: H1, the proportion of correct triage after the development is higher than before; H2, the proportion of under-triage after the development is lower than before; and H3, knowledge and competency scores after the development are higher than before, as shown in Figure 1.

Structure	Policy and multidisciplinary working group Staffing and qualifications of triage personnel (no triage by porters) Triage tools and equipment
Process	ESI version 4 triage manual and flowchart Workshop training and simulation-based practice Supervision, monitoring, and feedback
Outcome	Triage accuracy (primary outcome), under-triage, and over-triage Knowledge and competency of triage personnel Waiting time to see a physician and satisfaction

Figure 1 Conceptual framework

Objectives

1) To analyze the situation and causes of problems in the patient triage system of the outpatient department and emergency room of Samdet Hospital
2) To develop an ESI-based patient triage system appropriate to the context of Samdet Hospital
3) To evaluate the effectiveness of the developed system in terms of triage accuracy, knowledge, competency, triage time, and waiting time to see a physician by comparing before and after the development, and to assess staff and patient satisfaction after the development

Methods

This research and development study used a one-group pretest-posttest quasi-experimental design and was conducted in the outpatient department and emergency room of Samdet Hospital, Kalasin Province, from January

2024 to September 2025 (21 months) in four phases: Phase 1, situation analysis (January-March 2024); Phase 2, system design and development (April-June 2024); Phase 3, implementation (July 2024-March 2025); and Phase 4, evaluation and improvement (April-September 2025). Pre-development triage records were collected for April-September 2023 (retrospective data) and post-development records for April-September 2025 to control for seasonality and avoid overlap with the development period, as detailed in Figure 2.

Phase 1: Situation analysis (Jan-Mar 2024)	Review of risk reports, observation of practice, focus groups Data on the situation and causes of problems
Phase 2: System design and development (Apr-Jun 2024)	Working group, draft manual and flowchart, IOC review, 2-week pilot Content validity (IOC) assessed
Phase 3: Implementation (Jul 2024-Mar 2025)	Workshop training, full implementation, monthly supervision and monitoring Pre-training knowledge and competency assessment (Jul 2024)
Phase 4: Evaluation and improvement (Apr-Sep 2025)	Evaluation, lessons learned, improvement, and scale-up Repeat knowledge and competency assessment (Apr 2025); audit of post-development records (Apr-Sep 2025); satisfaction survey (Sep 2025)

Figure 2 The four research phases (pre-development records were retrospective data from April-September **2023)**

Population and sample

Population The population comprised 1) triage personnel of the outpatient department and emergency room of Samdet Hospital, including registered nurses, emergency medical technicians, and porters, totaling 24 persons (before the development, porters performed triage together with other staff; after the development, porters no longer performed triage but were still trained and assessed so that all participants could be compared before and after within the same group, with additional analyses by profession: registered nurses, emergency medical technicians, and porters); and 2) triage records of patients served before the development (April-September 2023, retrospective data) and after the development (April-September 2025), approximately 80,000 records per period, including approximately 79,300 from the outpatient department and 700 from the emergency room, or approximately 13,300 records per month.

Sample 1) Triage personnel: the entire population (census) of 24 persons (12 in the outpatient department and 12 in the emergency room). 2) Triage records: the sample size was calculated with G*Power for the chi-square test (df = 2) with a significance level of .05, power of 0.85, and effect size (w) of 0.12, yielding at least 759 records (w = 0.12 is a small effect by Cohen's criteria, consistent with a clinically important low-to-moderate difference in triage accuracy; N = 800 gives power = .87, and after adjusting for a design effect = 1 + (m-1)ICC with m = 16.7 records per triage person per period and ICC = 0.02

(estimated), the design effect was 1.31, the effective sample size ≈ 609 records, and power ≈ .76, which remained adequate for the effect size observed in this study (w = 0.17, power > .95)). Therefore, 800 records were used, 400 in each of the pre- and post-development periods, selected by stratified random sampling by month and department with equal allocation, 200 records per department per period (approximately 33-34 records per department per month), because the emergency room had few patients. Sampling was performed in R with seed = 2567.

Inclusion criteria Personnel: performing triage duties for at least 6 months and consenting to participate. Triage records: patients who received services through the triage point of the outpatient department or emergency room with complete records.

Exclusion criteria Personnel: continuous leave of more than 1 month, transfer, or withdrawal. Triage records: patients referred from other facilities directly to the emergency room, patients dead on arrival, and records for which the experts could not assign a standard ESI level (excluded because of incomplete records: 23 before and 14 after the development, replaced by additional random sampling to reach 400 records per period). Pediatric patients under 15 years were included in the main analysis and analyzed separately as an additional analysis.

Research instruments

The research instruments comprised 1) the development instrument, namely the ESI-based patient triage system, consisting of a triage manual and flowchart, a triage record form, role assignments, a staffing plan, and a supervision and monitoring system; and 2) data collection instruments: (1) a 20-item ESI knowledge test; (2) a triage competency assessment based on 20 simulated scenarios; (3) a triage accuracy audit form comparing assigned levels with the ESI levels determined by two experts (an emergency physician and a senior professional registered nurse in emergency nursing trained in ESI, each with at least 10 years of triage experience; the raters were blinded to the pre/post period by shuffling records and masking dates, and disagreements were adjudicated by a third expert, an emergency physician); (4) a triage time and physician waiting time record form; and (5) staff and patient satisfaction questionnaires (5-point rating scale). Content validity was examined by five experts, yielding an index of item-objective congruence (IOC) of 0.80-1.00 and a scale-level content validity index (S-CVI/Ave) of 0.95; items with IOC below 0.80 were revised before use. The reliability of the knowledge test (KR-20) was 0.82, and that of the competency assessment and satisfaction questionnaire (Cronbach's alpha) was 0.86 and 0.89, respectively. Inter-rater agreement (quadratic weighted kappa) between the two experts on 100 records was 0.85 (95% CI 0.78-0.92). KR-20 and Cronbach's alpha were tested with 30 triage personnel at a nearby community hospital who were not study participants.

Data collection

The researcher and two research assistants collected the data (the researcher was the head of the outpatient department and a supervisor and thus had a dual role toward the assessed staff; to reduce bias, the researcher did not assess accuracy or competency, assessors who were not supervisors were used, and staff completed questionnaires anonymously) as follows: 1) in Phase 1, reviewing risk reports and information system data, observing practice, and conducting

focus groups with the multidisciplinary team, patients, and relatives; 2) assessing knowledge and competency before the workshop (July 2024) and after 9 months of implementation (April 2025); 3) auditing triage accuracy and recording times from the sampled records before the development (April-September 2023, retrospective data) and after the development (April-September 2025); and 4) surveying staff and patient satisfaction in September 2025 (100 patients selected by consecutive sampling; inclusion criteria were age 18 years or older, receiving services through the triage point, ability to communicate, and consent to participate; exclusion criteria were critical illness (ESI level 1) or inability to complete the questionnaire; consent was obtained before the anonymous questionnaire).

Data analysis

Descriptive statistics, including frequency, percentage, mean, and standard deviation, were used. Assumptions were checked with the Shapiro-Wilk test and Levene's test. Pre-post knowledge and competency scores were compared using the paired t-test, reporting mean differences with 95% CI and Hedges' g (Wilcoxon signed-rank test as a sensitivity analysis). Pre-post triage time and waiting time to see a physician were compared using Welch's t-test (Mann-Whitney U test for non-normal data). Pre-post proportions of correct triage, under-triage, and over-triage were compared using the chi-square test for each indicator, together with GEE logistic regression adjusted for triage personnel, department, and month, reporting ORs with 95% CI and Holm-adjusted p values. The primary outcome was the proportion of correct triage, with two-sided tests at $\alpha = .05$. The comparison between departments (Table 5) was not a primary objective and served as baseline information for both departments. ESI level 1-2 patients were analyzed separately with Fisher's exact test as an additional analysis. Success indicators pre-specified by the working group in Phase 2 were at least 80% of staff passing the knowledge criterion, triage accuracy of at least 70%, and satisfaction of at least 80% (mean score of at least 4.00 out of 5).

Research ethics

This study adhered to the ethical principles of human research. Before data collection, the researcher explained the objectives and procedures to the participants, who voluntarily signed informed consent. Patient names in the triage records were replaced with codes, data were kept confidential, results were presented in aggregate, and participants could withdraw at any time without any effect on their work. The ethics committee waived consent for the retrospective triage records because de-identified data were used. Patients participating in focus groups and the satisfaction survey received an explanation and gave consent before participating. To avoid pressure from the researcher as a supervisor, staff completed questionnaires anonymously without the researcher present.

Results

1. Situation analysis and causes of problems

1.1 General characteristics of the sample The 24 triage personnel comprised 14

registered nurses (58.33%), 6 emergency medical technicians (25.00%), and 4 porters (16.67%); 12 worked in the outpatient department and 12 in the emergency room. Eighteen (75.00%) were female, the mean age was 38.25 ± 7.42 years, the mean work experience was 11.50 ± 6.31 years, and 7 (29.17%) had previously received ESI triage training, as shown in Table 1.

Table 1 General characteristics of triage personnel (n = 24) by department and profession

Characteristic	Total (n = 24)	Outpatient (n = 12)	Emergency (n = 12)	Registered nurse (n = 14)	EMT (n = 6)	Porter (n = 4)
Female, n (%)	18 (75.00)	10 (83.33)	8 (66.67)	13 (92.86)	3 (50.00)	2 (50.00)
Age (years), $\bar{x}$ ± S.D.	38.25 ± 7.42	39.58 ± 7.10	36.92 ± 7.78	40.07 ± 7.05	35.17 ± 6.62	36.50 ± 8.21
Age (years), range (min-max)	26-54	27-54	26-52	28-54	26-45	27-48
Experience (years), $\bar{x}$ ± S.D.	11.50 ± 6.31	12.33 ± 6.52	10.67 ± 6.12	13.00 ± 6.40	9.50 ± 5.20	9.25 ± 6.80
Experience (years), range (min-max)	2-27	3-27	2-24	3-27	2-18	2-20
Previous ESI training, n (%)	7 (29.17)	4 (33.33)	3 (25.00)	5 (35.71)	1 (16.67)	1 (25.00)

1.2 Triage situation before the development According to Samdet Hospital information system data for 2021-2023[8] (Table 2), the proportions of over-triage were 3.13%, 3.49%, and 3.91% (p for trend = .695), and the proportions of mis-triaged urgent patients were 11.25%, 10.99%, and 12.77% (p for trend = .649), with no significant change. Under-triage in the emergency room and the outpatient department remained at 12.87-17.36% and 15.76-18.62%, respectively (no trend: p for trend = .268 and .637, respectively; Cochran-Armitage test), and some patients deteriorated in front of the outpatient examination rooms and had to be sent for urgent care in the emergency room.

Table 2 Number and percentage of triage errors, Samdet Hospital, 2021-2023

Indicator	2021	2022	2023
Under-triage, emergency room	25/144 (17.36)	20/153 (13.07)	22/171 (12.87)
Under-triage, outpatient department	23/130 (17.69)	27/145 (18.62)	26/165 (15.76)
Over-triage	5/160 (3.13)	6/172 (3.49)	7/179 (3.91)
Mis-triaged urgent patients (Urgency)	18/160 (11.25)	20/182 (10.99)	24/188 (12.77)

Note: Data are presented as number/patients triaged (%). Source: Samdet Hospital information system[8]

1.3 Analysis of the causes of problems Causes were found in three areas. 1) Service system: during 07.00-16.00, triage errors occurred in which patients of urgency level or higher were sent to wait for examination at the outpatient department, 520 of 850 patients (61.18%) (the denominator of 850 refers to patients of ESI level 3 or higher sent to wait at the wrong point in the

outpatient department during the situation analysis, January-March 2024, counted from shift incident reports; this is a process indicator, unlike Table 2, which counts annual ESI-level errors (18-24 cases per year); the night shift (00.00-08.00) was not included in the reports because night-shift patients are served directly in the emergency room), followed by the evening shift (16.00-24.00), 330 patients (38.82%). Analysis of under-triage in the emergency room showed that the most frequent error was emergent patients triaged as urgent, 19 of 35 patients (54.29%; 95% CI 38.2-69.5) (the denominator of 35 refers to patients under-triaged in the emergency room in a 2-year retrospective review of incident reports (January 2022-December 2023) after excluding 7 cases with incomplete data from 42 cases (20 + 22 cases in Table 2); the remaining 4 cases (11.43%) were under-triage at other ESI levels), followed by resuscitation patients, 12 of 35 patients (34.29%). During 07.00-08.00 and 12.00-13.00, no nurse or emergency medical technician was available, so porters performed triage instead. During 08.00-09.00, when patient volume was high, only one triage person was on duty, resulting in long waits and delayed triage. Triage staff also had to take histories and enter additional data, and supervision and monitoring were not continuous. 2) Personnel: staff had unequal triage knowledge, skills, and experience, and specific qualifications and roles had not been clearly defined. 3) Tools: triage criteria were unclear, data collection was unsystematic and discontinuous, no indicators were defined, no one was responsible for data collection, no feedback was given to staff, and triage equipment was insufficient.

2. Development of the patient triage system

2.1 The developed patient triage system

The multidisciplinary working group jointly developed a system with six components: 1) a policy and working group for developing the triage system of the outpatient and emergency departments; 2) ESI version 4 triage criteria in an easy-to-understand manual and flowchart used as a common guideline in both departments; 3) triage personnel and staffing, designating registered nurses or emergency medical technicians as triage personnel instead of porters and adding triage staff during peak hours (2 persons during 07.00-09.00); 4) capacity building of personnel in symptom assessment and triage; 5) provision of adequate triage tools and equipment; and 6) continuous supervision, monitoring of indicators, and feedback to staff. The implementation steps are shown in Table 3.

Table 3 Steps in developing and implementing the ESI-based patient triage system

Phase/month	Activities/content	Academic rationale
Phase 1 (Jan-Mar 2024)	Situation analysis; review of risk reports and information system data; observation of triage practice; focus groups with the multidisciplinary team, patients, and relatives	Systematic analysis of problems in three areas (service system, personnel, and tools) before designing solutions
Phase 2 (Apr-Jun 2024)	Working group established; roles defined; ESI triage manual, flowchart, and record form designed and drafted; expert review; pilot testing	Participation of the multidisciplinary team and use of the ESI, which is easy to use and applicable in hospitals of various levels[5]

Phase/month	Activities/content	Academic rationale
Phase 3.1 (Jul 2024)	Workshop to introduce the system, demonstration, and simulation-based triage practice, with pre-training knowledge and competency assessment	Triage personnel need preparation in knowledge and skills training and should not rely on experience alone[9]
Phase 3.2 (Aug 2024-Mar 2025)	Full implementation in both the outpatient department and the emergency room; adequate triage staffing; monthly supervision and monitoring; incident review; and feedback	Continuous monitoring of indicators and feedback allow timely improvement of practice
Phase 4 (Apr-Sep 2025)	Evaluation of knowledge, competency, triage accuracy, time, and satisfaction; lessons learned; improvement; and guidelines for scale-up	Comparison of results with success indicators to decide on continuation and scale-up

2.2 Appropriateness and feasibility of the system Five experts evaluated the congruence of the triage manual, flowchart, and record form, yielding IOC values of 0.80-1.00 (pilot tested with 8 triage personnel and 120 patients, measuring mean triage time, triage accuracy, and feasibility). The system was then piloted for 2 weeks and improved in three respects: simplifying the flowchart to shorten triage time, adding examples of presenting symptoms by disease group, and revising the record form for faster completion. The pilot showed a mean triage time of 3.40 minutes (compared with 4.82 minutes before the development), triage accuracy of 90.00% (108/120 records), and a mean feasibility score of 4.31 out of 5, supporting the appropriateness and feasibility of the system for actual use.

3. Effectiveness of the developed system

3.1 Comparison of knowledge and triage competency scores before and after the development Staff in both the outpatient department and the emergency room had significantly higher ESI knowledge and triage competency scores after the development than before ($p < .001$). Overall, among all 24 staff, the knowledge score increased from 11.41 ± 2.32 to 17.38 ± 1.71 points and the competency score from 10.88 ± 2.56 to 16.55 ± 1.96 points (difference in knowledge 5.96 points, 95% CI 4.95-6.97, and in competency 5.67 points, 95% CI 4.53-6.81; Hedges' g by department 1.90-2.36), as shown in Table 4.

Table 4 Comparison of mean knowledge and triage competency scores before and after the development by department (paired t-test)

Variable	Department	Before $\bar{x}$	Before S.D.	After $\bar{x}$	After S.D.	t	p-value
ESI knowledge (full score 20)	Outpatient	11.58	2.43	17.25	1.81	8.50	< .001*
ESI knowledge (full score 20)	Emergency	11.25	2.30	17.50	1.68	8.77	< .001*
Triage competency (full score 20)	Outpatient	10.75	2.70	16.42	2.07	7.07	< .001*

Variable	Department	Before $\bar{x}$	Before S.D.	After $\bar{x}$	After S.D.	t	p-value
Triage competency (full score 20)	Emergency	11.00	2.52	16.67	1.92	7.41	< .001*
ESI knowledge (full score 20)	Total (n = 24)	11.41	2.32	17.38	1.71	12.21	< .001*
Triage competency (full score 20)	Total (n = 24)	10.88	2.56	16.55	1.96	10.29	< .001*

Note: *Statistically significant at $p < .05$

3.2 Comparison of scores between the outpatient department and the emergency room Before and after the development, knowledge and triage competency scores did not differ significantly between the two departments ($p > .05$). However, because each department had n = 12, only large differences could be detected ($d \geq 1.2$ at power .80), so the scores of the two departments cannot be considered equal. The mean differences (outpatient - emergency) with 95% CI were 0.33 (-1.67 to 2.33) for pre-development knowledge, -0.25 (-1.73 to 1.23) for post-development knowledge, -0.25 (-2.46 to 1.96) for pre-development competency, and -0.25 (-1.94 to 1.44) for post-development competency; these confidence intervals were wide and did not exclude clinically important differences. Table 5 therefore serves only as a preliminary baseline comparison of the two departments.

Table 5 Comparison of mean knowledge and triage competency scores between the outpatient department and the emergency room (independent t-test)

Variable	Outpatient (n = 12) $\bar{x}$	Outpatient (n = 12) S.D.	Emergency (n = 12) $\bar{x}$	Emergency (n = 12) S.D.	t	p-value
Knowledge, before (full score 20)	11.58	2.43	11.25	2.30	0.34	0.736
Knowledge, after (full score 20)	17.25	1.81	17.50	1.68	-0.35	0.729
Competency, before (full score 20)	10.75	2.70	11.00	2.52	-0.23	0.817
Competency, after (full score 20)	16.42	2.07	16.67	1.92	-0.31	0.762

3.3 Triage accuracy The audit of 800 triage records showed that before the development, 82.00% were correctly triaged, 13.00% under-triaged, and 5.00% over-triaged, whereas after the development, 93.00% were correctly triaged, 4.50% under-triaged, and 2.50% over-triaged. The distribution of the three triage outcomes differed significantly ($\chi^2 = 22.61$, df = 2, $p < .001$; w = 0.17). By category, correct triage increased by 11.00 percentage points (95% CI

6.47-15.58; OR = 2.92; $\chi^2(1) = 22.13$, $p < .001$), under-triage decreased by 8.50 percentage points (95% CI 4.64-12.50; $\chi^2(1) = 18.10$, $p < .001$), and over-triage did not differ significantly (a decrease of 2.50 percentage points; $\chi^2(1) = 3.46$, $p = .063$). Holm-adjusted p values were < .001, < .001, and .063, respectively. After adjustment for triage personnel using GEE, triage accuracy remained higher after the development (adjusted OR = 2.78, 95% CI 1.41-5.48, p = .003). Among ESI level 1-2 patients only (96 records before and 104 after), under-triage decreased from 21.88% (21/96) to 8.65% (9/104) (OR = 0.34; Fisher's exact test p = .010), as shown in Table 6.

