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March – April 2026

Nexus of Thai Health Sciences

NTHS

HEALTH SYSTEM RESEARCH & POLICY

Health Systems & Policy · Interprofessional Practice

Digital Health · Epidemiology · Health Economics

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NTHS

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Nexus of Thai Health Sciences (NTHS) aims to disseminate scholarly work and study findings in the integration of health sciences, with an emphasis on system- and policy-level research on health systems, interprofessional approaches, and the integration of knowledge across disciplines, in order to support the sustainable development and transformation of Thailand's health system and to advance the work of Thai public health and medical personnel, both nationally and internationally, as well as interested members of the public.

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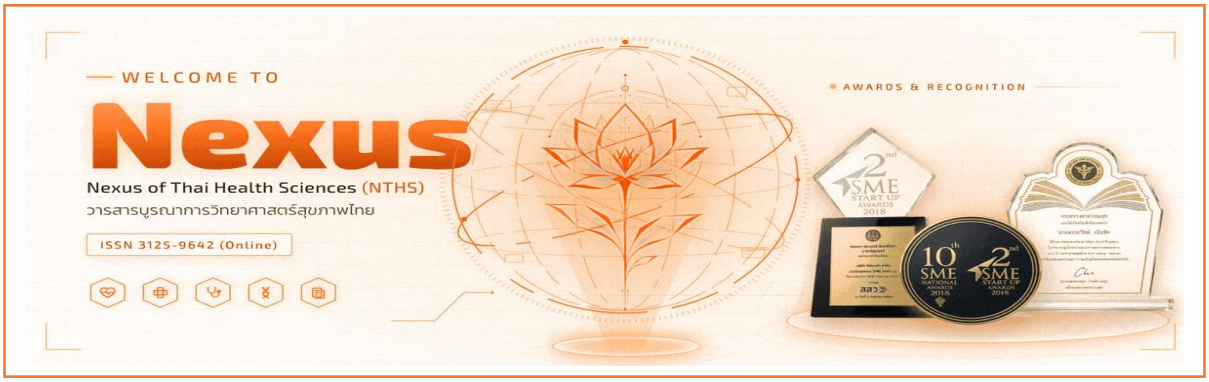
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INSTRUCTIONS FOR AUTHORS

Nexus of Thai Health Sciences (NTHS) welcomes submissions in the health sciences related to health systems research, health policy analysis, interprofessional practice, digital health, epidemiology, health economics, and related fields, with an emphasis on work that contributes to the development and transformation of Thailand's health system at the system and policy levels. Manuscripts must not have been published elsewhere previously and must not be under consideration by another journal. The criteria and guidelines are as follows:

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The journal is a forum for researchers, academics, public health personnel, and policymakers to exchange knowledge that connects multiple professions, from health systems research and policy analysis to digital health and health system innovation. The scope of the journal covers the following areas:

- Health systems research and health policy analysis
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- Public health and health promotion
- Digital health and health informatics
- Environmental health and occupational health
- Public health education and health workforce development
- Social determinants of health
- Health economics and resource allocation
- Epidemiology and disease surveillance

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Original research articles report the results of the authors' own studies and research, including research and development (R&D), action research, and the development of health service models or systems. They comprise the following sections, in order: title; author names and affiliations; abstracts in Thai and English; introduction; research objectives; methods; results; discussion; conclusions; recommendations; acknowledgments (if any); and references.

Academic articles present knowledge, concepts, or academic experience in the health sciences, with analysis, synthesis, and reference to reliable empirical evidence. They comprise an introduction, main content, conclusion, and references.

Review articles systematically compile and review knowledge on a given topic from domestic and international journals and books. They comprise an introduction, literature search methods, the content reviewed, critical commentary, conclusion, and references.

Policy analysis articles systematically analyze health policies or measures using empirical evidence and appropriate conceptual frameworks. They comprise an introduction and background to the policy issue, the analytical framework or method, analysis results, policy options and recommendations, conclusion, and references.