Table 6 Comparison of triage accuracy before and after the development (400 records per period) (chi-square test)

Triage accuracy	Before n (%)	After n (%)	χ^2	p-value
Correct triage	328 (82.00)	372 (93.00)	22.61	< .001*
Under-triage	52 (13.00)	18 (4.50)		
Over-triage	20 (5.00)	10 (2.50)		

Note: *Statistically significant at p < .05

3.4 Outcomes regarding time, safety, satisfaction, and success indicators After the development, the mean triage time decreased from 4.82 ± 1.95 to 2.96 ± 1.12 minutes (t = 16.54, p < .001) (difference 1.86 minutes, 95% CI 1.64-2.08; d = 1.17), and the mean waiting time to see a physician decreased from 41.37 ± 16.82 to 27.45 ± 11.36 minutes (t = 13.72, p < .001) (difference 13.92 minutes, 95% CI 11.93-15.91; d = 0.97; Welch's t-test; median (IQR) waiting time from 38.00 (28.00-52.00) to 26.00 (18.00-34.00) minutes).

Patients who deteriorated while waiting in front of the outpatient examination rooms and had to be sent for urgent care in the emergency room changed from 14 to 5 cases (1.75 and 0.63 per 10,000 records, based on a denominator of 80,000 records per period estimated from the hospital information system; exact test p = .064), and triage-related complaints changed from 5 to 1 (p = .219); these events were too few to conclude a reduction. Compared with the success indicators, 22 staff (91.67%) passed the knowledge criterion of 80.00% or higher (≥16 points), which did not differ significantly from the 80.00% target (95% CI 74.15-97.68; exact binomial test p = .115). Triage accuracy of 93.00% exceeded the 70.00% target (the success indicator was pre-specified as stated in the Methods; 95% CI for 93.00%, 90.07-95.11). The process indicator, the percentage of records triaged through all steps of the ESI flowchart, was 100% (400/400 records, 95% CI 99.05-100.00), which is a different indicator from ESI-level accuracy (93.00%).

Staff satisfaction with the system averaged 4.28 ± 0.41 (85.60%) (95% CI 4.11-4.45; compared with 4.00: t(23) = 3.35, p = .003), and patient satisfaction with the service averaged 4.38 ± 0.46 (87.60%; n = 100) (95% CI 4.29-4.47; t(99) = 8.26, p < .001; no pre-development data were available, so change cannot be interpreted; patients were selected by consecutive sampling

as stated in the Methods); both groups exceeded the criterion of 4.00 (80.00% of the full score).

Discussion

The situation analysis showed that triage errors resulted from a combination of the service system, personnel, and tools. During 07.00-09.00 and 12.00-13.00, qualified triage personnel were lacking and porters had to perform triage, and the triage criteria were broad and unclear, leading to varying judgments among triage personnel. This is consistent with studies showing that triage error rates depend on the triage personnel and the context of the facility.[12] The most common under-triage was emergent patients triaged as urgent (54.29%), resulting in long waits and deterioration. This is consistent with reports that under-triage delays diagnosis and treatment and may cause disability or death, whereas over-triage wastes resources and causes crowding.[9]

The developed system used ESI version 4 as a common guideline for both the outpatient department and the emergency room; the ESI has high validity and reliability, is easy to use, and is applicable in hospitals of various levels.[5,10,11] Development with the participation of the multidisciplinary team ensured that role assignment, staffing during peak hours, and equipment provision addressed the problems identified. In addition, workshop training combined with simulation-based practice prepared triage personnel in knowledge and skills, which is essential because accurate triage should not rely on experience alone.[9]

After the development, staff knowledge and triage competency scores increased significantly, triage accuracy increased from 82.00% to 93.00%, and under-triage decreased from 13.00% to 4.50%, consistent with the shorter waiting time to see a physician (the mean time to physician for ESI level 1 - 2 patients decreased from 9.6 to 5.1 minutes, from 10.8 to 5.7 minutes in the outpatient department and from 8.4 to 4.5 minutes in the emergency room) and with the patient safety goal of effective triage.[13] The absence of a difference between the outpatient department and the emergency room does not indicate equivalence, because n = 12 per group could detect only large differences (d ≥ 1.2) (mean differences between departments ranged from -0.25 to 0.33 points, with wide 95% CIs from -2.46 to 2.33 points, as shown in Table 5); it therefore cannot be attributed to the use of the same criteria and training. These results are consistent with ESI studies in Thailand reporting increased triage accuracy after training; Khaowong Hospital, Kalasin Province, achieved 96.80% triage accuracy after developing a model that included building staff knowledge and skills,[14] and with a meta-analysis reporting high ESI reliability, with a pooled weighted kappa of 0.79.[17]

Limitations This was a single-hospital study without a control group, so the influence of other concurrent factors, such as changes in staffing or patient volume, cannot be excluded. The accuracy raters were blinded to the pre/post period (masked dates and shuffled records) but might have inferred the period from differences in recording patterns, and the accuracy audit relied on records that might be incomplete. Other limitations were: 1) records were nested within 24 triage personnel and were therefore not independent, even after GEE adjustment; 2) each department had only 12 staff, resulting in low statistical power; 3) multiple indicators were tested, even with Holm adjustment; 4) secondary

indicators had few events (deterioration 14 to 5 cases, complaints 5 to 1); 5) no pre-development satisfaction data were available; 6) the pre- and post-development periods covered the same months in different years, which controlled for seasonality but not for secular trends; 7) ESI version 4 was used, although version 5 is now available; and 8) the researcher was a supervisor with a dual role toward staff, despite the use of other assessors and anonymous questionnaires.

Conclusion

The ESI-based patient triage system developed with the participation of a multidisciplinary team, comprising a policy and working group, triage criteria and flowchart, designation of triage personnel and staffing, staff capacity building, equipment provision, and supervision and monitoring, was associated with increased knowledge and competency, higher triage accuracy (an increase of 11.00 percentage points), reduced under-triage (8.50 percentage points), and shorter waiting time to see a physician (13.92 minutes), whereas over-triage did not differ significantly. Staff and patient satisfaction exceeded the 4.00 criterion. Given the one-group pretest-posttest design, causal effects and effects on patient safety cannot yet be concluded.

Recommendations

1. Recommendations for applying the findings 1) A lessons-learned and knowledge-sharing project should be established to create a unified, internationally recognized, up-to-date triage guideline that meets the ESI standard, using ESI version 5 of the Emergency Nurses Association (2023).[3] 2) Relevant definitions and academic literature should be reviewed, and guidelines that are easy for target groups to follow should be developed. 3) Project activities should be conducted jointly for outpatient and emergency room staff. 4) Performance should be monitored regularly to further develop a shared triage guideline between the two departments.

2. Recommendations for future research

Future studies should use a control group or multiple hospitals, follow clinical outcomes such as mortality and length of hospital stay, and examine electronic decision support systems in triage (a stepped-wedge cluster trial or interrupted time series in at least six community hospitals is proposed, with sample size calculated using ICC = 0.02 (design effect ≈ 1.31 in this study) and clinical indicators including 24-hour mortality, unplanned intensive care unit admission, and length of hospital stay).

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ORIGINAL ARTICLE

Development of a Care Model for Patients with Serious Mental Illness and Substance Use at High Risk of Violence in Yang Talat District, Kalasin Province

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Abstract

This action research, guided by the Kemmis and McTaggart cycle, aimed to study the situation and problems, and to develop and evaluate a care model for patients with serious mental illness and substance use at high risk of violence (SMI-V) in Yang Talat District, Kalasin Province. Participants were all 32 SMI-V patients in the Community-Based Treatment (CBTX) program in Ban Kham, and 45 health network members. Instruments included the Brief Psychiatric Rating Scale (BPRS), the Overt Aggression Scale (OAS), and measures of medication adherence, quality of life, knowledge, skills and satisfaction. Data were analyzed using descriptive statistics, paired t-test and exact McNemar's test, with Holm adjustment. The YT-VCare Model comprised five components: surveillance and risk assessment, team and network capacity building, rapid referral and crisis management, case management with home visits, and stigma reduction. After implementation, BPRS scores decreased from 41.56 ± 8.73 to 27.34 ± 6.12 (mean difference 14.22, 95% CI 11.55-16.89; $p < .001$), OAS scores decreased from 9.84 to 3.47 ($p < .001$). Good treatment adherence increased from 40.63% to 84.38% (exact McNemar $p = .0001$), whereas patients committing violence in the community decreased from 21.88% to 3.13% (exact McNemar $p = .031$; Holm-adjusted $p = .063$). Network members' knowledge increased from 11.38 to 16.87 ($p < .001$), and satisfaction was high (mean = 4.52). However, with a one-group pretest-posttest design and no comparison group, causal effects cannot be concluded, and effects on relapse and community violence remained unclear after multiplicity adjustment.

Keywords: Mental Disorders, Substance-Related Disorders, Violence, Community Mental Health Services, Community-Based Participatory Research

Introduction

Mental health and substance use problems are major global issues affecting large populations. The World Health Organization reported that in 2019, one in eight people worldwide, or more than 970 million, lived with a mental health condition,[1] and the latest data for 2021 show more than one billion people with mental disorders.[2] In Thailand, psychiatric service users increased from 1.30 million in fiscal year 2015 to 2.90 million in fiscal year 2023.[1] Patients with serious mental illness with high risk to violence (SMI-V) requiring follow-up numbered 27,737, but only 23.34% were followed up.[1] In fiscal year 2025, 96.18% of SMI-V patients who entered treatment received continuous care without repeated violence, exceeding the 85.00% target,[3] reflecting that continuous community care is central to violence prevention.

Kalasin Province, in northeastern Thailand, has a population of approximately 985,000 and 18 districts. Data from 2022-2024 showed that SMI-V patients in the province experienced medication discontinuation, service delays exceeding 48 hours, relapse, and community violence, all increasing every year (violent incidents rose from 23 to 47).[4] Yang Talat District is an area at risk for drug problems, and the number of SMI-V patients increased from 28 in 2022 to 38 in 2024, a 35.71% increase over three years. Between 2022 and 2024, medication discontinuation, delayed services, and relapse also increased every year, and community violent incidents rose from 6 to 12, mostly physical assaults on family members (58.33%).[5] This study purposively selected Ban Kham, Khlong Kham Subdistrict, as the study site because it had 32 SMI-V patients enrolled in the CBTX program, accounting for 84.21% of all SMI-V patients in the district (38 in 2024), and an existing CBTX team, enabling complete follow-up. The conclusions of this study are therefore limited to Ban Kham.

The Department of Mental Health has established a standard of care for SMI-V patients (V-Care) emphasizing systematic prevention, assessment, treatment, and follow-up of at-risk patients,[6] using standardized tools such as the Brief Psychiatric Rating Scale (BPRS) and the Overt Aggression Scale (OAS). Concepts previously used to develop care models include Kodner's integrated care,[7] Bandura's social learning theory of aggression,[8] Cobb's social support theory,[9] and case management. Research in a nearby area found that a network-participatory care model in Don Tan District, Mukdahan Province, reduced psychiatric symptom scores in 88.40% of patients.[10] However, facilitators and barriers to community care vary by context; key barriers include negative attitudes, staff shortages, and insufficient budgets.[11] These studies focused mainly on nursing practice guidelines or network participation, and no report was found on developing an SMI-V care model that integrates the hospital, the Community-Based Treatment (CBTX) team, and network partners specifically in the context of Yang Talat District. This is the knowledge gap this study aims to fill.

Against this background, the key problems in Yang Talat District were the lack of a systematic surveillance and follow-up system, the absence of clear standard guidelines, insufficient knowledge and skills among staff and CBTX members in risk assessment and management of

violent behavior, an ineffective referral and coordination system between the hospital and the community, and persistent negative attitudes and stigma toward patients in the community. There is therefore an urgent need to develop a systematic, multisectoral care model for SMI-V patients. The researcher thus used action research to develop a model suited to the local context to reduce symptom exacerbation, prevent violent incidents, and enhance community safety.

Conceptual framework and hypotheses: The conceptual framework was developed from the Kemmis and McTaggart action research cycle[12] together with the Department of Mental Health's V-Care standard,[6] as shown in Figure 1. Hypotheses were H1: BPRS and OAS scores after implementation would be lower than before; H2: the proportions of patients committing violence and relapsing after implementation would be lower than before; and H3: network members' knowledge and skill scores after implementation would be higher than before. The BPRS score was designated as the primary outcome, while the OAS score, medication adherence, quality of life, the proportions of patients committing violence and relapsing, and network members' knowledge and skills were secondary outcomes.

Inputs	Situation and problems of SMI-V care in Yang Talat District Department of Mental Health V-Care standard Related concepts and theories (integrated care, proactive prevention, systems theory, social learning, social support, case management)
Action research process (Plan-Act-Observe-Reflect)	Phase 1 Preparation (Oct-Dec 2025): planning; situation and problem analysis Phase 2 Implementation (Dec 2025-Jun 2026): acting; developing and piloting the YT-VCare Model (Jan-Apr 2026); observing and reflecting to refine the model over two cycles Phase 3 Evaluation and conclusion (Jun-Aug 2026)
Outcomes	Patients: BPRS (primary outcome), OAS, medication adherence, quality of life, relapse, and violence Network members: knowledge, skills, confidence, and satisfaction

Figure 1 Conceptual framework of the research

Research Objectives

1) To study the situation and problems in caring for patients with serious mental illness and substance use at high risk of violence (SMI-V) in Yang Talat District, Kalasin Province
2) To develop a care model for SMI-V patients in Yang Talat District, Kalasin Province
3) To evaluate the outcomes of the SMI-V care model in Yang Talat District, Kalasin Province, using a pre-specified primary outcome

Methods

This study was action research based on the Kemmis and McTaggart framework,[12] comprising four steps: planning, acting, observing, and reflecting, combined with a one-group pretest-posttest evaluation, as shown in Figure 1. Post-intervention outcomes were measured at one month (May 2026); follow-up at 3 and 6 months was not conducted owing to time constraints, which is a limitation of the study. The study was conducted in Ban Kham, Khlong Kham Subdistrict, and with health network partners in Yang Talat District, Kalasin Province, from 1 October 2025 to 31 August 2026 (11 months), with the model implemented among SMI-V patients from January to April 2026 (4 months). Details are as follows.

Population and Sample

Population comprised two groups: 1) SMI-V patients enrolled in the CBTX program in Ban Kham, Khlong Kham Subdistrict, Yang Talat District, Kalasin Province; and 2) health network members and registered nurses caring for psychiatric and substance use patients at risk of violence in Yang Talat District.

Sample comprised all 32 eligible SMI-V patients enrolled in the CBTX program in the area (census); therefore, no sample size calculation was performed (power = .78 for dz = 0.5 at α = .05). In addition, 45 health network members were purposively selected, including 12 registered nurses and health personnel from Yang Talat Hospital and subdistrict health promoting hospitals (SHPHs), 24 CBTX team members and village health volunteers (VHVs), and 9 representatives of subdistrict administrative organizations, the police station, and community leaders.

Inclusion criteria for patients were: 1) aged 18 years or older; 2) diagnosed with a psychiatric disorder or substance use disorder according to ICD-10 criteria and registered as an SMI-V patient using the Department of Mental Health's 10-domain risk assessment; 3) residing in Ban Kham for at least 6 months; 4) having a primary caregiver; and 5) consenting to participate. For network members: 1) working in SMI-V care for at least 6 months; and 2) consenting to participate.

Exclusion criteria were patients whose severe psychiatric symptoms prevented communication or providing information throughout the study, who relocated, were incarcerated, died, or withdrew, and network members attending less than 80.00% of activities. These criteria may cause the analysis to reflect only protocol-adherent participants (per-protocol) and overestimate benefits. In this study, all 32 patients and 45 network members completed all activities until the end of the study; thus, no participants were excluded or withdrew.

Research Instruments

Research instruments included 1) intervention tools: the SMI-V care model of Yang Talat District, the SMI-V care manual and practice guidelines, the Department of Mental Health's 10-domain risk assessment, and the network training plan; and 2) data collection tools: the Brief Psychiatric Rating Scale (BPRS) and Overt Aggression Scale (OAS), a demographic

questionnaire, the 10-item Medication Adherence Rating Scale (MARS; score 0-10), the 26-item Thai version of the WHO Quality of Life-BREF (WHOQOL-BREF-THAI; score 26-130), a 20-item network knowledge test, 5-point rating scales for risk assessment skills, crisis management skills, and practice confidence, a 5-point satisfaction scale, and a record form for treatment and violent incidents from medical records and the SMI-V registry. Six experts examined the content validity of the researcher-developed instruments, yielding an overall index of item-objective congruence (IOC) of 0.67-1.00. The BPRS,[13] OAS,[14] MARS,[15] and WHOQOL-BREF-THAI[16] are standardized, previously validated instruments. The knowledge test and the skill, confidence, and satisfaction scales were piloted with 30 workers similar to the network members in other areas of Yang Talat District, yielding reliability coefficients (KR-20 and Cronbach's alpha) of 0.82-0.91. For patient measures (MARS and WHOQOL-BREF-THAI), reliability values from the original studies were used.

Data Collection

Data collection followed the action research cycle in three phases:

Phase 1: Preparation (October-December 2025) The context and problems of SMI-V care were studied with the Yang Talat Hospital multidisciplinary team, network members, and patients through observation, inquiry, review of care processes and related research, and expert interviews. Ethics approval was sought, and a draft SMI-V care manual or practice guideline was prepared.

Phase 2: Implementation (December 2025-June 2026) Workshops were held with network members to develop a care model suited to the Yang Talat context; CBTX members, network members, and health personnel were trained; and the model was piloted with 32 SMI-V patients in Ban Kham from January to April 2026, with monthly home visits (4 visits in total), ongoing monitoring and evaluation (March-June 2026), and refinements as appropriate.

Phase 3: Evaluation and conclusion (June-August 2026) Model outcomes were evaluated in terms of quality of care, community safety, and service-user satisfaction, and results were analyzed and summarized by comparing outcomes before and after implementation.