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

3. Manuscript Preparation

3.1 General Format

- Type in Microsoft Word on single-sided A4 paper and format the manuscript according to the journal's template.
- Use TH Sarabun PSK font, 16 points, with 2.54 cm margins on all sides.
- Length must not exceed 15 pages, including tables, figures, and the reference list.

3.2 Components of the Article

Title: The title should be short, concise, and informative, consistent with the objectives and content, and provided in both Thai and English, without abbreviations.

Author names: Give the names and affiliations of all authors in both Thai and English (without abbreviations), and identify the corresponding author with an e-mail address and a telephone number at which they can be reached.

Abstract: Write in both Thai and English, not exceeding **300** words per abstract, as continuous prose without sub-headings. Cover the background and objectives, methods, results, and conclusions; report only the key statistics; and include no citations in the abstract.

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

Introduction: Describe the background and significance of the problem, the situation, related research, the gap in knowledge, and the rationale for the study.

Methods: Describe the research design, population and sample, sample size calculation and selection, instruments and their quality validation, data collection, data analysis, and research ethics, stating the name of the human research ethics committee, the certificate number, and the date of approval.

Results: Present in the order of the objectives. Where there are many figures or variables, use tables and do not repeat the information in the text except for key findings. Place table titles above the table with the sample size (n), and place figure or chart titles below the figure.

Discussion and Conclusions: Discuss the findings in relation to the objectives and hypotheses, explain the reasons for the results, cite related theories or studies, state the limitations of the research, and summarize the key findings in line with the objectives.

Recommendations: Provide recommendations for applying the findings in practice, administration, or policy, and for future research.

Acknowledgments (if any): Identify those who provided assistance, supporters, and sources of research funding.

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The journal uses the Vancouver referencing style. Reference numbers are placed in square brackets [ ] at the end of the statement being cited. Number 1 is used for the first source cited, and numbering continues in the order in which sources appear in the text. A source that is cited again keeps its original number. All references are listed at the end of the article. Authors are responsible for the accuracy of their references. For works with more than 6 authors, list the first 6 authors followed by “et al.” (or “และคณะ” for Thai-language references).

4.1 Journal Articles

Author(s). Article title. Journal title. Year of publication;Volume(Issue):First page-Last page.

1. Nualnet P, Somboon O. Development of the primary health care system in rural communities [in Thai]. Journal of Thai Public Health. 2023;18(3):112-128.
2. 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.

4.2 Books

Author(s). Book title. Edition. Place of publication: Publisher; Year of publication.

1. Ativanichayaphong N. Health policy and the Thai health service system [in Thai]. Bangkok: Thammasat University Press; 2022.
2. Gilstrap LC, Cunningham FG. Operative obstetrics. 2nd ed. New York: McGraw-Hill; 2002.

4.3 Book Chapters

Author(s). Chapter title. In: Editor(s), editor. Book title. 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.

4.4 Electronic Sources and Articles with a DOI

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

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
2. Degenhardt L, Bohnert KM, Anthony JC. Assessment of cocaine and other drug dependence in the general population. Drug Alcohol Depend [Internet]. 2008 Mar [cited 2010 Apr 15];93(3):227-32. doi:10.1016/j.drugalcdep.2007.09.024

4.5 Theses and Dissertations

Author(s). Title [Type/degree level]. Place of publication: University; Year the degree was awarded.

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.

5. Manuscript Submission

Authors submit manuscripts through the online system on the journal's website. Authors must register as a member before submitting and can track the status of their manuscript online at any time. Research articles involving human subjects must state the name of the human research ethics committee and the certificate number in the article. For further information, contact E-mail: fetp1yr@gmail.com

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- The editorial office checks that each manuscript is consistent with the aims and scope of the journal and with the manuscript preparation format.
- Every article is reviewed by at least 3 experts who have no conflict of interest with the authors, using double-blind peer review.
- The editor decides whether to accept or reject an article based primarily on academic quality and consistency with the scope of the journal.