Data were collected by the researcher and two research assistants (registered nurses trained in the instruments). Before data collection, the researcher and assistants rated the BPRS and OAS in 10 patients to assess inter-rater reliability, yielding an ICC for the BPRS of 0.846 (95% CI 1.94-3.41) and for the OAS of 0.742 (95% CI 1.89-2.56). Pre-intervention measurements were taken in December 2025-January 2026 and post-intervention measurements in May 2026. Relapse and violent incident data were compared between the 4 months before the intervention (September-December 2025) and the 4 months during the intervention (January-April 2026) using medical records and the SMI-V registry. Outcomes were defined as follows: good treatment adherence, taking medication as prescribed ≥ 80.00% based on the MARS score or dispensing records; committing violence, any incident of harm to others or property assessed by the OAS or recorded in the SMI-V registry; continuous

follow-up as required, follow-up according to the Department of Mental Health's V-Care guideline;[6] and relapse, symptom exacerbation requiring hospital admission. Six success indicators and criteria were pre-specified before the intervention: network knowledge (≥ 85.00%), model adherence (≥ 90.00%), satisfaction (≥ 90.00%), treatment adherence (≥ 80.00%), continuous follow-up (≥ 90.00%), and reduction in violent incidents (≥ 50.00%), based on Ministry of Public Health targets[3] and consensus between the research team and network members.

Data Analysis

Data analysis: General data were analyzed using frequency, percentage, mean, and standard deviation (S.D.). Assumptions were checked with the Shapiro-Wilk test of differences. Pre-post mean scores were compared using the paired t-test, reporting mean differences, 95% CI, and Hedges' g (with the Wilcoxon signed-rank test as a sensitivity analysis, particularly for the OAS and 5-point scales). Pre-post proportions were compared using the exact McNemar's test, reporting differences in proportions with 95% CI, and p-values were adjusted using the Holm method. The primary outcome (BPRS) was pre-specified, with two-sided tests at α = .05. Qualitative data from workshops and reflections were analyzed by content analysis.

Research Ethics

This study adhered to human research ethics. Data collection from patients and network members began only after ethics approval. Activities in October-November 2025 consisted of reviewing documents and de-identified registry data, while observation, inquiry, and expert interviews in Phase 1 were conducted after approval. The researcher explained the objectives, procedures, benefits, and risks to participants and caregivers, who signed voluntary informed consent. Data were kept confidential using codes instead of names and presented in aggregate, and participants could withdraw at any time without affecting their treatment. Before enrollment, a psychiatric nurse assessed each patient's capacity to consent; patients participated when their symptoms were stable and they could understand the study information. If a patient could not consent, consent was obtained from a legally authorized representative (the primary caregiver) together with the patient's assent. For violent incidents involving the police or the community, data were used without identifying individuals and disclosed only as necessary for safety or as required by law. When a high risk of harm to self or others was identified, the researcher followed the individual crisis management plan, notified the physician and caregiver, and referred the patient within 48 hours, prioritizing the safety of the patient and others.

Results

1. Situation and problems of SMI-V care (Objective 1)

1.1 General characteristics of the sample Of the 32 SMI-V patients, most were male (68.75%), with a mean age of 35.19 ± 8.46 years (range 19-54), and methamphetamine (yaba) was the most commonly used substance (75.00%). Of

the 45 health network members, most were CBTX team members and VHVs (53.33%), as shown in Table 1.

Table 1 General characteristics of SMI-V patients (n = 32) and health network members (n = 45)

Characteristic	n (%) or $\bar{x}$ ± S.D. (min-max)
SMI-V patients (n = 32)	
Male	22 (68.75)
Female	10 (31.25)
Age (years)	35.19 ± 8.46 (19-54)
Diagnosis: schizophrenia with substance use	17 (53.13)
Diagnosis: substance-induced psychosis	9 (28.13)
Diagnosis: bipolar disorder with history of substance use	6 (18.75)
Most used substance: methamphetamine (yaba)	24 (75.00)
Substance used: crystal methamphetamine (ice)	5 (15.63)
Substance used: cannabis	3 (9.38)
Risk factor: unemployed or no regular income	21 (65.63)
Risk factor: lack of family support	19 (59.38)
Risk factor: history of violent behavior	14 (43.75)
Risk factor: history of drug-related arrest	12 (37.50)
Health network members (n = 45)	
Registered nurses and health personnel	12 (26.67)
CBTX team and village health volunteers (VHVs)	24 (53.33)
Subdistrict administrative organization, police, and community leaders	9 (20.00)

1.2 Situation and problems of SMI-V care

Situation analysis with the multidisciplinary team, network members, and patients identified problems in four domains: 1) Personnel: registered nurses and health personnel lacked specialized knowledge and skills in systematic risk assessment and management of violent behavior, lacked confidence, and had heavy workloads, making follow-up discontinuous and incomplete. 2) Organization: the hospital lacked clear standard guidelines; referral and coordination between the hospital and the community were ineffective; there was no monitoring and evaluation mechanism; and there was no linked database for patient surveillance. 3) Community workers: VHVs and CBTX teams lacked knowledge for caring for complex patients and skills in initial

assessment and emergency management, had no tools or guidelines, and were concerned for their own safety. 4) Network and community: coordination among the hospital, subdistrict administrative organizations, the police station, and community leaders was discontinuous, roles were unclear, there was no mechanism for communication and information sharing, and the community held negative attitudes and stigma toward patients. These data were obtained from focus groups with the 45 network members (3 groups by profession), together with observation, inquiry into work practices, and review of SMI-V registry data, and were analyzed by content analysis, with the researcher and assistant analyzing independently and then reaching consensus.

2. Development of the SMI-V care model (Objective 2)

2.1 Components of the SMI-V care model Two one-day workshops with network members and two cycles of reflection within the action research cycle yielded the Yang Talat SMI-V care model (YT-VCare Model), consisting of five main components: community surveillance and risk assessment; capacity building for the CBTX team and network members; rapid referral and crisis management; case management with continuous home visits; and building understanding and reducing stigma in the community, as shown in Table 2.

Table 2 Components, summary of activities, and duration of the Yang Talat SMI-V care model (YT-VCare Model)

Component	Summary of activities	Duration
1. Community surveillance and risk assessment	Screening and individual registration of SMI-V patients; risk assessment using the Department of Mental Health's 10-domain tool, BPRS, and OAS; monthly monitoring of warning signs by CBTX members and VHVs, recorded in a shared network database	Throughout the project (Jan-Apr 2026)
2. Capacity building for the CBTX team and network members	Workshop training on basic risk assessment, recognition of warning signs, de-escalation techniques, emergency management, and worker safety	2 days (12 hours)
3. Rapid referral and crisis management	Establishing coordination channels among the community, SHPHs, the hospital, subdistrict administrative organizations, and the police station; defining clear roles; developing individual crisis plans; and referring patients within 48 hours when high risk is identified	Throughout the project

Component	Summary of activities	Duration
4. Case management with continuous home visits	A nurse case manager develops individual care plans, conducts monthly home visits, monitors medication intake, dispenses medication in the community, educates patients and families, and promotes emotion-management skills	4 visits, 60 minutes each
5. Building understanding and reducing stigma in the community	Educating community leaders and residents about psychiatric and substance use disorders, establishing family and community support groups, and linking patients with occupational groups and community activities	Every 2 months (2 sessions)

2.2 Appropriateness of the model

Five experts (one psychiatrist, two psychiatric nurses, one representative of the Provincial Public Health Office, and one community leader) assessed the model as consistent with its objectives (IOC of the model and manual = 0.80-1.00) and highly appropriate and feasible (mean = 4.48, S.D. = 0.36). They suggested adding a LINE coordination group and individual crisis management plans, which the researcher incorporated before implementation.

3. Evaluation of the SMI-V care model (Objective 3)

3.1 Outcomes for psychiatric symptoms, aggressive behavior, medication adherence, and quality of life After implementation, the 32 SMI-V patients had significantly lower psychiatric symptom (BPRS) and aggressive behavior (OAS) scores and significantly higher medication adherence and quality of life scores than before ($p < .001$). The BPRS score decreased by a mean of 14.22 points (95% CI 11.55-16.89; Hedges' g = 1.87), as shown in Table 3.

Table 3 Comparison of mean scores for psychiatric symptoms, aggressive behavior, medication adherence, and quality of life of SMI-V patients before and after implementation (n = 32)

Variable	Score range	Before $\bar{x}$ (S.D.)	After $\bar{x}$ (S.D.)	Difference (95% CI)	Hedges' g	t	p-value
Psychiatric symptoms (BPRS)	18-126	41.56 (8.73)	27.34 (6.12)	14.22 (11.55-16.89)	1.87	10.87	< .001*
Aggressive behavior (OAS)	0-56	9.84 (4.21)	3.47 (2.58)	6.37 (5.05-7.69)	1.70	9.87	< .001*
Medication adherence (MARS)	0-10	5.38 (1.74)	7.91 (1.32)	2.53 (1.92-3.14)	1.46	8.47	< .001*
Quality of life (WHOQOL-BREF-THAI)	26-130	77.94 (9.85)	91.28 (8.62)	13.34 (10.13-16.55)	1.46	8.48	< .001*

Note: *Statistically significant at p < .05

3.2 Outcomes for network members' knowledge, skills, and satisfaction After participating, the 45 network members had significantly higher scores for knowledge, risk assessment skills, crisis management skills, and practice confidence than before (p < .001), as shown in Table 4, which also presents mean differences (95% CI) and Hedges' g. Sensitivity analysis using the Wilcoxon signed-rank test yielded the same conclusions. Satisfaction with the model was high to very high (mean = 4.52, S.D. = 0.48; 95% CI 4.38-4.66), with 42 members (93.33%; 95% CI 82.1-97.7) satisfied at a high level or above; this 95% CI includes the pre-specified 90.00% criterion.

Table 4 Comparison of mean knowledge, skill, and confidence scores of network members before and after implementation (n = 45)

Variable	Before $\bar{x}$ (S.D.)	After $\bar{x}$ (S.D.)	Difference (95% CI)	Hedges' g	t	p-value
Knowledge of SMI-V care (maximum 20)	11.38 (2.74)	16.87 (1.96)	5.49 (4.69-6.29)	2.04	13.90	< .001*
Risk assessment skills (maximum 5)	2.84 (0.62)	4.21 (0.47)	1.37 (1.20-1.54)	2.45	16.71	< .001*
Crisis management skills (maximum 5)	2.71 (0.66)	4.12 (0.51)	1.41 (1.23-1.59)	2.31	15.76	< .001*
Practice confidence (maximum 5)	2.93 (0.71)	4.17 (0.54)	1.24 (1.04-1.44)	1.79	12.23	< .001*

Note: *Statistically significant at p < .05

3.3 Outcomes for treatment adherence, continuous follow-up, relapse, and violent incidents The proportions of patients with good treatment adherence and continuous follow-up as required increased, whereas the proportions of patients with relapse requiring hospitalization and those committing violence in the community decreased (exact McNemar p = .031 for both; Holm-adjusted p = .063, not significant at .05, and therefore reported as exploratory), as shown in Table 5. Violent incidents decreased from 9 to 2 over 4 months (a 77.78% reduction; exact conditional test p = .065, not significant). Compared with the success indicators, all six values numerically exceeded the criteria: 39 network members (86.67%) met the knowledge criterion (≥ 80.00% of the total score; criterion ≥ 85.00%), 41 (91.11%) adhered correctly to the model (criterion ≥ 90.00%), satisfaction was 93.33% (criterion ≥ 90.00%), patient treatment adherence was 84.38% (criterion ≥ 80.00%), continuous follow-up was 93.75% (criterion ≥ 90.00%), and violent incidents decreased by 77.78% (criterion ≥ 50.00%). However, the 95% CIs (Wilson) included the criteria for all indicators; therefore, it cannot be concluded that the criteria were met.

Table 5 Comparison of the number and percentage of SMI-V patients before and after implementation by treatment and safety outcomes (n = 32)

Outcome/status	Before n (%)	After n (%)	Pairs improved/ worsened (b/c)	p-value	Difference in proportion (95% CI)
Good treatment adherence (regular medication ≥ 80.00%)	13 (40.63)	27 (84.38)	14/0	.0001*	43.75 (26.6-60.9)
Continuous follow-up as required	17 (53.13)	30 (93.75)	13/0	.0002*	40.63 (23.6-57.6)
Relapse requiring hospitalization	8 (25.00)	2 (6.25)	6/0	.031*	-18.75 (-32.3 to -5.2)
Committing violence in the community	7 (21.88)	1 (3.13)	6/0	.031*	-18.75 (-32.3 to -5.2)

Note: *Statistically significant at p < .05

Discussion

The situation analysis showed that problems in SMI-V care in Yang Talat District arose at multiple levels, including personnel, organizations, community workers, and network partners, consistent with a study reporting that barriers to community mental health services for this group include negative attitudes, staff shortages, and insufficient budgets.[11] The sample characteristics, predominantly male, under 40 years, methamphetamine users, and unemployed, are consistent with risk factors for violent behavior in patients with schizophrenia.[17] The yearly increase in medication discontinuation and delayed services indicates that hospital-centered follow-up is insufficient and that a surveillance and referral system linked to the community is needed.

The YT-VCare Model was developed through an action research process in which network partners participated from problem analysis and design to reflection, consistent with the network-participatory care model for high-risk psychiatric patients in Don Tan District, Mukdahan Province,[10] which reported that network participation fostered sustainable implementation. The model's components are consistent with the concept of integrated care linking multiple levels of services.[7] An integrated community SMI-V care model in Patong Subdistrict, Songkhla Province (71 patients) significantly increased medication adherence and reduced aggressive behavior.[18] In addition, participatory community case management in Mueang District, Sakon Nakhon Province (34 patients) reduced psychiatric symptom scores and improved global functioning,[19] consistent with the case management and home visit component of the YT-VCare Model. Training CBTX teams to recognize warning signs and use de-escalation techniques is consistent with key components of de-escalation that reduce aggression without restrictive measures.[20] However, these studies differ in context, sample

size, and outcomes, so the comparisons indicate only trends.

After implementation, patients' psychiatric symptoms and aggressive behavior decreased, and medication adherence and quality of life increased significantly, consistent with the network-participatory model in which 88.40% of patients had reduced psychiatric symptom scores,[10] and with Bandura's social learning theory, which explains that aggressive behavior is learned and modifiable.[8] Improved treatment adherence may be related to social support from families and community networks (social support was not directly measured in this study), in line with Cobb's social support theory, which holds that social support buffers the effects of stress.[9] The reductions in patients committing violence and relapsing (21.88% to 3.13% and 25.00% to 6.25%; exact McNemar p = .031 for both, but Holm-adjusted p = .063) are consistent with a report of continuous community care in which no relapse occurred after discharge.[18] Network members' knowledge, skills, and confidence increased, which may have helped the surveillance and referral system to function continuously.

Limitations This was a one-group pretest-posttest study without a comparison group; therefore, the influence of other factors cannot be ruled out. The sample was small and from a single area, the follow-up period was short (4 months), some data were reported by caregivers and staff, and statistical tests for variables with small counts may be imprecise. In addition, (1) post-intervention measurement was conducted at only one month, and relapse and violence data covered a different period from the score measurements; (2) the researcher was both care provider and assessor without blinding to the pre-post period, and substance use was not verified by urine testing or the ASSIST; (3) the two safety outcomes (relapse and violence) were not significant after Holm adjustment, and the 95% CIs of all success indicators included the criteria; (4) effect sizes were unusually large (dz approximately 1.5-2.5), warranting caution regarding measurement bias and regression to the mean; and (5) the network comprised three professional groups that were not analyzed separately, and patients came from a single village. The results should therefore be interpreted and applied with caution.

Conclusion

This action research produced the Yang Talat SMI-V care model (YT-VCare Model) with five components (Table 2). After 4 months of implementation, patients' psychiatric symptoms (BPRS decreased by 14.22 points) and aggressive behavior decreased, and treatment adherence and continuous follow-up increased. Relapse and community violence decreased numerically but were not significant after Holm adjustment. Network members' knowledge and skills increased, and their satisfaction was high to very high. Given the one-group pretest-posttest design without a comparison group, causality cannot be concluded, and the 95% CIs of all six success indicators included the criteria.

Recommendations

1. Recommendations for applying the findings This model should be adopted as

hospital- and district-level policy and guidelines for SMI-V care, supported by budget and personnel resources, continuous training for staff and CBTX members, a linked database among network partners, guidance materials for patients, families, and communities, and efforts to build community understanding and acceptance of patients. The model should also be extended to other subdistricts of Yang Talat District and to areas with similar contexts.

2. Recommendations for future research

Future studies should use a comparison group (quasi-experimental or stepped-wedge design) with larger, multi-site samples, conduct long-term follow-up of at least 12 months, and analyze the cost-effectiveness of the model.

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RESEARCH ARTICLE

Development of a Seamless Care Management Model for Patients with Chronic Obstructive Pulmonary Disease in the District-to-Provincial Health Service Network, Banthi Hospital, Lamphun Province

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Abstract

This participatory action research, following the Plan-Act-Observe-Reflect (PAOR) cycle with a one-group pretest-posttest evaluation, aimed to develop a seamless care management model for patients with chronic obstructive pulmonary disease (COPD) in the district-to-provincial health service network at Banthi Hospital, Lamphun Province, and to compare outcomes before and after implementation. The study ran from October 2023 to September 2024. Participants were 25 interprofessional team members and network partners, and 57 COPD patients in GOLD groups B and E with their 57 primary caregivers. The model comprised five components operating at sub-district, district, and provincial levels. Data were analyzed using descriptive statistics, paired t-test or Wilcoxon signed-rank test, McNemar's test, and chi-square test. Among the 54 patients followed up, knowledge scores increased by 5.13 points (95% CI 4.36-5.90), self-management scores by 21.65 points (95% CI 20.26-23.03), and COPD Assessment Test (CAT) scores decreased by 3.59 points (95% CI -4.56 to -2.62); correct inhaler use in all steps rose from 27.78% to 77.78% (all $p < .001$). Acute exacerbations in the six months before and after enrollment decreased from 55 to 30 episodes ($p = .032$). The number of service indicators meeting targets increased from 3 to 10 of 15, and complete information transfer rose from 12.90% to 91.03%, whereas the 28-day readmission rate (20.41% vs 12.50%) did not allow a conclusion. Satisfaction was high ($\bar{x} = 4.41$). Knowledge, self-management, and referral processes improved after implementation; however, the single-group design without a comparison group precludes causal conclusions, and controlled studies with longer follow-up are needed.

Keywords: Chronic Obstructive Pulmonary Disease, Seamless Care, Health Service Network

Introduction

Chronic obstructive pulmonary disease (COPD) is a global public health problem and the third leading cause of death worldwide. In 2023, it caused 3.4 million deaths, approximately 6% of all deaths. The main risk factors are cigarette smoking, household air pollution from cooking fuels, and occupational exposure to dust and fumes.[1] International guidelines emphasize continuity of care after discharge, patient follow-up within 1–4 weeks, pulmonary rehabilitation, review of inhaler technique, and management of risk factors in the community.[2]

Thailand has more than 3 million COPD patients, half of whom are unaware that they are ill, and more than 20,000 deaths per year, or about 50 per day. Half of the patients die within 3.6 years after their first exacerbation.[3] In northern Thailand, the number of patients seeking care for exacerbations varies with PM2.5 levels (r = 0.536); periods when PM2.5 exceeds 50 μg/m³ increase the odds of exacerbation 1.47-fold, and a history of smoking increases the odds 2.30-fold.[4] The 28-day readmission rate is an important quality indicator of health service systems.