- Authors revise their articles according to the suggestions of the reviewers and the editorial board within the specified time, and follow the review outcome through the online system.

7. Article Processing Charge

The journal charges an article processing charge only after an article has been accepted for publication. The editorial office will notify authors of the payment channels together with the acceptance letter. The rates are as follows:

Thai-language articles	English-language articles
THB 4,500 (≈ USD 130)	THB 6,500 (≈ USD 190)

USD amounts are approximate, based on an exchange rate of about THB 34 per USD.

8. Publication Ethics

8.1 Editors' Ethics

Editors are responsible for deciding whether to accept or reject articles based primarily on academic quality and consistency with the scope of the journal, without regard to the authors' race, gender, nationality, religious beliefs, or institutional affiliation. They must keep manuscripts under review confidential, withdraw from the review when there is a conflict of interest, and take appropriate action when evidence of research misconduct, plagiarism, or duplicate submission is found, in line with the guidelines of the Committee on Publication Ethics (COPE).

8.2 Reviewers' Ethics

Reviewers must evaluate articles impartially, have expertise in the relevant field, and provide constructive suggestions. They must keep articles confidential and not use information in the articles for personal benefit; inform the editor when they have a conflict of interest or find that an article is substantially similar to other work; and accept the invitation and submit their review within the agreed timeframe.

8.3 Authors' Ethics

Authors must certify that the article is original work that has not been published before and is not under consideration by another journal; name all contributors in accordance with the principles of authorship; report data and research findings truthfully, without distorting, falsifying, or omitting significant information; disclose all conflicts of interest of every kind; and cite sources of information fully. Duplicate submission and plagiarism are serious violations of publication ethics.

8.4 Ethics of Research Involving Humans

Research articles involving humans must be approved by a human research ethics committee, and the certificate number and the name of the committee must be stated in the article. The research must be conducted in accordance with the principles of the Declaration of Helsinki, with informed consent obtained from every participant, and personally identifiable data must be strictly protected.

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EDITORIAL

Nexus of Thai Health Sciences (NTHS), Vol. 1 No. 2 (March – April 2026), presents research from health service units, showing that sustainable health system development begins with solving real problems at the point of care. This issue contains six original research articles with a shared emphasis on developing models and practices of care that keep people and patients safe, are of high quality, and fit the local context, ranging from care for pregnant adolescents, influenza vaccination services for children, and the assessment of postpartum blood loss, to the care of patients with knee pain using herbal poultice sheets, health promotion for older adults through an elderly school, and the care of hospitalized patients with antimicrobial-resistant infections.

The work in this issue falls into three main themes. The first is maternal and child health, comprising improvement of antenatal care quality through the participation of nurses and families in the care of teenage pregnant women; the development of an influenza vaccination service model for children aged 6 months – 4 years and 5 – 11 years; and improvement in the accuracy of postpartum blood loss assessment, moving from visual estimation to the gravimetric (weighing) method. The second is community health care drawing on Thai traditional medicine wisdom and community participation, comprising the effects of a community hospital–formulated herbal poultice sheet on patients with knee pain, and the development of an elderly school model using community participation. The third is patient safety and the development of hospital service systems, comprising the development of a nursing care model for patients with antimicrobial-resistant infections through the role of professional nurses, with an emphasis on infection prevention and control.

Taken as a whole, the editorial board sees this research as consistent with the spirit of the name “Nexus”: a journal that serves as a point of connection among practitioners in the field, researchers, and policymakers. Each study begins with a problem in the real context of a hospital or community and leads to a model or system that other service units can study and adapt. Every article in this issue was screened by at least 3 expert reviewers through double-blind peer review to ensure academic quality and credibility, and the journal is published as open access so that all readers can access this knowledge free of charge. The editorial board sincerely hopes that the knowledge in these articles will benefit the development of health services, administration, and health policy-making, and can be applied concretely in readers’ own work contexts.

Sergeant Arthawit Noenchard
Executive Editor
Nexus of Thai Health Sciences

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RESEARCH ARTICLE

Improving Antenatal Care Quality through Nurse and Family Partnership for Teenage Pregnant Women at Kamalasai Hospital, Kalasin Province

Thanimkan Yanatham[1*]

[1] Professional Nurse (Senior Level), Primary and Holistic Care Department, Kamalasai Hospital, Kamalasai District, Kalasin Province

*Corresponding author

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Abstract

This action research, conducted in two PDCA cycles, aimed 1) to study the situation, problems, and needs, 2) to develop, and 3) to evaluate antenatal care quality improvement through nurse and family partnership for teenage pregnant women at Kamalasai Hospital, Kalasin Province, Thailand, from January 2025 to January 2026. Purposively selected participants were 15 nurses, 30 pregnant adolescents aged 15–19 years, and 30 family caregivers. Outcomes were evaluated using a pretest–posttest comparison and a historical control group (fiscal year 2024, n = 86). Instruments comprised the "Youth Health Coaching" model, interview and focus-group guides, a knowledge test, a skill assessment, an attitude scale, a self-care behavior scale, a satisfaction questionnaire, and an antenatal care outcome record form. Data were analyzed using descriptive statistics, the paired t-test, Welch's t-test, the chi-square test, Fisher's exact test, and content analysis.

The model comprised three components: team development with families and the community, multidisciplinary intensive care (home visits and follow-up until delivery), and mentor-nurse capacity building. After implementation, knowledge, skill, attitude, and self-care behavior scores were significantly higher than at baseline (p-value <0.001); for example, nurses' knowledge increased from 12.40±2.10 to 17.20±1.52 (t = 8.08). Compared with fiscal year 2024, the proportion of adolescents completing eight antenatal contacts increased from 45.35% to 70.00% (RR = 1.54, χ^2 = 5.41, p-value = 0.020), whereas anemia, low birth weight, and complications (16.67% vs. 29.07%) decreased without statistical significance. Satisfaction was at the highest level ($\bar{x}$ = 4.53–4.62). The model should be adopted as a maternal and child health practice guideline and expanded to the service network.

Keywords: Antenatal care, Teenage pregnancy, Family participation, Action research

Introduction

Adolescent pregnancy is a major global public health problem. In 2023, the global adolescent birth rate was 41 per 1,000 women aged 15–19 years, down from about 65 per 1,000 in 2000. Even so, each year approximately 21 million girls aged 15–19 years in developing countries become pregnant and about 12 million give birth.[1] Complications of pregnancy and childbirth are a leading cause of death among women aged 15–19 years, and pregnant adolescents face a higher risk of preeclampsia, uterine infection, and systemic infection than women aged 20–24 years;[1] about 13% of adolescent girls worldwide give birth before the age of 18.[2] In Thailand, the birth rate among adolescents aged 15–19 years fell from 24.4 per 1,000 women of the same age in 2021 to 21.0 in 2022, and the rate in the 10–14 age group fell to 0.8 per 1,000,[3] but it remains a key indicator under the national strategy for preventing and solving adolescent pregnancy.

Kalasin Province had a higher birth rate among girls aged 10–14 years than other provinces in Health Region 7, with 55 cases (1.90 per 1,000 population), compared with Khon Kaen (1.30), Maha Sarakham (1.00), and Roi Et (1.20) (source: HDC, Ministry of Public Health, fiscal year 2025). The percentages of births to mothers younger than 20 years in the province in 2022–2024 were 16.50, 15.80, and 15.20, and in Kamalasai District were 15.20, 14.80, and 14.30, respectively. Kamalasai Hospital registered 95, 89, and 86 new pregnant adolescents for antenatal care in fiscal years 2022–2024, of whom 68, 64, and 56 attended late (gestational age over 12 weeks) and 32, 28, and 25 developed pregnancy complications, respectively. In fiscal year 2024, 65.12% attended late, only 45.35% completed eight antenatal visits, 38.37% had anemia, and 9.30% of infants weighed less than 2,500 g at birth. The systemic problems identified were that adolescents were cared for in the same way as other pregnant women without a specific guideline, there was no individual follow-up system, families were not prepared, and there was no tool for assessing psychosocial risk factors.