Effective management of COPD requires the integration of three core concepts. The first is chronic disease management based on the Chronic Care Model, which comprises self-management support, delivery system design, clinical decision support, clinical information systems, health care organization, and community resources.[5] The second is continuity of care, which has three dimensions: informational, management, and relational continuity between patients and providers.[6] The third is seamless care, which links risk assessment, care and referral across all service levels, case management for complex patients, information linkage and continuous follow-up, and a quality assurance system.[7] Developing a model within a network involving stakeholders at multiple levels calls for participatory action research following the cycle of planning, acting, observing, and reflecting, so that practitioners can jointly analyze problems and improve their own systems.[8]

Lamphun Province is located in upper northern Thailand, where smog from open burning and transboundary haze occur every year. Community hospitals in the province continue to face problems of exacerbations and readmissions. Implementing a discharge planning program based on the D-METHOD has helped reduce readmission and exacerbation rates.[9] However, this was development at the single-facility level and was not linked into a network from the sub-district and district levels to the provincial hub hospital.

Banthi District, Lamphun Province, is an agricultural area. Residents have long smoked tobacco to repel insects and mosquitoes, and they are exposed to smoke from burning in households and communities and to transboundary haze, together with high-risk occupations such as sewing, dairy farming, longan drying, and furniture making. COPD has therefore been designated a key disease group by the clinical lead team because of its high risk, high cost, and complexity of care.[10] In fiscal years (FY) 2021–2023, 134, 153, and 151 patients were registered, respectively. Hospital admissions increased from 34 to 54 and then to 98, an increase of 188.24%. The 28-day readmission rate was 20.59%, 16.67%, and 20.41% of admissions, and the proportion of patients undergoing spirometry was 35%, 29%, and 51.20%, below the 100% target every year. A review of 43 readmitted patients found that 37 (86.05%) had never received a long-acting muscarinic antagonist (LAMA).[10]

Banthi Hospital's previous care model had several key components: an interprofessional clinic, assessment according to the GOLD guidelines, discharge planning using the D-METHOD, inhaler verification by pharmacists, pulmonary rehabilitation, referral to a smoking cessation clinic, and influenza vaccination. However, limitations remained. Continuing home care was limited to patients hospitalized more than twice a month or using home oxygen, and covered only 2 sub-district health promoting hospitals (SHPHs). Patient information was not linked into a single system among the SHPHs, the community hospital, and the provincial hub hospital. Adjustment of medication according to severity was delayed because cross-level consultation had no clear channel, and management of environmental factors in the community relied on a single mechanism, the District Quality of Life Development Committee (DQLDC).[10]

Reviews of model development in Thailand point to the benefits of reorganizing care. Using nurse case managers together with clinical guidelines and continuing care resulted in no 28-day readmissions,[11] and interprofessional guidelines developed through an action research cycle reduced the readmission rate from 20% to 10%.[12] However, most work was developed within a single hospital or focused on individual programs. There remains a lack of a COPD care management model that links seamlessly from the community and SHPHs through the community hospital to the provincial hub hospital, covering screening, diagnosis by spirometry, access to medication according to severity, discharge planning, information transfer, and management of environmental factors in areas with severe smog, and no research in Lamphun Province has involved network partners at every level.

The researcher was therefore interested in developing a seamless COPD care management model in the district-to-provincial health service network, using participatory action research following the PAOR cycle together with the interprofessional team, SHPHs, community partners, and the provincial hub hospital, in order to reduce exacerbations and readmissions, increase access to standard treatment, and sustainably improve patients' quality of life in the local context.

Research Objectives

1) To study the situation, problems, obstacles, and needs in the management of care for patients with chronic obstructive pulmonary disease in the health service network of Banthi District, Lamphun Province
2) To develop a seamless care management model for patients with chronic obstructive pulmonary disease, with the participation of the district and provincial health service networks
3) To evaluate the effects of the seamless care management model for patients with chronic obstructive pulmonary disease on patient and health service system outcomes

Methods

This study was participatory action research that aimed to develop a seamless COPD care management model in the district-to-provincial health service network, Banthi Hospital, Lamphun Province. It followed the PAOR cycle, which comprises four main steps: Step 1, Plan: analysis of the situation, problems, obstacles, and needs in caring for COPD patients from the community level and SHPHs through Banthi Hospital to Lamphun Hospital; Step 2, Act: development and trial of the

model with the interprofessional team and network partners at all three levels; Step 3, Observe: collection and analysis of patient and health service system outcome data; and Step 4, Reflect: summarizing, revising, and refining the model to suit the context of the Banthi District health service network. The study was conducted from October 2023 to September 2024, a total of 12 months, with the model trialed in two cycles (cycle 1 in March–May and cycle 2 in June–August 2024). Outcome evaluation compared patient outcomes before and after implementation of the model, together with a comparison of service indicators between FY 2023 and FY 2024.

Population and Sample

1. Population. The population comprised two groups. Group 1 consisted of COPD patients registered at the Banthi Hospital COPD clinic and residing in Banthi District, numbering 151 (FY 2023), together with their primary caregivers. Group 2 consisted of interprofessional team members and network partners involved in the care of these patients: physicians, registered nurses, pharmacists, physical therapists, SHPH staff, Lamphun Hospital coordinators, village health volunteers (VHVs), and DQLDC representatives.

2. Sample. The sample, totaling 139 participants, was divided according to research step as follows. In Step 1, planning and model development, there were 25 participants selected by purposive sampling: 2 physicians, 8 registered nurses, 2 pharmacists, 1 physical therapist, 4 SHPH staff, 2 Lamphun Hospital coordinators, 4 VHVs, and 2 DQLDC/local administrative organization representatives, each with at least 1 year of experience caring for COPD patients or community patients with chronic diseases. In Step 2, outcome evaluation, the sample comprised 57 COPD patients in GOLD group B or E, aged 40 years or older and registered for treatment for at least 6 months, and 57 primary caregivers aged 18 years or older. The sample size was calculated using G*Power 3.1[14] for a one-tailed paired t-test with an effect size of 0.50, a significance level of .05, and a power of .95, giving 45 patients; this was increased by 25% to compensate for attrition, giving 57 patients, who were selected by simple random sampling from a list of 151 eligible patients. During follow-up, 3 patients left the study (1 died, 1 was permanently referred, and 1 withdrew); data from the 54 patients and 54 primary caregivers who completed follow-up (94.74%) were therefore analyzed.

Research Instruments

Fifteen research instruments were used, divided into two groups: 1) qualitative instruments for studying the situation and developing the model, comprising a general information form for focus group participants, a focus group guide for situation analysis (9 issues), a focus group guide for model development and reflection (7 issues), and a model appropriateness assessment form (20 items, 6 domains); and 2) quantitative instruments for outcome evaluation, comprising a general information questionnaire for patients and primary caregivers, a COPD knowledge test (20 items, 4 domains), a self-management behavior questionnaire (24 items, 5 domains, maximum score 120), the COPD Assessment Test (CAT)[15] and the modified Medical Research Council (mMRC) dyspnea scale,[16] an inhaler technique checklist, an individual clinical outcome record comparing the 6 months before and after enrollment, an information transfer completeness checklist (12 items), a service indicator record form (20 indicators), a satisfaction questionnaire for patients and primary caregivers (16 items), and a satisfaction questionnaire for the interprofessional team and network partners (13 items). Score levels were interpreted according to the criteria of Best.[17]

The instruments developed by the researcher were checked for content validity by 5 experts, yielding index of item-objective congruence (IOC) values of 0.80–1.00 (overall 0.93), and were tried out with 30 patients and primary caregivers and 15 interprofessional team members, yielding reliability coefficients of 0.82–0.95: KR-20 = 0.84 for the knowledge test, Cronbach's alpha = 0.90 for the self-management behavior questionnaire, KR-20 = 0.82 for the inhaler checklist (inter-rater agreement = 0.90), and a pooled Cronbach's alpha of 0.91 for the rating-scale instruments.

Data Collection

Step 1, Plan (October 2023 – February 2024). The researcher reviewed the literature and concepts, namely the Chronic Care Model, continuity of care, seamless care, case management, D-METHOD, and the GOLD 2025 guidelines; analyzed retrospective secondary data for 3 fiscal years (2021–2023) together with a review of the medical records of readmitted patients; and conducted focus group discussions with the 25 interprofessional team members and network partners, divided into 3 groups according to the sub-district, district, and provincial levels. A workshop was then held to design the preliminary model and its accompanying tools, 5 experts evaluated their appropriateness, and a training workshop was held for the team that would use the model. Step 2, Act (March – August 2024). The model was trialed with 57 patients and 57 primary caregivers, with a pretest before implementation and a posttest at 12 weeks. Step 3, Observe. Implementation of the model at each service point was observed, field notes were recorded, the completeness of every information transfer was recorded, and clinical events were monitored monthly. Step 4, Reflect. Reflection meetings were held at the end of cycle 1 (28 May 2025) and cycle 2 (24 September 2025) to improve the model until the final version was obtained.

Data Analysis

1. General information of the sample, model appropriateness scores, and satisfaction scores were analyzed using frequency, percentage, arithmetic mean, and standard deviation.

2. Knowledge, self-management behavior, CAT, mMRC, inhaler technique accuracy, and clinical outcomes before and after implementation of the model in the same sample (one-group pretest-posttest) were compared using the paired t-test, or the Wilcoxon signed-rank test when the data were not normally distributed according to the Shapiro-Wilk test, and McNemar's test for dichotomous variables. Service indicators between FY 2023 and FY 2024 were compared using the chi-square test, or Fisher's exact test when the expected frequency was less than 5. One-tailed tests were used according to the direction of the hypotheses, with a significance level of $p < .05$.

3. Qualitative data from focus groups, reflection meetings, and field notes were analyzed by content analysis following Lincoln and Guba.[18] Trustworthiness was ensured through triangulation and member checking.

Research Ethics

The researcher observed the principles of research involving human participants by explaining the objectives, procedures, benefits, and risks to every participant both verbally and in writing. All participants took part voluntarily and signed informed consent forms, and they had the right to withdraw at any time without any effect on their medical care or work. All patients received standard care as usual alongside the model that was developed. Data were kept confidential using codes instead of names, results were presented in aggregate, and data will be destroyed 3 years after publication of the research results.

Results

1. Situation, problems, obstacles, and needs in the management of care for patients with chronic obstructive pulmonary disease in the health service network of Banthi District

Analysis of secondary data for 3 fiscal years and focus group discussions with the 25 interprofessional team members and network partners (8 at the sub-district level, 9 at the district level, and 8 at the provincial level) showed that most were female (80.00%), with a mean age of 45.60±10.26 years, mean health work experience of 15.72±5.33 years, and mean experience caring for COPD or chronic disease patients of 7.28±4.10 years; however, only 48.00% had received COPD training in the past 3 years. Retrospective data from Banthi Hospital showed that the number of registered patients was similar across years but service utilization increased markedly: admissions rose from 34 to 98 (an increase of 188.24%), and spirometry coverage remained below the 100% target.

Evaluation of quality indicators for FY 2024 against target values showed that only 3 of 15 indicators (20.00%) were met: the percentage of patients with a CAT score < 10 (88.74%), the number of acute exacerbations (28), and the percentage of patients receiving influenza vaccination (96.03%). The indicators furthest from target were the percentage of complete information transfer (12.90% against a target of ≥ 80), the percentage of patients using inhalers correctly (47.93% against a target of ≥ 85), the percentage of new patients confirmed by spirometry (52.63%), and the percentage of home visits within 7 days after discharge (25.51% against a target of ≥ 80). In addition, the 28-day readmission rate (20.41%) was about twice the target, and 2 patients died of COPD. A review of the medical records of 43 readmitted patients found that 86.05% had never received a LAMA.

The focus group discussions (10–17 December 2023) yielded 24 key statements, organized into 10 categories and 8 main problem themes: 1) delayed case finding and incomplete spirometry coverage, because older adults with chronic cough assumed it was due to smoking hand-rolled tobacco and SHPHs had no spirometer; 2) the district–province interface delaying access to medication according to severity, because patients had to wait up to a month for specialist consultation and consultation forms were incomplete; 3) patients and caregivers lacking self-management skills, both in inhaler use and in recognizing warning symptoms; 4) the hospital-to-home interface, with discharge planning incomplete when discharge occurred outside office hours and narrow home visit criteria; 5) information not following the patient and no feedback loop; 6) the community having no clear role; 7) environmental triggers of exacerbations, including smog in March–April and the burning of leaves and garbage; and 8) insufficient team capacity and resources, such as having only one pharmacist and too few spacers. The needs identified were a fast channel for specialist consultation via LINE, a case manager who cares for patients from the ward to the home, and a central network referral form. Synthesis showed that the quantitative and qualitative data were consistent: system-level problems lay at the interfaces of care, patient-level problems were inhaler technique and smoke exposure, and the remaining problems concerned resources.

2. Development of the seamless care management model for patients with chronic obstructive pulmonary disease in

the district-to-provincial health service network

The model was developed following the PAOR process with 25 interprofessional team members and network partners from all three levels. In the Plan step, the researcher and the team jointly designed a preliminary model with 5 components, together with accompanying tools: clinical guidelines, an information transfer form, a handbook for patients and caregivers, teaching media for inhaler use and pulmonary rehabilitation, an exacerbation action plan, and a network communication channel with a dust-level alert system. In the Act step, the model was trialed in 2 cycles. From 11 field note entries, in cycle 1, 6 of 9 patients whose technique was verified by the pharmacist did not coordinate breathing with actuating the inhaler, and teaching took 15 minutes per patient, so the team changed to group teaching sessions before the physician visit. Discharge planning by the D-METHOD was completed in 4 of 5 patients because the incomplete case was discharged on a Saturday, so a checklist was attached to the front of the chart. During a period of high dust levels, 4 patients came to the emergency room in a single week, so alerts via VHVs and SHPHs were initiated. SHPHs replied to referrals in 7 of 10 cases because the form was 2 pages long, so it was shortened. In cycle 2, practitioners could complete the referral form within 5 minutes, the nurse case manager prepared individual plans for all 6 group E patients, VHVs recorded symptom follow-up for 18 of 20 patients, and Lamphun Hospital sent treatment summaries back within 24 hours in 3 of 4 cases. Remaining problems were the night-shift workload of the case manager, 2 VHVs without smartphones, and 1 case in which Lamphun Hospital sent a patient back without a medication plan.

The final model comprises 5 components operating in an interlinked manner across the 3 levels of the network, with patients and primary caregivers at the center. The sub-district and community level screens, makes home visits, monitors symptoms, and issues dust-level alerts. The district level performs spirometry, classifies severity groups, provides case management, and plans discharge. The provincial level provides treatment consultation, receives referrals of severe cases, and sends information back. A 12-item information transfer form serves as the mechanism linking information between levels, as shown in Table 2 and Figure 1. Compared with the previous approach, the new model retains the original components that worked and adds linking mechanisms: a specialist consultation channel via LINE using a 1-page consultation form, a standardized information transfer form with a reply loop, case managers (with 2 backups), the roles of VHVs and local authorities, and expanded home visit criteria, which were previously limited to patients hospitalized more than twice a month or using home oxygen.

The appropriateness of the model was evaluated by 5 experts and the 25 interprofessional team members and network partners (30 persons in total). In round 1 (preliminary model), the overall mean score was 4.00±0.30, at the high level (experts 4.25±0.24, interprofessional team 3.96±0.29). The lowest-scoring items were the specialist consultation channel at Lamphun Hospital ($\bar{x}$ = 3.73) and the time to send information to SHPHs after discharge ($\bar{x}$ = 3.83). After revision, in round 2 (final model), the overall mean score was 4.46±0.25, at the high level (experts 4.65±0.31, interprofessional team 4.42±0.23), with every item in the range 4.37–4.60; the highest domain was discharge planning and information transfer ($\bar{x}$ = 4.53, S.D. = 0.30). The paired t-test showed that the total score increased significantly ($t = 5.87$, $p < .001$, $d = 1.07$) and increased in every domain, most in home and community continuing care (difference 0.55) and treatment and access to

medication (difference 0.54). The experts' scores increased but not significantly (t = 1.63, p = .089), which may be because there were only 5 experts.

3. Evaluation of the effects of the seamless care management model for patients with chronic obstructive pulmonary disease on patient and health service system outcomes

3.1 General information of patients and primary caregivers. The 57 patients were mostly male (70.18%), with a mean age of 68.23±8.73 years; 78.95% had primary school education, 73.68% had a family income below 10,000 baht per month, and 73.68% had been exposed to dust and smoke through their occupations, most commonly charcoal burning/field burning (40.35%) and longan drying (15.79%). Of the patients, 26.32% were still smoking, 52.63% used firewood/charcoal for cooking, and 35.09% regularly burned garbage/leaves around the home. In terms of severity, 59.65% were in group B and 40.35% in group E, with a mean FEV1 of 46.84±11.25% of predicted; only 10.53% used LAMA drugs and 19.30% used spacers. The 57 primary caregivers were mostly female (73.68%), with a mean age of 53.49±13.73 years; they were most often children of the patient (42.11%), and only 35.09% had ever been taught how to help patients use inhalers.

3.2 Knowledge, self-management behavior, disease impact, and inhaler use. Among the 54 patients and caregivers who completed follow-up, after implementation of the model the patients' knowledge score increased from 11.96±3.77 (low level) to 17.09±2.76 (high level) out of a maximum of 20 (t = 13.33, p < .001, d = 1.81), with medication and inhaler use increasing the most. The proportion of patients with a high level of knowledge rose from 18.52% to 79.63%. The primary caregivers' knowledge score increased from 13.56±3.52 to 17.89±2.04 (Z = 6.18, p < .001, r = 0.84), with the largest increase on the item on using a spacer for those who cannot press the inhaler (40.74% to 85.19%). The self-management behavior score increased from 71.96±10.38 to 93.61±9.30 out of a maximum of 120 (mean difference 21.65, 95% CI: 20.26, 23.03; t = 31.35, p < .001, d = 4.27), increasing in all 5 domains and all 24 items; the largest increases were in wearing a mask when going outdoors during the smog period (2.43 to 3.65) and using the controller inhaler daily as prescribed (2.93 to 4.13). The CAT score decreased from 14.81±3.68 to 11.22±3.37 (mean difference −3.59, 95% CI: −4.56, −2.62; t = 7.44, p < .001, d = 1.01). The proportion of patients with a CAT score below 10 increased from 5.56% to 31.48%, and the mMRC dyspnea grade decreased from a median of 2 to a median of 1. For inhaler use, the proportion of patients using the inhaler correctly in all steps increased from 27.78% to 77.78%; the step performed correctly least often before implementation was actuating the inhaler while inhaling slowly and deeply (63.04%). Only 8 patients used dry powder inhalers (Ellipta), and no significant difference was found at the step level, as shown in Table 1.

3.3 Clinical outcomes and service utilization. Comparing medical record data of the 54 patients between the 6 months before and the 6 months after enrollment, the number of acute exacerbations decreased from 55 to 30 (a 45.45% reduction), or from a mean of 1.02±1.17 to 0.56±0.69 per patient (Z = 2.15, p = .013, r = 0.29). Emergency room visits for exacerbations, hospital admissions, length of stay, inpatient treatment costs, and missed appointments all decreased significantly. The number of 28-day readmissions fell from 5 to 1 but was not statistically significant (p = .051), as shown in Table 5. The proportion of patients with at least one exacerbation fell from 55.56% to 44.44% (p = .163),

and the proportion of patients readmitted within 28 days fell from 7.41% to 1.85% (p = .124), neither of which was statistically significant. In terms of care processes, the proportion of patients undergoing spirometry increased from 68.52% to 100.00%, the proportion receiving medication according to severity group increased from 77.78% to 94.44%, and the proportion receiving LAMA or LAMA/LABA (long-acting beta-2 agonist) drugs increased from 9.26% to 64.81% (p < .001). Among hospitalized patients, home visits within 7 days after discharge increased from 2 of 18 patients (11.11%) to 9 of 11 patients (81.82%) (p < .001), and the time from specialist consultation to receipt of medication decreased from a mean of 27.00±5.20 days to 6.31±2.30 days.