The World Health Organization recommends at least eight antenatal contacts for a positive pregnancy experience.[4] Family-centered care emphasizes family participation, respect for needs and differences, and transparent communication.[5,6] Family nurses play an important role in helping families adapt to parenthood.[7] Perceived social support predicts successful maternal role attainment among adolescents,[8] and parents are the primary caregivers who give love and promote the health of their pregnant teenage

daughters.[9] Nurse home visits during pregnancy increase attendance at scheduled antenatal appointments and service use among pregnant adolescents,[10,11] and action research using the cycle of planning, doing, checking, and acting enables practitioners to solve problems together systematically.[12,13] However, there is still no model that integrates the proactive role of nurses with family preparation and is developed from the data and context of community hospitals in the area.

The researcher therefore developed antenatal care quality improvement in the form of the "Youth Health Coaching" model, which combines family-centered care, empowerment,[14] and social support[15] and uses the PDCA process to reduce risk factors and improve the health outcomes of pregnant adolescents and their families.

Research Objectives

1. To study the situation, problems, and needs in caring for pregnant adolescents among nurses and families at Kamalasai Hospital, Kalasin Province
2. To develop antenatal care quality improvement through nurse and family partnership for the care of pregnant adolescents
3. To evaluate the results of the antenatal care quality improvement, with the primary outcome being the percentage completing eight antenatal visits and the secondary outcomes being knowledge, skills, attitudes, self-care behavior, satisfaction, and pregnancy and birth outcomes

Methods

This study was action research following the PDCA cycle, comprising four steps: Plan, Do, Check, and Act,[13] conducted in two cycles at Kamalasai Hospital from January 2025 to January 2026. The co-researchers were all 15 nurses, who took part in analyzing problems, designing, piloting, and adjusting the model at every step. The research process is shown in Figure 1.

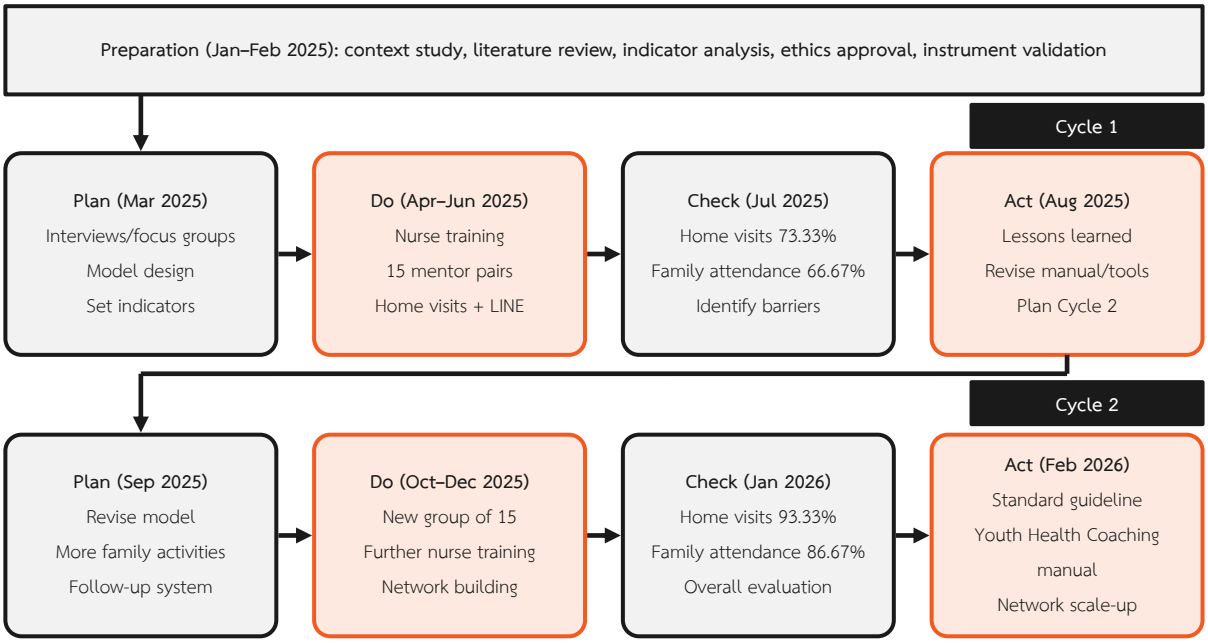


Figure 1 Action research process following the PDCA framework in two cycles

Population

The population comprised three groups: 1) professional nurses and persons responsible for maternal and child health services at Kamalasai Hospital, the Kamalasai District Public Health Office, and sub-district health promoting hospitals (SHPHs); 2) pregnant adolescents aged 15–19 years receiving antenatal care at Kamalasai Hospital; and 3) family caregivers (fathers, mothers, or guardians).

Sample

Participants were selected by purposive sampling: 1) 15 nurses; 2) 30 volunteer pregnant adolescents (15 per cycle); and 3) 30 caregivers (one per family). The sample size was determined by the number of eligible service users during the study period. Data on the 86 pregnant adolescents registered for antenatal care in fiscal year 2024 were used as a historical control group, selected using the same criteria as the development group: aged 15–19 years, singleton pregnancy, and no severe complications.

Inclusion Criteria

Nurses: worked in maternal and child health for at least 1 year and were willing to participate throughout the project. Pregnant adolescents: aged 15–19 years, singleton pregnancy, gestational age no more than 28 weeks, no severe complications requiring immediate referral, able to communicate in Thai, and willing to participate. Caregivers: fathers, mothers, or guardians who lived with the pregnant adolescent and were willing to participate.

Exclusion Criteria

Withdrawal from the study, relocation or referral for antenatal care elsewhere, or

severe complications preventing participation in activities. Participants who attended less than 80% of activities remained in the analysis (intention-to-treat). No participants withdrew from this study.

Research Instruments

The instruments comprised 1) instruments for developing the model: focus-group and in-depth interview guides, a family participation observation form, and the "Youth Health Coaching" manual; and 2) evaluation instruments: a knowledge test (20 items, 1 point per correct answer, good level ≥16 points), a participatory care skills assessment (observation and simulation, 30 points), a family attitude scale (5-point rating scale), a self-care behavior assessment (50 points), a satisfaction questionnaire (5-point rating scale; mean interpretation: 4.21–5.00 = highest, 3.41–4.20 = high), and an antenatal care outcome record form. Content validity was examined by three experts, giving IOC values of 0.67–1.00. A pilot test with 15 nurses and family members who were not in the sample gave a KR-20 of 0.82 for the knowledge test, Cronbach's alpha coefficients of 0.88, 0.84, and 0.91 for the attitude scale, behavior assessment, and satisfaction questionnaire, and an inter-rater reliability (ICC) of 0.86 for the skills assessment.

Data Collection

In the planning step, situational data were collected through in-depth interviews and focus groups. In the doing step, operational results were recorded. In the checking step, quantitative and qualitative data were collected by the researcher and two research assistant nurses who were not mentors of the participants being assessed. Knowledge, skills, attitudes, and behaviors were measured before the activities began and after the doing step of each cycle ended (Cycle 1 in July 2025; Cycle 2 in January 2026). Antenatal care and birth outcomes were collected from medical records and maternal and child health handbooks until every participant had delivered (through January 2026).