3.4 Health service system outcomes. Comparing service system indicators between FY 2024 (before development) and FY 2025 (after development)[10,19], the number of indicators meeting targets increased from 3 to 10 of the 15 indicators with targets (20.00% to 66.67%). The indicators that increased significantly were new patients confirmed by spirometry, classification of severity group, receipt of medication according to severity group, correct inhaler use, complete discharge planning by the D-METHOD, complete information transfer, and home visits within 7 days after discharge. The 28-day readmission rate decreased from 20.41% (20 of 98 admissions) to 12.50% (9 of 72 admissions) but was not statistically significant and remained above target. In terms of workload, admissions decreased from 98 to 72 (a 26.53% reduction), acute exacerbations decreased from 28 to 17 (a 39.29% reduction), and patients receiving LAMA or LAMA/LABA drugs increased from 12 to 33, as shown in Table 6. For information transfer (62 transfers in FY 2024 and 78 in FY 2025), transfers with all 12 items complete increased from 12.90% to 91.03% (χ^2 = 85.74, p < .001), the mean completeness score increased from 10.19±1.10 to 11.90±0.35 out of 12, information reaching the receiving unit within 24 hours increased from 29.03% to 85.90%, and replies from the receiving unit increased from 27.42% to 84.62%, with the mean reply time decreasing from 5.41±2.85 days to 2.15±1.23 days. However, reverse-direction transfers (from SHPHs and Lamphun Hospital to Banthi Hospital) were only 75.00% complete and still need to be improved.

3.5 Satisfaction. The 54 patients and 54 primary caregivers were satisfied with the model overall at the same high level ($\bar{x}$ = 4.41, S.D. = 0.31 and 0.33, respectively). Together, the 108 respondents had a mean score of 4.41±0.32. The highest domain was knowledge and skills gained ($\bar{x}$ = 4.48), and the highest item was that inhaler use was taught clearly and practiced until proficient ($\bar{x}$ = 4.53). The lowest items were alerts and advice during the smog period ($\bar{x}$ = 4.14) and follow-up home visits by SHPH staff/VHVs ($\bar{x}$ = 4.28). The 25 interprofessional team members and network partners were satisfied overall at the high level ($\bar{x}$ = 4.22, S.D. = 0.29), with the highest domain being capacity development and participation ($\bar{x}$ = 4.38) and the lowest item being that the Lamphun Hospital specialist consultation system responded in a timely manner ($\bar{x}$ = 3.72).

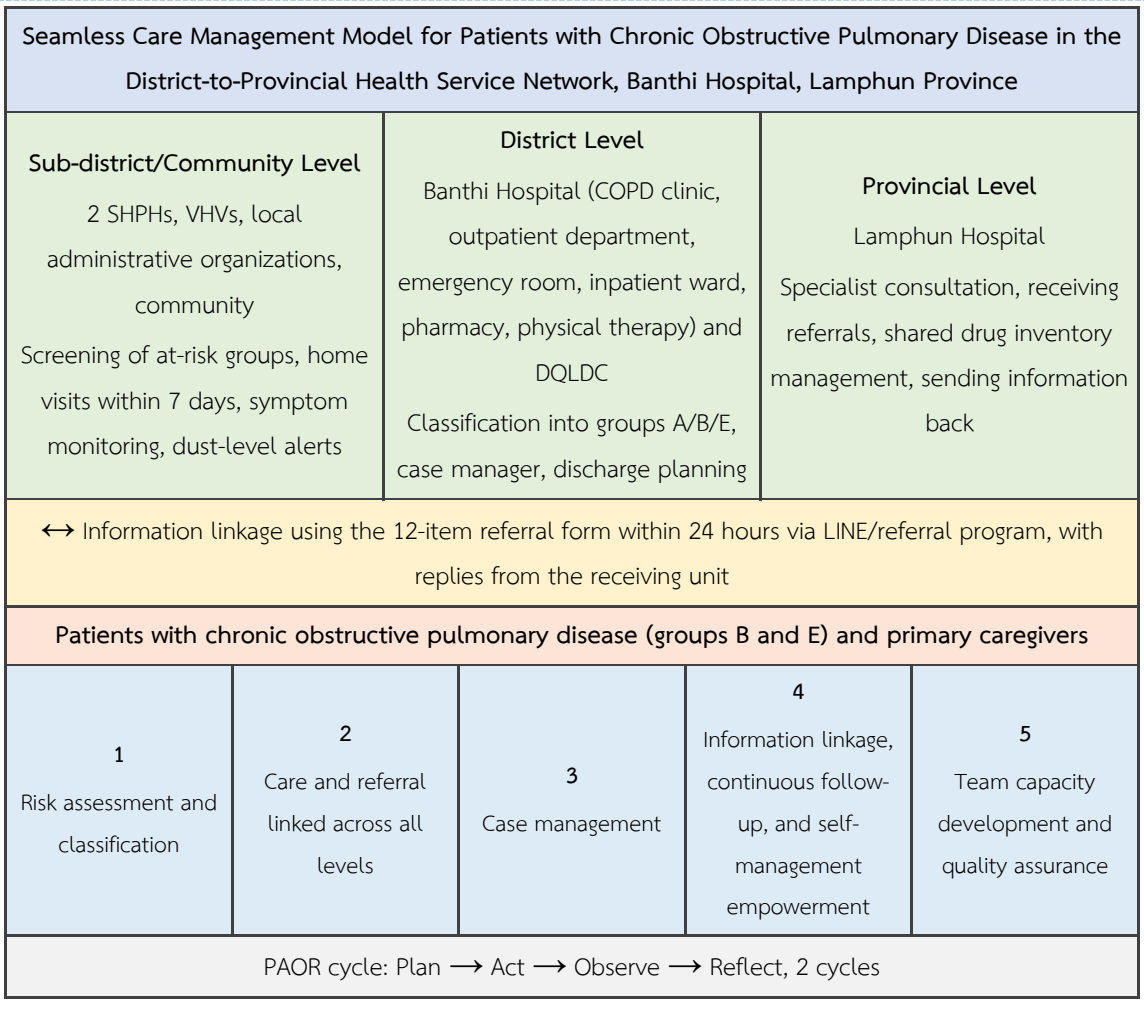
Table 1 Comparison of patient outcomes before and after implementation of the model (n = 54)

Outcome	Before	After	Test statistic	p-value
Patient knowledge score (0–20)	11.96±3.77	17.09±2.76	t = 13.33	< .001*

Outcome	Before	After	Test statistic	p-value
Primary caregiver knowledge score (0–20)	13.56±3.52	17.89±2.04	Z = 6.18	< .001*
Self-management behavior (24–120)	71.96±10.38	93.61±9.30	t = 31.35	< .001*
CAT score (0–40)	14.81±3.68	11.22±3.37	t = 7.44	< .001*
CAT < 10, n (%)	3 (5.56)	17 (31.48)	χ^2 = 12.07	< .001*
mMRC dyspnea grade	1.74±0.94	1.33±0.97	Z = 4.11	< .001*
Correct inhaler use score (%)	85.23±13.63	97.59±4.58	Z = 4.88	< .001*
Correct inhaler use in all steps, n (%)	15 (27.78)	42 (77.78)	χ^2 = 23.31	< .001*
6-minute walk distance (meters)	288.91±61.44	335.59±60.18	t = 4.92	< .001*
Peak flow (L/min)	196.59±52.82	217.20±42.41	t = 2.70	= .005*

Note: *Statistically significant (p < .05)

Figure 1 Seamless care management model for patients with chronic obstructive pulmonary disease in the district-to-provincial health service network, Banthi Hospital, Lamphun Province (final version)



Outcomes: Patient: knowledge, self-management behavior, CAT/mMRC, inhaler use, exacerbations, readmissions. Health service system: completeness of information transfer, receipt of medication according to severity, satisfaction

Discussion

The study of the situation, problems, obstacles, and needs in COPD care management in the Banthi District health service network found that the main problem in the area was not a lack of services but discontinuity of care at the interfaces between service levels. The indicators furthest from target were all interface indicators: complete information transfer, home visits within 7 days after discharge, and correct inhaler use. This is consistent with Piyanan,[12] who found that before developing care guidelines in a community hospital, the 28-day readmission rate was 20%, and with Licskai et al.,[20] who found that before an integrated disease management program was implemented, disease-related service use tended to rise continually. This suggests that when care is fragmented across service units, the hospitalization burden rises even though the number of patients does not. In terms of self-management, only 47.93% of patients used inhalers correctly, some patients stopped their medication on their own when their breathlessness resolved, and caregivers did not know the warning signs that require going to hospital promptly. In addition, smog in March–April and the burning of leaves and garbage in the community triggered exacerbations, and the community had no clear role.

Development of the model through 2 PAOR cycles with practitioners from all 3 levels of the network produced a model with 5 components. This is consistent with Piyanan,[12] who used participatory action research in 2 cycles with interprofessional personnel to obtain guidelines that clearly define the role of each profession. However, this model extends participation to the provincial hub hospital and local authorities, whereas most earlier Thai studies remained at the district level or within a single hospital.[9,11] Considering each component, risk assessment and severity classification together with receipt of medication by group follow the same principles as integrated disease management in primary care by Hussey et al.[21] and Licskai et al.[20] Case management is consistent with Sangmanthon et al.,[11] and discharge planning by the D-METHOD is consistent with Chumphuthep et al.,[9] but extends from in-hospital planning to information transfer using a standard 12-item form and home visits together with SHPHs and VHVs. The use of LINE as a channel for consultation and dust-level alerts is consistent with Zhuang et al.,[22] who showed that digital technology helps reduce CAT scores; however, reflection found that 2 VHVs had no smartphones, so the team designed a paper record form to be used in parallel with the digital channel. The appropriateness score increased significantly from 4.00 to 4.46, reflecting that the action research process could bring problems from actual practice into the model and adjust it accurately.

Regarding knowledge, self-management behavior, and quality of life, after implementation of the model patients and caregivers had higher knowledge scores, and patients' self-management behavior scores increased from 71.96 to 93.61. This is consistent with Sangmanthon et al.[11] and Junlasuk,[13] who found that knowledge and self-care behavior scores increased after care models were used. The CAT score decreased by 3.59 points, more than the mean reductions of 2.30 points in Hussey et al.[21] and 2.43 points at 6 months in Zhuang et al.,[22] and

exceeding the reduction of at least 3 points that Hussey et al.[21] used to indicate a clinically meaningful improvement in quality of life. The decreases in CAT and mMRC were accompanied by an increase of 46.69 meters in 6-minute walk distance, whereas Zhuang et al.[22] found no difference in 6-minute walk distance from digital technology alone; this may reflect that the pulmonary rehabilitation activities and the teaching of coughing and breathing included in this model contributed to physical capacity. Correct inhaler use in all steps increased from 27.78% to 77.78%, with a large improvement in coordinating actuation with inhalation, the same problem found in the focus groups; however, 22.22% of patients still did not perform all steps, so verification should continue.

Regarding exacerbations and readmissions, the numbers of exacerbations, emergency room visits, hospital admissions, length of stay, and inpatient treatment costs decreased significantly by 43.75–53.90%, in the same direction as Hussey et al.[21] and Licskai et al.,[20] who found that integrated disease management reduced emergency service use and hospitalization. However, the proportion of patients with at least one exacerbation and 28-day readmissions decreased but not significantly, and the system-level readmission rate fell from 20.41% to 12.50% but remained above target. The non-significant results of this study may be explained by the very small number of events (5 falling to 1), the small sample size, and the fact that the increase in patients receiving LAMA or LAMA/LABA drugs occurred only after development (9.26% to 64.81%), whose effect on reducing exacerbations may become clearer with longer follow-up. This is consistent with Licskai et al.,[20] who found that disease-related reductions nearly doubled by 36 months.

Regarding health service system outcomes, the number of indicators meeting targets increased from 3 to 10, with complete information transfer rising from 12.90% to 91.03%, home visits within 7 days from 25.51% to 87.50%, and complete discharge planning by the D-METHOD from 69.39% to 98.61%. For access to medication, the time from specialist consultation to receipt of medication fell from 27.00 days to 6.31 days, consistent with the use of the LINE consultation channel with a 1-page consultation form, and addressing the problem found before development that most readmitted patients had never received a LAMA. For information transfer, using the referral program and a network LINE group increased the proportion of information reaching the receiving unit within 24 hours from 29.03% to 85.90%, which supports the conclusion of Zhuang et al.[22] that digital technology is beneficial to care. However, digital channels should be used together with the roles of personnel such as case managers and VHVs. Patients and caregivers were highly satisfied ($\bar{x}$ = 4.41), most highly with the knowledge and skills gained, particularly the teaching of inhaler use, which was the most common problem in the situation analysis phase. This is consistent with Sangmanthon et al.[11] and Junlasuk,[13] whose patients were also highly satisfied.

Limitations of the study. This study used a one-group pretest-posttest design without a comparison group, so causal conclusions cannot be drawn. The sample size was small, the number of readmission events was low, and the follow-up period was relatively short. Some outcomes, such as the 28-day readmission rate, therefore cannot yet be concluded to have changed. The findings should be confirmed by studies with a comparison group and long-term follow-up.

Conclusion

The seamless care management model for patients with chronic obstructive pulmonary disease in the district-to-provincial health service network,

developed with the participation of network partners at all 3 levels, comprises 5 components: risk assessment and classification; care and referral linked across all levels; case management; information linkage, continuous follow-up, and self-management empowerment; and team capacity development and quality assurance. Its appropriateness was rated at the high level. After implementation of the model, improvements were found in knowledge, self-management behavior, CAT score, correct inhaler use, acute exacerbations, and the information transfer process, whereas the 28-day readmission rate cannot yet be concluded to have changed. However, this was a single-group study without a comparison group, so causal conclusions cannot be drawn.

Recommendations

1. The Lamphun Provincial Public Health Office and Lamphun Hospital should establish the specialist pulmonary consultation channel for network community hospitals as an official channel, specifying the responsible person, response time, and a standard consultation form; review the provincial drug list so that patients with severe disease have continuous access to LAMA or LAMA/LABA drugs; and support the budget for spirometers and spacers.

2. The director of Banthi Hospital should designate this model as the clinical practice guideline of the network, appoint a nurse case manager and backups, allocate pharmacists and physical therapists appropriately to the workload, and monitor the service indicators every fiscal year.

3. The model should be scaled up to other district health service networks in Lamphun Province and areas with similar contexts, adapting the components, communication channels, and home visit criteria to the resources of each area, together with training at least once a year for the interprofessional team, SHPHs, and VHVs in inhaler teaching, spacer use, interpretation of spirometry, and use of the 12-item referral form, and producing a video on inhaler use in the Northern Thai dialect as suggested by the evaluators.

4. Information transfer in the reverse direction from SHPHs and Lamphun Hospital to Banthi Hospital should be developed to be as complete as in the forward direction; a backup channel should be provided for patients and VHVs who cannot conveniently use smartphones, such as paper record forms via SHPHs; and spirometry days should be added so that new patients receive diagnostic confirmation in line with the target.

5. The DQLDC and local administrative organizations should include management of the environmental factors of COPD patients in their annual plans, for example, leaf and garbage disposal points in every village, village-level dust alert systems, and campaigns to reduce burning and smoking.

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ORIGINAL ARTICLE

Development of Health Literacy for Medical Cannabis Use in Yangtalad District, Kalasin Province

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Abstract

This research and development study aimed to examine the situation, develop a model, and evaluate the effects of enhancing health literacy on medical cannabis use among the general public and network partners in Yangtalad District, Kalasin Province, from January 2023 to October 2025 (34 months). The sample comprised 470 members of the general public and 470 network partners (n = 940), selected by proportionate simple random sampling across 15 sub-districts. Instruments were group processes for model development, an emergency-department case record form, and a seven-domain health literacy interview (total score 45; Cronbach's alpha = 0.86). Data were analyzed using descriptive statistics, paired t-test, independent t-test, and chi-square test, and verified through in-depth interviews, focus groups, and content analysis.

Before the development (January–March 2023), 286 cannabis-related patients visited the emergency department; the most common symptom was dry mouth and throat (24.13%) and the main purpose of use was recreation (48.25%). After the development (July–September 2025), visits decreased to 149, and use for cooking (42.28%) and medical purposes (38.26%) increased (χ^2 = 35.49, p<0.001). Health literacy among the public and network partners (n = 940) rose significantly from a low level ($\bar{x}$±S.D. = 32.95±2.72) to a moderate level (37.74±2.51) (t = 41.25, 95%CI = 4.56–5.02, p<0.001), with no difference between groups afterward (p = 0.625). The model comprised seven components: joint situation analysis; a committee with assigned duties; a medical cannabis education and service clinic; personnel training; support for sub-district health promoting hospitals; health literacy promotion through community enterprises; and surveillance of former drug-use groups through networks and communities. Districts with similar contexts may adopt this model, with continued surveillance of former drug-use groups, emergency-management training, and health literacy promotion.

Keywords: Medical cannabis, Health literacy, Network partners, Research and development

Introduction

Cannabis is the most widely used drug in the world. The World Drug Report 2025 of the United Nations Office on Drugs and Crime (UNODC) estimated that approximately 244 million people used cannabis in 2023, or 4.6% of the population aged 15–64 years.[1] Some users combine it with other drugs such as heroin, cocaine, and methamphetamine, and use is common among adolescents and working-age adults. Globally, cannabis has been promoted following the approach of developed countries that permit smoking or its use as a food ingredient. The United Nations removed cannabis from Schedule IV of the most dangerous drugs to allow more research and medical use, mainly for nausea and vomiting, chronic pain, spasticity, and seizures, although its efficacy remains limited and evidence is still scarce.[2] Long-term use reduces immunity; smokers face risks of respiratory disease and cancer similar to tobacco; cardiovascular effects may include myocardial infarction; and use may also cause infertility, nausea and vomiting, and reduced perception or consciousness.[3,4] Inappropriate dosing most commonly causes tachycardia (about 30%), and other symptoms may include apnea, cyanosis, bradycardia, hypotonia, and severe dystonic posturing.[5] Thailand classified cannabis as a Category 5 narcotic under the Narcotics Act (No. 7) B.E. 2562 (2019), but physicians could prescribe it for medical purposes only in necessary individual cases. On 9 June 2022, the Ministry of Public Health issued the Notification on Controlled Herbs (Cannabis) B.E. 2565, designating cannabis and cannabis extracts (genus Cannabis) as controlled herbs and allowing persons aged 20 years and over to possess, use, care for, store, transport, and sell cannabis, while prohibiting smoking in public places, use by pregnant or breastfeeding women, and sale to persons under 20 years or to pregnant or breastfeeding women.[6] Subsequently, the Ministry issued the Notification on Controlled Herbs (Cannabis) B.E. 2568, effective 26 June 2025, which repealed the 2022 notification and designated only cannabis inflorescences as controlled herbs for medical use, requiring a physician's prescription.[7]

Kalasin Province promoted cannabis, hemp, and kratom as the "three economic crops" and as alternative cash crops for farmers, except for inflorescences containing more than 0.2% tetrahydrocannabinol (THC); it also promoted the use of five cannabis formulations and established three pilot medical cannabis clinics.[8] Yangtalad was the first district in Kalasin Province to establish a medical cannabis clinic, using cannabis for cancer, Parkinson's disease, and epilepsy and to relieve inflammation and pain. Since 2020, in collaboration with Kamalasai Hospital, the Yangtalad Thai Herbal Plant Community Enterprise has grown cannabis and supplied it to Kamalasai Hospital, which produces licensed cannabis-based herbal medicines for patients who require such treatment.[9] Nevertheless, in January–March 2023, at the start of this study, 286 cannabis-related patients still presented to the emergency department of Yangtalad Hospital, mostly for recreational use (48.25%) rather than medical use (21.33%), reflecting misuse and inadequate health literacy among the public.