Data Analysis

General data were analyzed using frequency, percentage, mean ($\bar{x}$), and standard deviation (S.D.). Pre–post scores were compared using the paired t-test with effect size (dz). Comparison with the historical control group used Welch's t-test for continuous variables and the chi-square test (or Fisher's exact test when expected counts were less than 5) with risk ratio (RR) for categorical variables. Normality was checked using the Shapiro-Wilk test, and the significance level was set at 0.05. Qualitative data were analyzed by thematic analysis[16] and trustworthiness was verified by source triangulation.

Research Ethics

This research followed ethical principles for research involving human participants and was conducted in accordance with the Declaration of Helsinki. The researcher explained the objectives and procedures to all participant groups and obtained written informed consent. Pregnant women younger than 18 years provided assent in addition to written consent from a guardian. Retrospective data for fiscal year 2024 were exempt from the requirement for consent. Data were kept confidential using codes instead of names, the LINE group did not disclose individual information, and referral pathways were in place when psychosocial problems or domestic violence were found. Results were presented in aggregate, and participants could withdraw at any time without affecting the services they received.

Results

1. Situation, Problems, and Needs

1.1 General information All 15 nurses were female, with a mean age of 38.47±6.12 years and mean maternal and child health experience of 11.20±5.80 years; 4 (26.67%) had been trained in caring for pregnant adolescents. The 30 pregnant adolescents had a mean age of 17.43±1.25 years; 14 (46.67%) were aged 17 years or younger, 26 (86.67%) were pregnant for the first time, 11 (36.67%) were still in school, and 19 (63.33%) lived with their parents. The 30 caregivers had a mean age of 44.13±8.70 years: 17 (56.67%) were mothers, 7 (23.33%) grandparents, 4 (13.33%) fathers, and 2 (6.67%) other guardians. The historical control group had a mean age of 17.2±1.4 years and 84.9% were first pregnancies, which did not differ from the development group.

1.2 Situation, problems, and needs In-depth interviews and focus groups (15 nurses, 8 pregnant adolescents, and 10 families) revealed four issues: 1) a lack of proactive care targeted at this group; 2) a lack of individual follow-up beyond appointments during office hours; 3) limited family participation because families had not been prepared; and 4) a lack of systematic psychosocial assessment, as in the statement "There is no systematic operation" (N03). The needs identified were that nurses wanted practice guidelines and psychosocial assessment tools; pregnant adolescents wanted non-judgmental listeners and a channel for consultation outside office hours, "The hospital is closed and there is no one to consult after hours at all" (T05); and families wanted knowledge about caregiving and communicating with adolescents.

2. Antenatal Care Quality Improvement

2.1 The "Youth Health Coaching" model comprises three components: 1) team development with families and the community for holistic care planning; 2) intensive care by a multidisciplinary team,

emphasizing home visits, family education, and follow-up of every case until delivery; and 3) continuous capacity building of mentor nurses, together with monthly follow-up meetings and a LINE group for problem consultation, as shown in Figure 2. Activities following the PDCA cycle are shown in Table 1.