Health literacy is a concept promoted by the World Health Organization for global health at the 7th Global Conference on Health Promotion in Nairobi, Kenya.[10] It is associated with appropriate health behaviors, good health, and media literacy that lead to behavior change. The Department of Health has defined the basic components of health literacy that enable people to maintain their own health and advise their families.[11] The expansion of social media requires critical judgment to distinguish credible information. Health literacy is now highly important in an era in which cannabis is used for medical, culinary, or recreational purposes, in order to shape appropriate behaviors and reduce the systemic and individual health impacts of cannabis use.[12] Thailand has endorsed this concept to maintain good health in the dimensions of self, family, society, online media, critical judgment, information discernment, and practice leading to health skills.[13] Related studies include the development of a surveillance network and health literacy promotion for medical cannabis use among people in Nakhon Nayok Province[14] and a survey of cannabis-use health literacy among people in Phanna Nikhom District, Sakon Nakhon Province.[15] However, studies that develop a model using network partners and communities as the main mechanism, follow outcomes continuously at the district level for more than two years, and compare health literacy between the general public and network partners remain limited. This study aimed to fill this knowledge gap.

Thailand is now facing a transition from cannabis as an illegal substance to an era of liberalized cannabis. Traditional community knowledge existed but had long been unused, and people often rely on trial and error, leading to incorrect, unsafe, excessive, or inappropriate use. With the 2025 legal change restricting cannabis inflorescences to medical use, the public and network partners need accurate and up-to-date literacy even more. The researcher therefore aimed to develop a model to address these community problems appropriately and sustainably over 34 continuous months (January 2023 – October 2025). The findings are expected to guide districts with similar contexts, health service units, and network partners in promoting health literacy and reducing harm from inappropriate cannabis use.

Research Objectives

1) To examine the situation, approaches, and existing model of medical cannabis use among the general public and network partners in Yangtalad District, Kalasin Province.
2) To develop a model for promoting health literacy on medical cannabis use among the general public and network partners in Yangtalad District, Kalasin Province.
3) To evaluate the effects of health literacy development on medical cannabis use among the general public and network partners in Yangtalad District, Kalasin Province.

Methods

This research and development study examined the development of health literacy for medical cannabis use in Yangtalad District, Kalasin

Province, from January 2023 to October 2025 (34 months). It comprised three phases: Phase 1, study of context and situation (months 1–3: January–March 2023); Phase 2, model development (months 4–6: April–June 2023); and Phase 3, evaluation, activity improvement, and lessons learned every three months (months 7–34: July 2023 – October 2025), as detailed below.

Population and Sample

Population included 109,028 residents of the 15 sub-districts of Yangtalad District during January 2023 – October 2025 (34 months), 722 network partners, and all patients who presented to the emergency department with cannabis-related conditions.

Sample The sample consisted of two parts. Part 1 was the sample for measuring health literacy before and after development. The sample size was calculated using the formula for estimating a proportion with a known population size,[16] yielding 469.78, rounded to 470 per group (940 in total): 1) 470 members of the general public and 2) 470 medical cannabis network partners. Part 2 comprised the groups involved in model development, namely community leaders, village health volunteers (VHVs), public representatives, heads of government agencies, public health personnel, community enterprises, and former drug-use groups under surveillance (details in Results). Sampling covered all 15 sub-districts, with households in each sub-district allocated proportionally by household size, followed by simple random sampling by lottery; one person was selected per household, and the next household was drawn if needed. Participants lost before the end of the project were replaced by the next participants on the list whose data had already been collected.

Inclusion criteria 1) Aged 15 years or older, resident in Yangtalad District for at least one year, able to communicate in Thai, and willing to participate; 2) network partners had worked in medical cannabis or health in the area for at least six months, including community leaders, VHVs, public health personnel, and community enterprise members.

Exclusion criteria Moving out of the area, loss to follow-up, withdrawal from the study, or incomplete interviews (replaced by the next person on the list whose data had already been collected).

Research Instruments

The research instruments comprised: 1) instruments for context study and model development, namely a problem-solving process for medical cannabis use and health literacy in the area, consisting of group interviews, group processes to gather and analyze problems, setting of measures, community forums, assignment of network partner roles, lessons learned on problems, obstacles, and solutions, and revision of measures, activities, and partner roles in line with the lessons learned; and 2) data collection instruments, namely 2.1) a medical cannabis use record form for health facilities and 2.2) a health literacy interview developed from a literature review and adapted from the Department of Health, Ministry of Public Health, covering seven domains of medical cannabis use: 1) knowledge and understanding, 2) access to information and services, 3) communication, 4)

self-management of health conditions, 5) media and information literacy, 6) decision-making on correct practices, and 7) self-care behavior. The total score for all seven domains was 45, interpreted at three levels: low (below 34.00), moderate (34.00–38.99), and high (39.00–45.00). Content validity (IOC) was examined by three lecturers from the Faculty of Health Sciences, Kalasin University, and reliability was tested with 30 participants in a neighboring district, yielding a Cronbach's alpha coefficient of 0.86.

Data Collection

Data were collected in two forms: secondary data copied from the records of Yangtalad Hospital, Kalasin Province, and primary data obtained from group activities and interviews. The procedures were as follows: letters requesting permission to collect data and participate in group activities were sent to heads of government and private agencies; letters were sent to communities requesting permission to collect data in the area; the situation, local problems, number of patients, symptoms, purposes of cannabis use, and health literacy before development were collected and analyzed (January–March 2023); the roles of network partners in problem-solving were defined (April 2023); measures, activities, and partner roles were implemented (April–June 2023); lessons learned on problems, obstacles, and solutions were summarized (July 2023); measures, activities, and partner roles were revised according to the lessons learned (August 2023); the revised measures were implemented with lessons learned every three months (September 2023 – June 2025); emergency department data were collected and health literacy was assessed after development (July–September 2025); and the final lessons learned were summarized (October 2025).

Data Analysis

Data from the interviews and record forms were tabulated and analyzed using R-studio. Descriptive statistics, including frequency distribution, percentage, arithmetic mean ($\bar{x}$), and standard deviation (S.D.), were used to describe sex, age, marital status, education level, and income. Inferential statistics were tested at a significance level of .05: paired t-test to compare scores before and after development, independent t-test to compare scores between the general public and network partners, and chi-square test to compare the proportions of emergency department patients before and after development. Data from in-depth interviews and group meetings were analyzed using content analysis.

Research Ethics

This study was conducted with consideration for human research ethics of the Kalasin Provincial Public Health Office, with continuous attention to privacy, confidentiality, and informed consent. The researcher explained the objectives and procedures to participants before data collection and obtained signed informed consent. Emergency department data were de-identified, and participants could withdraw from the study at any time without affecting their access to services.

Results

1. Situation, approaches, and existing model of medical cannabis use among the general public and network partners

1.1 General characteristics of the sample The 470 members of the general public were mostly female (72.55%), aged 25 years or younger (52.77%; $\bar{X}$±S.D. = 28.14±8.10 years), and all were Buddhist (100%). Most were married (58.72%), had a primary school education (54.26%), worked in agriculture (77.87%), and had a family income below 10,000 baht (55.96%; $\bar{X}$±S.D. = 10,420.50±9,610.25 baht). Among the 470 medical cannabis network partners, most were female (70.43%) and aged 41–45 years (34.89%; $\bar{X}$±S.D. = 41.20±7.28 years), and all were Buddhist (100%); 79.15% were married, 35.96% held a bachelor's degree or higher, 38.94% were government employees, and 51.28% had a family income below 10,000 baht ($\bar{X}$±S.D. = 18,532.40±18,970.15 baht), as shown in Table 1.

1.2 Situation, problems, approaches, and existing model of medical cannabis use Before the development (January–March 2023), 286 patients presented to the emergency department of Yangtalad Hospital because of cannabis use. The largest group was aged 60 years or older (84 patients; 29.37%). The most common symptoms were dry mouth and throat (24.13%), palpitations (18.53%), and drowsiness (13.64%), respectively, followed by seizures (12.59%) and unsteady gait (11.54%). The main purpose of use was recreation (48.25%), followed by cooking (30.42%) and medical purposes (21.33%), respectively. The existing model emphasized passive services in public health facilities. Focus groups indicated that increasing cannabis use was associated with news trends, popularity in the community, online ordering, and changes in the law, while the public and network partners still lacked knowledge and confidence about correct use and legal requirements. Health literacy before the development was low ($\bar{X}$±S.D. = 32.95±2.72 points out of a possible 45).

2. Development of a model to promote health literacy for medical cannabis use

2.1 Process and target groups for model development The model development addressed seven domains of health literacy, with the following target groups: 1) community leaders from 15 villages (15 persons); 2) VHVs, 5 per village (75 persons); 3) public representatives, 10 per village from 15 villages (150 persons); 4) the Yangtalad District Chief Officer and heads of government agencies (22 persons); 5) the director of Yangtalad Hospital, the District Public Health Officer, and the persons responsible for medical cannabis services in the community hospital and sub-district health promoting hospitals (54 persons in total); 6) two community enterprise groups in Yangtalad District (106 persons); and 7) former drug-use groups requiring community surveillance (34 persons). Activities followed the steps shown in Table 2.

2.2 Model obtained from the development In the initial phase of development (April–June 2023), Yangtalad District found more patients using cannabis for recreation than for medical purposes, and severe symptoms such as seizures and unsteady gait began to appear more often. The model was therefore

adjusted by increasing surveillance of former drug-use groups and sending personnel and community members for training on medical cannabis use, emphasizing appropriate dosing and avoidance of use by people with allergies. After the measures were revised, the model comprised seven components: 1) joint situation analysis using the district health system approach; 2) a committee with assigned duties and responsible persons among the network partners; 3) a medical cannabis education and service clinic dispensing five cannabis formulations; 4) personnel development, sending physicians, pharmacists, nurses, Thai traditional medicine practitioners, sub-district health promoting hospital staff, VHVs, and community leaders for training to strengthen health literacy in medical cannabis use; 5) support for sub-district health promoting hospitals to promote health literacy in the community; 6) health literacy promotion through community enterprises, namely the Yangtalad Thai Herbal Plant Community Enterprise (growing, processing, and producing medicines), together with the hemp group, the Nong Tok Paen group, and a private group in Yangtalad Sub-district; and 7) surveillance of former drug-use groups through the community and network partners. When the law changed in June 2025, the committee adjusted its publicity and training to comply with the new notification controlling cannabis inflorescences for use under a physician's prescription.

3. Effects of health literacy development on medical cannabis use

3.1 Comparison of health literacy before and after the development Health literacy scores of the 940 members of the general public and network partners differed significantly in every domain before and after the continuous development, in both the general public and the network partners ($p<0.001$). The total score across the seven domains for both groups combined increased from a low level (32.95±2.72 points) to a moderate level (37.74±2.51 points) ($t = 41.25$, 95%CI = 4.56–5.02, $p<0.001$). The general public increased from 32.35±2.71 to 37.70±2.54 points, and the network partners from 33.55±2.60 to 37.78±2.47 points. The domain with the greatest increase in both groups was self-care behavior ($t = 18.43$ and 17.12, respectively), as shown in Table 3.

3.2 Comparison of health literacy between the general public and network partners Before the development, the network partners had a significantly higher total health literacy score than the general public (33.55 and 32.35 points; $t = -6.93$, $p<0.001$). After the development, however, the scores were 37.70 points for the general public and 37.78 points for the network partners, which did not differ ($t = -0.49$, $p = 0.625$), as shown in Table 4.

3.3 Emergency department patients with cannabis-related conditions before and after the development After the continuous development (July–September 2025), 149 patients presented to the emergency department, down from 286 (a decrease of 47.90%). The largest group was again aged 60 years or older (43 patients; 28.86%). The most common symptoms were dry mouth and throat (26.85%), palpitations (20.13%), and drowsiness (16.11%), respectively. Indicators of severity decreased: seizures fell from 12.59% to 5.37% ($\chi^2 = 5.61$, $p = 0.018$), while unsteady gait fell from

11.54% to 7.38%, which was not statistically significant (χ^2 = 1.86, p = 0.173). The main purpose of cannabis use shifted from recreation (48.25% before the development) to cooking (42.28%) and medical purposes (38.26%), and the proportion using cannabis for recreation fell to 19.46%, a statistically significant change (χ^2 = 35.49, p<0.001), as shown in Table 5.

Table 1 Demographic characteristics of the general public and medical cannabis network partners

Demographic characteristic	General public (n = 470) n (%)	Medical cannabis network partners (n = 470) n (%)
Sex		
Male	129 (27.45)	139 (29.57)
Female	341 (72.55)	331 (70.43)
Age (years)		
25 years or younger	248 (52.77)	12 (2.55)
26-30 years	83 (17.66)	38 (8.09)
31-35 years	42 (8.94)	49 (10.43)
36-40 years	52 (11.06)	83 (17.66)
41-45 years	24 (5.11)	164 (34.89)
46 years or older	21 (4.47)	124 (26.38)
Marital status		
Single	181 (38.51)	71 (15.11)
Married and living together	276 (58.72)	372 (79.15)
Widowed/divorced/separated	13 (2.77)	27 (5.74)
Education level		
Primary school	255 (54.26)	118 (25.11)
Lower secondary school	142 (30.21)	74 (15.74)
Upper secondary school/Vocational certificate	53 (11.28)	109 (23.19)
Bachelor's degree or higher	20 (4.26)	169 (35.96)
Occupation		
Agriculture/farming	366 (77.87)	152 (32.34)
Government service/public sector	0 (0.00)	183 (38.94)
Trading/private business	20 (4.26)	87 (18.51)
General labor/student/other	84 (17.87)	48 (10.21)
Monthly family income (baht)		
Below 10,000	263 (55.96)	241 (51.28)

Demographic characteristic	General public (n = 470) n (%)	Medical cannabis network partners (n = 470) n (%)
10,000 or more	207 (44.04)	229 (48.72)

Table 2 Steps of model development, activities, tools, duration, and academic rationale (January 2023 – October 2025)

Phase/Month	Activities/Content	Tools used	Duration	Academic rationale
Jan–Mar 2023	Studied the context and analyzed the situation jointly using the district health system approach; collected emergency department patient data; assessed health literacy before the development	Emergency department case record form, health literacy interview, focus groups	3 months	Used empirical data to define problems and as the baseline for before–after comparison
Apr 2023	Established a committee, assigned duties, and defined network partner roles	Group processes, community forums	1 month	Principle of community and network participation for sustainability
Apr–Jun 2023	Implemented the measures: set up the medical cannabis education and service clinic (five formulations), trained personnel, and supported sub-district health promoting hospitals and community enterprises	Educational media, training, user manual	3 months	Developed the seven health literacy domains based on the Department of Health concept
Jul 2023	Lessons learned on problems, obstacles, and solutions	Lessons-learned group process	1 month	Action learning to improve the measures
Aug 2023	Revised the measures, adding surveillance of former drug-use groups and training in emergency management of cannabis-related conditions	Community forums, group processes	1 month	Responded to the severe symptoms observed, such as seizures and unsteady gait
Sep 2023 – Jun 2025	Implemented the revised measures, monitored results, and drew lessons learned every 3 months	Case record form, group meetings	22 months	Continuous improvement (PDCA) in line with changing contexts and laws

Phase/Month	Activities/Content	Tools used	Duration	Academic rationale
Jul–Sep 2025	Post-development evaluation: collected emergency department patient data and measured health literacy	Case record form, health literacy interview	3 months	Systematic before–after comparison of results
Oct 2025	Summarized the final lessons learned and the model	Group processes, in-depth interviews	1 month	Verified the model qualitatively against the quantitative results

Table 3 Comparison of mean health literacy scores for medical cannabis use before and after the development, by group (Paired t-test)

Variable	Group	Before		After		t	p-value
		$\bar{x}$	S.D.	$\bar{x}$	S.D.		
1. Knowledge and understanding (full score 10)	General public	7.18	1.60	8.20	1.27	10.79	<0.001*
	Network partners	7.48	1.52	8.22	1.23	8.23	<0.001*
2. Access to information and services (full score 5)	General public	3.55	0.92	4.17	0.69	11.69	<0.001*
	Network partners	3.70	0.88	4.18	0.67	9.46	<0.001*
3. Communication (full score 5)	General public	4.42	0.84	4.93	0.79	11.06	<0.001*
	Network partners	4.54	0.80	4.93	0.77	8.90	<0.001*
4. Self-management of health conditions (full score 5)	General public	3.40	0.94	4.04	0.85	11.56	<0.001*
	Network partners	3.55	0.90	4.07	0.83	9.80	<0.001*
5. Media and information literacy (full score 5)	General public	3.75	1.05	4.22	0.78	7.84	<0.001*
	Network partners	3.89	1.00	4.21	0.76	5.55	<0.001*
6. Decision-making on correct practices (full score 5)	General public	2.98	0.86	3.37	0.67	8.05	<0.001*
	Network partners	3.10	0.82	3.38	0.65	6.07	<0.001*
7. Self-care behavior (full score 10)	General public	7.07	1.56	8.77	0.82	18.43	<0.001*
	Network partners	7.29	1.50	8.79	0.78	17.12	<0.001*
Total score, 7 domains (full score 45)	**General public**	**32.35**	**2.71**	**37.70**	**2.54**	**32.04**	**<0.001***
	Network partners	**33.55**	**2.60**	**37.78**	**2.47**	**26.20**	**<0.001***

Note: *Statistically significant at p-value <.05

Table 4 Comparison of mean health literacy scores for medical cannabis use between the general public and network partners, before and after the development (Independent t-test)

Variable	General public (n = 470)		Network partners (n = 470)		t	p-value
	$\bar{x}$	S.D.	$\bar{x}$	S.D.		
Overall health literacy before the development (full score 45)	32.35	2.71	33.55	2.60	-6.93	<0.001*
Overall health literacy after the development (full score 45)	37.70	2.54	37.78	2.47	-0.49	0.625
Knowledge and understanding domain before the development (full score 10)	7.18	1.60	7.48	1.52	-2.95	0.003*
Knowledge and understanding domain after the development (full score 10)	8.20	1.27	8.22	1.23	-0.25	0.806

Note: *Statistically significant at p-value <.05

Table 5 Comparison of cannabis use purposes and severe symptoms among emergency department patients before and after the development (Chi-square test)

Variable	Before the development (N = 286) n (%)	After the development (N = 149) n (%)	χ^2	p-value
Purpose: cooking	87 (30.42)	63 (42.28)	35.49	<0.001*
Purpose: recreation	138 (48.25)	29 (19.46)		
Purpose: medical	61 (21.33)	57 (38.26)		
Seizures	36 (12.59)	8 (5.37)	5.61	0.018*
Unsteady gait	33 (11.54)	11 (7.38)	1.86	0.173

Note: *Statistically significant at p-value <.05

Discussion

The results showed that before the development (January–March 2023), most emergency department patients used cannabis for recreation (48.25%) rather than for medical purposes (21.33%), and public health literacy was low. The number of cannabis-related patients tended to rise at first because of news trends, popularity in communities, online ordering, government policy, and the announcement or amendment of important laws. Development was difficult in the initial phase: strategies had to be adjusted, the public had to

be informed of the dangers of incorrect medical use or overdose, and psychiatric patients with former substance use had to be monitored, after which the number of patients could be reduced. This is consistent with Worathanarat, whose final report on a medical cannabis policy case study identified key problems to be addressed, namely knowledge and understanding, medical beliefs, effects on medical treatment, fake news and misleading advertising, the expansion of the cannabis business, difficulties in building knowledge about cannabis, and social problems arising from the medical cannabis policy.[17]

Indicators of severity, such as seizures and unsteady gait, observed in the early phase showed that cannabis was being used in the community in increasing amounts and without adequate knowledge of its use, or possibly mixed with other substances and obtained easily. The researcher therefore adjusted the measures by publicizing information in the community, monitoring former substance-use groups and previously ill patients to prevent recurrence, and advising that cannabis be used appropriately for sex, age, or body weight and avoided by people with allergies. These measures reduced the severe symptoms, with seizures decreasing significantly. This is consistent with Panwichian, who studied factors associated with medical cannabis use behavior and found that personal characteristics, patterns of use, and perceived advantages and disadvantages of medical cannabis were related to the public's medical cannabis use behavior.[18] The seven-component model can be sustained only if the community is placed at the center and participates in building health literacy. This is consistent with Jomsri et al., who developed a program to enhance correct health literacy on medical cannabis use among people in Chiang Rai Province and found that the program increased health literacy and that continuous information from relevant agencies was important to its success.[19]

The purpose of cannabis use shifted from recreation to cooking and medical purposes after the development. The patients presenting to the emergency department were mostly recreational users rather than medical users, and the relaxation of the law for medical use worked in this group's favor. Although the model in Yangtalad District was implemented seriously, the proportion of medical use after the development rose to only 38.26%, still slightly below cooking use (42.28%). Only public health facilities encouraged use in patients, and the public itself still used cannabis little for medical purposes, possibly because of fear and lack of knowledge. Development should therefore focus on promoting health literacy for medical cannabis use. This is consistent with Sihakhom and Sihakhom, who studied knowledge and attitudes toward medical cannabis use among pharmacists in community hospitals in Sakon Nakhon Province and found moderate knowledge and attitudes; sex and training experience affected knowledge, while sex, age, work experience, and training experience affected attitudes. Training activities on medical cannabis use should therefore be provided for both the public and personnel.[20]

The model-based development significantly increased health literacy. Because the Yangtalad model used network partners and the community as the main driving mechanism, it succeeded readily, although it took a long time,

measured in years. In the early phase, legal problems arose and network partner personnel lacked confidence, so they were sent for additional training on medical cannabis use and relevant laws. This is consistent with Onklai and Suwanphan, who studied health literacy on medical cannabis use among village health volunteers in Khon Kaen Province and found that most had moderate literacy in each domain, and that relevant agencies should develop this literacy, especially among VHVs whose level was still low, including those with misconceptions, such as using cannabis to relieve asthma.[21] In addition, before the development the network partners scored higher than the general public, but after the development the scores of the two groups did not differ (37.70 and 37.78 points), indicating that promotion through network partners and the community brought the public's health literacy close to that of those who work directly in this field.

Limitations of the study This research and development study had no control group, so causal relationships cannot be clearly concluded. The findings may have been influenced by external factors, particularly the June 2025 legal change that restricted cannabis inflorescences to medical use under a physician's prescription, which took effect before the post-development data collection period (July–September 2025). In addition, the emergency department data came from a single hospital, and health literacy was measured by interview, which may be subject to social desirability bias.

Conclusion

The development of health literacy for medical cannabis use in Yangtalad District, Kalasin Province, between January 2023 and October 2025 produced a seven-component model that uses network partners and the community as the main mechanism. After the development, emergency department visits decreased from 286 to 149 patients, seizures decreased significantly, the purpose of use shifted from recreation to cooking and medical purposes, and the health literacy of the public and network partners increased significantly from a low to a moderate level ($p<0.001$). After the development, the scores of the general public did not differ from those of the network partners.

Recommendations

1. Recommendations for applying the findings Districts with similar contexts can adopt this model, but should monitor former drug-use groups, promote training in managing cannabis-related medical emergencies, promote health literacy among network partners and the public, and keep communication up to date with legal changes, namely the Notification on Controlled Herbs (Cannabis) B.E. 2568 (2025).

2. Recommendations for future research Future studies should include a comparison group in areas that did not receive the model, follow up over the long term after legal changes, and also examine the clinical outcomes and safety of medical cannabis users.

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ORIGINAL ARTICLE

Development of Clinical Nursing Practice Guidelines for the Prevention of Early Postpartum Hemorrhage in the Labor Room, Ban Dung Crown Prince Hospital, Udon Thani Province

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Abstract

This action research aimed to 1) develop clinical nursing practice guidelines for the prevention of early postpartum hemorrhage (PPH) in the labor room of Ban Dung Crown Prince Hospital, Udon Thani Province, 2) evaluate the outcomes of guideline implementation, 3) test the outcomes against predefined criteria using inferential statistics, and 4) compare knowledge and self-care practices of postpartum women before and after receiving care under the guideline. The Plan–Act–Observe–Reflect cycle was applied with an evidence-based practice approach from January to August 2026. Participants were 13 registered nurses in the labor and postpartum nursing units (total population). In addition, 32 postpartum women who received care under the guideline were included for outcome evaluation. The study had three phases: situation analysis and planning, guideline development and pilot implementation, and outcome evaluation and reflection. Instruments were a demographic questionnaire, a 20-item knowledge test, and assessments of problems and development needs, feasibility, and satisfaction, together with knowledge and self-care practice assessments for postpartum women. Data were analyzed using descriptive statistics, the one-sample t-test, and the paired t-test with 95% confidence intervals (CI) and Cohen's d, at a significance level of 0.05.

The guideline comprised six components: risk assessment, care during labor, active management of the third stage of labor (AMTSL), surveillance during the first two hours postpartum, assessment and management based on the 4Ts, and handover and continuity of care. After implementation, the mean knowledge score was 17.15 out of 20 (85.77%), which did not differ significantly from the 80% criterion (t=2.02, p=0.066). Among the 32 postpartum women, knowledge scores (11.84 to 16.53 out of 20) and self-care practice scores (3.12 to 4.05 out of 5) were significantly higher after receiving care under the

guideline ($p<0.001$). Development needs ($\bar{x}=3.84$), feasibility ($\bar{x}=3.78$), and satisfaction ($\bar{x}=4.03$) were at a high level and significantly higher than the criterion of 3.40 ($p<0.05$). The guideline was clear, appropriate to the context, feasible, and well accepted. Continuous monitoring of adherence and clinical outcomes, together with a pre–post evaluation using a paired t-test, is recommended.

Keywords: early postpartum hemorrhage, clinical nursing practice guideline, labor room, inferential statistics

Introduction

Postpartum hemorrhage (PPH) is an obstetric emergency and a major cause of maternal death worldwide. The World Health Organization reports that it accounts for 25–30% of maternal deaths, particularly in developing countries, and it can occur in women with or without antecedent risk factors.[1] Early postpartum hemorrhage is defined as blood loss of 500 mL or more after vaginal delivery, or 1,000 mL or more after cesarean section, within the first 24 hours after birth.[2] ACOG and RCOG further emphasize that diagnosis should consider clinical signs, namely changes in vital signs, shock, and the need for transfusion, rather than the volume of blood lost alone.[3,4] The causes are explained by the 4Ts: uterine atony (Tone), the most common cause at 70–80%; genital tract trauma (Trauma), 20%; retained placenta or placental fragments (Tissue), 10%; and coagulopathy (Thrombin), 1%.[5] Despite standard measures such as active management of the third stage of labor (AMTSL), risk assessment, and continuous monitoring of blood loss, PPH still occurs even in women without risk factors; therefore, surveillance systems and practice guidelines suited to the context of each service unit are needed.

Thailand has set the reduction of maternal mortality as a key indicator of the health service system,[6] with a target maternal mortality ratio of no more than 17 per 100,000 live births. Meanwhile, the Thai maternal mortality ratios in 2019–2023 were 22.5, 22.9, 39.8, 25.66, and 21 per 100,000 live births, respectively, and hemorrhage remained the leading cause of obstetric death,[7] especially in community hospitals, which have limited resources and personnel. Ban Dung Crown Prince Hospital, Udon Thani Province, is a 120-bed, level M2 community hospital with one obstetrician and 15 registered nurses assigned to the labor room nursing unit and postpartum ward. Statistics for 2021–2025 show 625, 681, 602, 486, and 467 deliveries and 21, 26, 12, 7, and 4 cases of postpartum hemorrhage, or 3.36%, 3.82%, 1.99%, 1.44%, and 0.85%, respectively.[8] Although the declining trend was statistically significant (chi-square test for trend: $\chi^2=12.62$, df=1, $p<0.001$), medical record review, practice observation, case review, and focus group discussions revealed inconsistent practice between individuals, inconsistent risk assessment and uterine contraction monitoring, incomplete documentation, and unsystematic information handover between the labor room and the postpartum ward, which may affect maternal safety. Note that these figures are unit-level statistics and did not test the effectiveness of any guideline.

Action research following the concept of Kemmis and McTaggart allows practitioners to participate in analyzing problems, designing, piloting, reflecting on, and improving their work through the Plan–Act–Observe–Reflect cycle, which fosters ownership of the guideline and sustainability of change.[9] When integrated with evidence-based practice (EBP),[10] the model of

Rosswurm and Larrabee,[11] Donabedian's framework of quality of care,[12] and guidance from the World Health Organization, ACOG, RCOG, and the Royal Thai College of Obstetricians and Gynaecologists,[1–4,13] it yields a guideline that is academically sound and consistent with the context. Studies in Thailand have found that participatory guideline development enhances team capacity, increases satisfaction, and reduces the incidence of PPH.[14–18] However, the unit has no guideline developed jointly by practitioners on the basis of empirical evidence, leaving a knowledge-to-practice gap. The researchers therefore developed a guideline through action research to raise nurses' knowledge and practice, promote teamwork, and enhance maternal safety, using inferential statistics to assess whether knowledge, feasibility, and satisfaction differed significantly from predefined criteria and to compare the knowledge and self-care practices of postpartum women before and after receiving care under the guideline.

Research Objectives

1) To develop a guideline for the prevention of early postpartum hemorrhage in the labor room of Ban Dung Crown Prince Hospital, Udon Thani Province, using a participatory action research process.
2) To study the outcomes of implementing the guideline for the prevention of early postpartum hemorrhage in the labor room of Ban Dung Crown Prince Hospital, Udon Thani Province.
3) To test the outcomes of guideline implementation, namely knowledge, feasibility, and satisfaction, against predefined criteria using inferential statistics.
4) To compare the knowledge and self-care practices of postpartum women before and after receiving care under the guideline using inferential statistics.

Methods

This study was action research following the Plan–Act–Observe–Reflect cycle[9] combined with evidence-based practice. It was conducted in the labor room nursing unit and the postpartum nursing unit of Ban Dung Crown Prince Hospital, Udon Thani Province, from January to August 2026. The work was divided into three phases: Phase 1, situation analysis and planning (Plan); Phase 2, guideline development and pilot implementation (Act–Observe); and Phase 3, outcome evaluation and reflection (Reflect), as detailed below.

Population and Sample

Population Group 1 : registered nurses working in the labor room nursing unit and the postpartum nursing unit of Ban Dung Crown Prince Hospital during the study period, totaling 13 nurses. **Population Group 2:** women who gave birth in the labor room nursing unit of Ban Dung Crown Prince Hospital during the study period.

Nurse sample. The total population of **13** registered nurses was used, without random sampling, because all staff rotate in caring for women in labor from the waiting stage through delivery and the first **2** hours postpartum, and have a direct role in developing and using the guideline. A sample of **1 3** provides statistical power of **7 5 %** for a large effect size (Cohen's d = **0.80)** and **38%** for a medium effect size (d = **0.50)** at a two-sided significance level of **0.05.**

Postpartum women sample. Thirty-two women were selected by purposive sampling according to the specified criteria. A sample of 32 provides power of approximately 78% for a medium effect size (d = 0.50) and more than 99% for a large effect size (d = 0.80) for the paired t-test at a two-sided significance level of 0.05.

Inclusion criteria for registered nurses: holding a license to practice nursing and midwifery, working in the unit for at least 6 months, being involved in the care of women in labor, and volunteering to participate in the study.

Exclusion criteria for registered nurses: taking study leave or maternity leave, or transferring to another unit during the study; being unable to participate in all phases of activities; or withdrawing from the study.

Inclusion criteria for postpartum women were age 18 years or older, singleton pregnancy, gestational age of at least 37 weeks, vaginal delivery at the study hospital, ability to communicate in Thai, and willingness to participate in the study. **Exclusion criteria for postpartum women** were severe complications requiring immediate referral, inability to complete both assessments, or withdrawal from the study.

Research Instruments

The instruments comprised: 1) the intervention instrument, namely the guideline for the prevention of early postpartum hemorrhage in the labor room with six components (risk assessment, care during labor, delivery care according to AMTSL, surveillance during the first 2 hours postpartum, assessment and management according to the 4Ts, and handover and continuity of care), linked to a risk assessment form, a flowchart, and an audit checklist; and 2) data collection instruments, namely (1) a demographic questionnaire; (2) a 20-item multiple-choice knowledge test with four options per item, with a full score of 20; (3) a 20-item assessment of problems and development needs on a 5-point rating scale; (4) a feasibility assessment; and (5) a satisfaction assessment on a 5-point rating scale. Mean scores were interpreted as follows: 1.00–1.80 lowest, 1.81–2.60 low, 2.61–3.40 moderate, 3.41–4.20 high, and 4.21–5.00 highest. Quality was verified by three experts (an obstetrician, a nursing instructor in midwifery, and an expert nurse), yielding an IOC of 0.67–1.00 (criterion ≥0.50); the guideline had an S-CVI of 0.95 (criteria: I-CVI ≥0.78 and S-CVI ≥0.90). The reliability of the knowledge test (KR-20) was 0.78, and Cronbach's alpha for the rating scales was 0.86–0.92 (criterion ≥0.70).

Data collection instruments for postpartum women were (1) a demographic questionnaire; (2) a 20-item multiple-choice knowledge assessment on the prevention of postpartum hemorrhage and postpartum self-care, with a full score of 20; and (3) a 10-item self-care practice assessment on a 5-point rating scale, interpreted using the same criteria as above. Quality was verified by three experts, yielding an IOC of 0.67–1.00. The reliability of the knowledge test (KR-20) was 0.76, and Cronbach's alpha for the self-care practice assessment was 0.84.

Data Collection

Phase 1: the researchers reviewed medical records, observed practice, held case review meetings and focus groups, and collected demographic data, problems, and development needs. Phase 2: evidence was searched for and synthesized, and the guideline was drafted with the co-researchers, validated by experts, introduced through training, and piloted in clinical practice for 8 weeks. Phase 3: knowledge, feasibility, and satisfaction were assessed after implementation, and a reflection meeting was held to improve the guideline. The researchers collected all data themselves.

For postpartum women, the researchers assessed knowledge and self-care practices before care under the guideline (pre-test) and reassessed them after care under the guideline, before hospital discharge (post-test), using the

same instrument. The researchers collected all data themselves.

Data Analysis

Descriptive statistics comprised frequency, percentage, mean, standard deviation, median, and range. Qualitative data were analyzed by content analysis. For inferential statistics, the one-sample t-test was used to compare mean scores for development needs, feasibility, and satisfaction against the criterion of 3.40 (the upper limit of the moderate level), and knowledge scores against the criterion of 80% (16 of 20 points), with the null hypothesis H0: μ = criterion value and the alternative hypothesis H1: $\mu \neq$ criterion value (two-sided). The t value, df, p-value, 95% CI of the mean, and Cohen's d were reported. Normality was checked with the Shapiro-Wilk test, and the Wilcoxon signed-rank test was used when the assumptions were not met. The annual trend in PPH incidence was tested with the chi-square test for trend. Knowledge and self-care practice scores of postpartum women before and after receiving care under the guideline were compared with the paired t-test (df = 31), with the null hypothesis H0: $\mu d = 0$ and the alternative hypothesis H1: $\mu d \neq 0$ (two-sided). The mean difference, t value, p-value, 95% confidence interval (95% CI) of the difference, and effect size (Cohen's d) were reported. Normality of the differences was checked with the Shapiro-Wilk test. The level of statistical significance was set at 0.05.

Research Ethics

The researchers observed the ethical principles of research involving human participants. Co-researchers were informed of the objectives, procedures, and their right to participate or withdraw at any time without any effect on their work, and signed informed consent before participating. Postpartum women were likewise informed and signed informed consent before participating. Individual data were kept confidential and presented only in aggregate.

Results

1. Results of developing the guideline for the prevention of early postpartum hemorrhage in the labor room

1.1 General information of co-researchers The 13 registered nurse co-researchers had a mean age of 36.23±7.70 years (median 37 years, range 27–51 years). Most held a bachelor's degree (92.3%), were at the professional level (69.2%), had more than 15 years of service (38.5%), had 6–10 years of experience in labor nursing (38.5%), and had previously received related training (69.2%), as shown in Table 1.

1.2 Problems before guideline development The overall mean problem score was 2.38 (low level). The highest-scoring issue was insufficient staff knowledge about PPH ($\bar{x}$=2.77, S.D.=1.17), followed by unsystematic postpartum outcome monitoring ($\bar{x}$=2.62, S.D.=1.12), both at the moderate level. The lowest was the absence of a clear manual or guideline ($\bar{x}$=2.08, S.D.=0.95). This indicates that the main problems lay in knowledge, outcome monitoring, and consistency in applying practice standards, as shown in Table 2.

1.3 Need for guideline development The overall mean need for development was 3.84 (high level). The highest was the use of a common guideline across the unit ($\bar{x}$=4.15, S.D.=1.07), followed by an outcome monitoring system ($\bar{x}$=4.08, S.D.=1.04) and training/knowledge enhancement ($\bar{x}$=4.00, S.D.=1.00). The three lowest items ($\bar{x}$=3.69) were still at the high level, as shown in Table 3, and the overall mean was

significantly higher than the high-level criterion (3.40) (p=0.025), as shown in Table 8.

1.4 Development process and the resulting guideline The guideline was developed through the three phases of the action research cycle, as shown in Table 4. The resulting guideline had six components: 1) risk assessment from admission through labor/delivery to the postpartum period, covering factors such as previous postpartum hemorrhage, fourth or later pregnancy, multiple pregnancy or polyhydramnios, macrosomia (EFW >3,500 g), previous uterine surgery, BMI >30, induction or augmentation of labor, prolonged labor, and receipt of MgSO4 or terbutaline; 2) care during labor; 3) delivery care according to AMTSL, namely giving oxytocin 5 units intravenously at delivery of the anterior shoulder, followed by an intravenous infusion containing oxytocin 20 units at 120 mL/hr, inspection of the birth canal, placenta, membranes, and umbilical cord, uterine massage and assessment of contraction, and assessment of the bladder; 4) surveillance during the first 2 hours postpartum, with responses defined by blood loss (300 mL as a warning sign, 500–999 mL, and 1,000–1,500 mL) and referral to Udon Thani Regional Hospital when blood loss exceeds 1,500 mL; 5) assessment and management according to the 4Ts; and 6) handover and continuity of care, linked to the flowchart and audit checklist.

2. Outcomes of implementing the guideline for the prevention of early postpartum hemorrhage

2.1 Knowledge of prevention of early postpartum hemorrhage After guideline implementation, the mean knowledge score was 17.15 out of 20 (85.77%). Six items were answered correctly by every nurse (items 3, 5, 8, 9, 11, and 19), whereas the items with the fewest correct answers (53.8%) were item 10, the interval for postpartum vital sign assessment, and item 13, the major complications of PPH, as shown in Table 5. The mean score did not differ significantly from the 80% criterion (16 points) (p=0.066), as shown in Table 8.

2.2 Feasibility of implementing the guideline The overall mean was 3.78 (high level). The highest were clarity of the guideline and readiness of resources, equipment, and personnel (both $\bar{x}$=3.85), and the lowest was appropriateness of the time required ($\bar{x}$=3.69), which was still at the high level, as shown in Table 6. The overall mean was significantly higher than the high-level criterion (3.40) (p=0.028), as shown in Table 8.

2.3 Satisfaction of registered nurses with using the guideline The overall mean was 4.03 (high level). The highest was usefulness of the guideline for work ($\bar{x}$=4.15), followed by clarity and ease of the steps and confidence in caring for women in labor (both $\bar{x}$=4.08). The lowest was the presentation format and convenience of use in real situations ($\bar{x}$=3.92), as shown in Table 7. The overall mean was significantly higher than the high-level criterion (3.40) (p<0.001), as shown in Table 8.

2.4 Inferential statistical testing The one-sample t-test (df = 12), shown in Table 8, found that development needs ($\bar{x}$=3.84; t=2.56, p=0.025, 95% CI = 3.47–4.21, d=0.71), feasibility ($\bar{x}$=3.78; t=2.49, p=0.028, 95% CI = 3.45–4.11, d=0.69), and satisfaction ($\bar{x}$=4.03; t=4.73, p<0.001, 95% CI = 3.74–4.32, d=1.31) were significantly higher than the high-level criterion (3.40) at the 0.05 level, with medium to large effect sizes. Knowledge scores ($\bar{x}$=17.15) did not differ from the 80% criterion, or 16 points (t=2.02, p=0.066, 95% CI = 15.91–18.39, d=0.56). Because the 95% confidence interval included the criterion value, it cannot be concluded that knowledge was

higher than the criterion, which may relate to the small sample and limited statistical power.

3. Outcomes in postpartum women after receiving care under the guideline for the prevention of early postpartum hemorrhage

3.1 General information of postpartum women The 32 postpartum women in the sample had a mean age of 27.41±5.62 years (range 18–39 years). Most had less than a bachelor's degree education (65.6%), were in a subsequent pregnancy (56.3%), and had a normal vaginal delivery (84.4%); 28.1% had risk factors for postpartum hemorrhage, as shown in Table 9.

3.2 Inferential testing of knowledge and self-care practices of postpartum women The paired t-test (df = 31), shown in Table 10, with normally distributed differences (Shapiro-Wilk $p>0.05$), found that the mean knowledge score after care under the guideline ($\bar{x}$=16.53, S.D.=2.11) was significantly higher than before care ($\bar{x}$=11.84, S.D.=2.76) at the 0.05 level, with a mean difference of 4.69 points (t=8.56, p<0.001, 95% CI = 3.57–5.81, d=1.51). The mean self-care practice score after care ($\bar{x}$=4.05, S.D.=0.46, high level) was also significantly higher than before care ($\bar{x}$=3.12, S.D.=0.58, moderate level), with a mean difference of 0.93 points (t=8.22, p<0.001, 95% CI = 0.70–1.16, d=1.45). The effect sizes for both variables were large, and the 95% confidence intervals of the differences did not include zero, indicating that the women's knowledge and self-care practices improved after receiving care under the guideline.

Table 1 General information of the registered nurse co-researchers (n = 13)

General information	Number (persons)	Percent
Age (years) $\bar{x}$±S.D.	36.23±7.70	
Median (min–max)	37 (27–51)	
Education level		
Bachelor's degree	12	92.3
Master's degree	1	7.7
Position		
Registered Nurse, Practitioner Level	4	30.8
Registered Nurse, Professional Level	9	69.2
Length of service		
1–5 years	3	23.1
6–10 years	2	15.4
11–15 years	3	23.1
More than 15 years	5	38.5
Experience in labor nursing		
Less than 1 year	2	15.4
1–5 years	4	30.8
6–10 years	5	38.5
11–15 years	0	0.0
More than 15 years	2	15.4
Training in labor care/PPH prevention		
Yes	9	69.2
No	4	30.8

Table 2 Problems in the prevention of early postpartum hemorrhage before guideline development (n = 13)

Problem	$\bar{x}$	S.D.	Level
1. Insufficient staff knowledge about PPH	2.77	1.17	Moderate
2. Postpartum outcome monitoring is not systematic	2.62	1.12	Moderate
3. Risk assessment for postpartum hemorrhage is not systematic	2.46	1.33	Low
4. Emergency preparedness is inadequate	2.46	0.88	Low
5. Care documentation is not standardized	2.38	0.96	Low
6. Blood loss estimation is inaccurate	2.31	1.03	Low
7. Team communication/handover is unclear	2.31	1.11	Low
8. Postpartum hemorrhage surveillance is not comprehensive	2.23	0.93	Low
9. Staff follow differing practice approaches	2.15	1.07	Low
10. No clear manual or guideline	2.08	0.95	Low
Overall	**2.38**	-	**Low**

Table 3 Needs for developing the guideline for the prevention of early postpartum hemorrhage (n = 13)

Development needs	$\bar{x}$	S.D.	Level
1. Need for a common guideline across the unit	4.15	1.07	High
2. Need for an outcome monitoring system	4.08	1.04	High
3. Need for training/knowledge enhancement	4.00	1.00	High
4. Need for a clear guideline	3.77	1.09	High
5. Need for guidance when risks occur	3.77	1.09	High
6. Need for a practice manual	3.77	1.09	High
7. Need for a recording and monitoring system	3.77	1.17	High
8. Need for a standardized risk assessment approach	3.69	1.03	High
9. Need for a postpartum hemorrhage surveillance approach	3.69	1.03	High
10. Need for a system ready for risk assessment	3.69	0.85	High
Overall	**3.84**	-	**High**

Table 4 Guideline development process following the action research cycle

Phase	Activities/content	Instruments used	Duration	Academic rationale
1. Situation analysis and planning (Plan)	Reviewed PPH statistics and medical records for 2021–2025, observed practice, held case review meetings and focus groups, and assessed problems and development needs	Demographic questionnaire, problem and development needs assessment, focus group question guide	8 weeks (Jan–Feb 2026)	Action research cycle of Kemmis and McTaggart; problem analysis step of Rosswurm and Larrabee

Phase	Activities/content	Instruments used	Duration	Academic rationale
2. Guideline development and pilot implementation (Act–Observe)	Searched for and synthesized evidence from WHO, ACOG, RCOG, and the Royal Thai College of Obstetricians and Gynaecologists; drafted a six-component guideline; expert validation; training and orientation; piloted and observed practice	Guideline, risk assessment form, flowchart, and audit checklist	16 weeks (Mar–Jun 2026)	Evidence-based practice of Melnyk and Fineout-Overholt; AMTSL and 4Ts principles
3. Outcome evaluation and reflection (Reflect)	Assessed knowledge, feasibility, and satisfaction; held a reflection meeting and refined the guideline into a unit standard	Knowledge test, feasibility assessment, and satisfaction assessment	8 weeks (Jul–Aug 2026)	Donabedian's framework of quality of care (structure–process–outcome)

Table 5 Number and percentage of registered nurses answering each knowledge item correctly (n = 13)

Item	Correct (persons)	Percent
1. Definition of PPH after vaginal delivery ≥500 mL	12	92.3
2. Early PPH occurs within 24 hours	12	92.3
3. The most common cause is poor uterine contraction	13	100.0
4. 4Ts: Tone means poor uterine contraction	12	92.3
5. The first-line drug recommended for PPH prevention is oxytocin	13	100.0
6. Timing of oxytocin administration to prevent PPH	11	84.6
7. Meaning of AMTSL	12	92.3
8. Purpose of uterine massage after delivery	13	100.0
9. Major risk factors for PPH	13	100.0
10. Interval for postpartum vital sign assessment	7	53.8
11. Major warning signs of PPH	13	100.0
12. Method of postpartum uterine assessment	10	76.9
13. Major complications of PPH	7	53.8
14. Purpose of calculating blood loss	10	76.9
15. When risk assessment should be performed	10	76.9
16. Risk category of anemia	10	76.9
17. Outcome that clinical practice guidelines help achieve	12	92.3
18. Key persons in PPH surveillance	10	76.9
19. Appropriate response when risks are identified	13	100.0
20. Key goal of PPH prevention	10	76.9
Overall mean score (full score 20)	**17.15**	**85.77**

Table 6 Feasibility of implementing the guideline (n = 13)

Item	$\bar{x}$	S.D.	Level
1. Clarity of the guideline enabling correct adherence	3.85	0.80	High
2. Readiness of resources, equipment, and personnel to support adherence	3.85	0.69	High
3. Convenience of applying the guideline steps in real work settings	3.77	0.83	High
4. Ability to sustain use of the guideline in practice	3.77	1.17	High
5. Appropriateness of the time required to follow the guideline	3.69	0.85	High
Overall	**3.78**	-	**High**

Table 7 Satisfaction of registered nurses with using the guideline (n = 13)

Item	$\bar{x}$	S.D.	Level
1. Usefulness of the guideline for work	4.15	0.55	High
2. Steps are clear and easy to follow	4.08	0.64	High
3. Confidence in caring for women in labor after implementing the guideline	4.08	0.76	High
4. Guideline content is complete and useful	4.00	0.58	High
5. Presentation format is appropriate and easy to understand	3.92	0.64	High
6. Convenience of using the guideline in real situations	3.92	0.64	High
Overall	**4.03**	-	**High**

Table 8 Testing of mean outcomes against criterion values using inferential statistics (n = 13)

Variable	$\bar{x}$	S.D.	d	t	95% CI	p-value
Development needs	3.84	0.62	0.71	2.56	3.47–4.21	0.025*
Knowledge (full score 20)	17.15	2.05	0.56	2.02	15.91–18.39	0.066
Feasibility	3.78	0.55	0.69	2.49	3.45–4.11	0.028*
Satisfaction	4.03	0.48	1.31	4.73	3.74–4.32	<0.001*

Note: *Statistically significant ($p < 0.05$)

Table 9 General information of the postpartum women in the sample (n = 32)

General information	Number (persons)	Percent
Age (years) $\bar{x}$±S.D.	27.41±5.62	
Min–max	18–39	
Education level		
Below bachelor's degree	21	65.6
Bachelor's degree or higher	11	34.4
Pregnancy order		
First pregnancy	14	43.8
Subsequent pregnancy	18	56.3
Mode of delivery		
Normal vaginal delivery	27	84.4

Obstetric procedure-assisted delivery	5	15.6
Risk factors for postpartum hemorrhage		
Present	9	28.1
Absent	23	71.9

Table 10 Inferential comparison of knowledge and self-care practice scores of postpartum women before and after receiving care under the guideline (n = 32)

Variable	Before ($\bar{x}$±S.D.)	After ($\bar{x}$±S.D.)	Mean difference (95% CI)	t	d	p-value
Knowledge (full score 20)	11.84±2.76	16.53±2.11	4.69 (3.57–5.81)	8.56	1.51	<0.001*
Self-care practice (full score 5)	3.12±0.58	4.05±0.46	0.93 (0.70–1.16)	8.22	1.45	<0.001*

Note: *Statistically significant at the 0.05 level

Discussion

Regarding guideline development (objective 1), the problems with the highest means were insufficient staff knowledge about PPH ($\bar{x}$=2.77) and unsystematic outcome monitoring ($\bar{x}$=2.62), while the lowest was the absence of a clear manual or guideline ($\bar{x}$=2.08). This indicates that the unit's key issues are the gap between knowledge and actual practice, consistent application of standards, outcome monitoring, and team communication. The highest need was for a common guideline across the unit ($\bar{x}$=4.15), because PPH care requires rapid response and teamwork, and a common standard reduces variability in assessment and decision-making. This is consistent with Forbes et al.,[21] who found that barriers to detecting and managing PPH in Kenya, Nigeria, and South Africa included shortages of personnel and resources, limited training, and inconsistent use of guidelines, and with Pojana et al.,[14] who used participatory action research to develop a risk assessment form and PPH prevention guideline that enhanced the capacity of the multidisciplinary team. The six-component guideline therefore responds directly to the unit's problems and needs.

Regarding knowledge (objective 2), the mean score after guideline implementation was 17.15 out of 20, which may be attributable to the guideline being developed from empirical evidence, practitioners' participation in its development and piloting, and 69.2% of co-researchers having previously received training. The items answered correctly least often were the interval for vital sign assessment and the major complications of PPH (53.8%), possibly because they require recalling time-related details and linking complications to clinical changes. This is consistent with Coelho et al.,[19] who found that simulation training of 37 nurses raised knowledge scores from 65% to 90%, and Faustine et al.,[20] who found that simulation-based learning significantly increased the knowledge and skills of student nurse-midwives (p<.001). It supports the view that using the guideline together with continued practice drills will help sustain knowledge and improve staff readiness.

Regarding feasibility and satisfaction, overall feasibility was at the high level ($\bar{x}$=3.78), with clarity of the guideline and readiness of resources highest ($\bar{x}$=3.85) and appropriateness of the time required lowest ($\bar{x}$=3.69), which may reflect the workload and urgency of the labor

room. This is consistent with Kulnit et al.,[18] who found feasibility at the highest level, and Promchan et al.,[17] who found feasibility of 95.45% and a significant reduction in PPH incidence. Overall satisfaction was at the high level ($\bar{x}$=4.03), with usefulness for work highest ($\bar{x}$=4.15), indicating that a guideline that clearly sequences assessment, prevention, and response reduces uncertainty and increases practitioners' confidence. This is consistent with Wongwattanakan and Promthat,[16] who found satisfaction at the highest level and no postpartum hemorrhage in the group that piloted the guideline, and Luangkwan et al.,[15] who found satisfaction at the highest level and a PPH rate that fell from 18.9% to 3.9%.

Regarding inferential statistics, development needs, feasibility, and satisfaction were significantly higher than the high-level criterion (3.40) ($p<0.05$), with satisfaction showing the largest effect size ($d=1.31$), suggesting that the findings are unlikely to be due to random variation alone. This is consistent with studies reporting statistical significance after learning or use of guidelines.[19,20] The knowledge score did not differ from the 80% criterion ($p=0.066$), and its 95% confidence interval (15.91–18.39) was fairly wide, so the result can be interpreted only as uncertain, not as evidence that knowledge was inadequate, because the statistical power of a sample of 13 is limited. In addition, statistical significance is not equivalent to clinical importance, and the tests compared scores with predefined criteria rather than comparing nurses before and after, so it cannot yet be inferred that the guideline caused the outcomes.

For postpartum women, after receiving care under the guideline, the 32 women had knowledge scores ($\bar{x}$=16.53, S.D.=2.11) and self-care practice scores ($\bar{x}$=4.05, S.D.=0.46) significantly higher than before care ($\bar{x}$=11.84 and 3.12, respectively) ($p<0.001$), with large effect sizes ($d=1.51$ and $d=1.45$) and 95% confidence intervals of the differences that did not include zero. This may be explained by the guideline's requirement for systematic risk assessment, information provision, and communication with postpartum women, which helped them understand warning signs and practice self-care more correctly. However, because this was a single-group pre–post comparison without a control group, the results should be interpreted with caution, as they may be related to information from other sources, experiences during childbirth, and retesting with the same instrument.

Limitations This study had a small sample and was conducted in a single service unit. Nurses' knowledge scores were not collected before guideline implementation, so it cannot be concluded statistically that knowledge increased, and maternal clinical outcomes such as PPH incidence and blood loss were not evaluated. The inferential analyses had low statistical power, wide confidence intervals, and potentially unstable p-values; normality tests have low sensitivity; multiple tests without adjustment of the significance level may increase the risk of type I error; and one-sample t-tests against criteria should not be cited as evidence of the guideline's effectiveness. Generalization to other populations should therefore be done with caution. For postpartum women, the study was a single-group pre–post comparison without a comparison group and may have been influenced by a testing effect, so the increases in knowledge and self-care practices should not be attributed to the guideline alone.

Conclusions

The guideline for the prevention of early postpartum hemorrhage in the labor room,

developed through the action research cycle, comprises six components: risk assessment, care during labor, delivery care according to AMTSL, surveillance during the first 2 hours postpartum, assessment and management according to the 4Ts, and handover and continuity of care. After implementation, nurses' knowledge was fairly high (17.15 out of 20), and feasibility and satisfaction were at the high level, indicating that the guideline is clear, appropriate to the context, and practicable. Development needs, feasibility, and satisfaction were significantly higher than the high-level criterion ($p<0.05$), whereas knowledge did not differ from the 80% criterion ($p=0.066$), which should be confirmed by comparative studies with an adequate sample size. Among the 32 postpartum women, knowledge and self-care practice scores after receiving care under the guideline were significantly higher than before ($p<0.001$).

Recommendations

1. Recommendations for applying the findings The guideline should be established as a common standard for the labor room nursing unit and postpartum ward; knowledge should be refreshed and simulation drills held periodically, emphasizing postpartum vital sign assessment and the major complications of PPH; the guideline format should be made more concise, for example as a flowchart, checklist, and trigger tool, to reduce time constraints; and results should be reported as confidence intervals and effect sizes alongside p-values.

2. Recommendations for future research Future studies should design pre–post evaluations in the same participants using the paired t-test or Wilcoxon signed-rank test according to data distribution; increase the sample size and number of service units (with an a priori power analysis, e.g., $\alpha=0.05$, power=0.80); include a comparison group among postpartum women; follow up for at least 6–12 months; and add clinical outcomes such as blood loss, PPH incidence, transfusion, shock, referral, and length of hospital stay, considering a mixed-effects model when data come from multiple service units or time points.

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