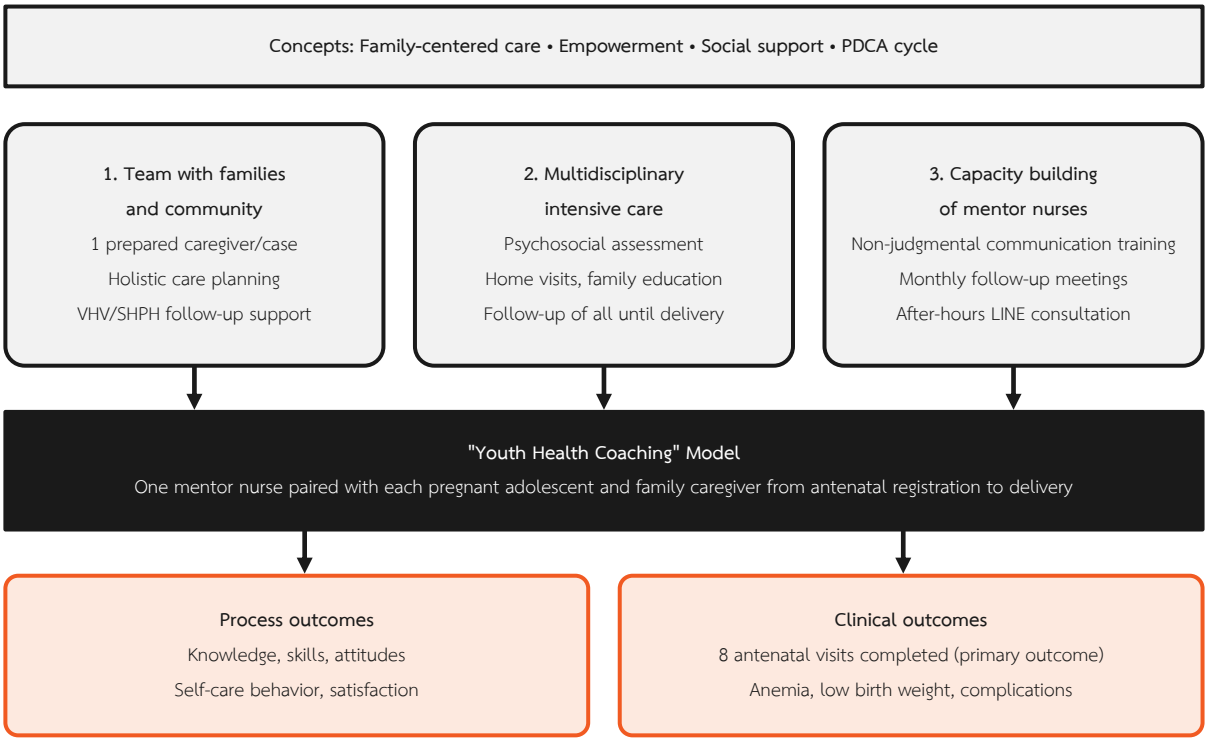


Figure 2 The "Youth Health Coaching" model for the care of pregnant adolescents

Table 1 Antenatal care quality improvement activities following the PDCA cycle, by implementation period

Phase/Month	Key activities	Instruments	Duration
Preparation Jan–Feb 2025	Studied the context, reviewed literature, analyzed indicators, obtained ethics approval, validated instruments	Medical records, outcome record form	8 weeks
Cycle 1 Plan Mar 2025	Interviews and focus groups, model design, setting goals and indicators	Interview guides	4 weeks
Cycle 1 Do Apr–Jun 2025	Nurse training, family education, mentor matching, home visits, LINE follow-up, monthly meetings	Manual, psychosocial assessment tool	12 weeks
Cycle 1 Check Jul 2025	Quantitative and qualitative evaluation, identification of problems and barriers	All assessment forms	4 weeks
Cycle 1 Act Aug 2025	Lessons learned, revision of the model and instruments, Cycle 2 planning	Lessons-learned record form	4 weeks

Phase/Month	Key activities	Instruments	Duration
Cycle 2 Plan Sep 2025	Model revision, strengthened family participation strategies, follow-up system development	Cycle 2 development plan	4 weeks
Cycle 2 Do Oct–Dec 2025	Applied the revised model to a new group, added family activities, additional nurse training, network building	Revised manual, home visit record form	12 weeks
Cycle 2 Check–Act Jan 2026	Overall evaluation, development of standard guidelines and manual, preparation for scale-up	All assessment forms	4 weeks

2.2 Results of implementation following the PDCA cycle In the checking step of Cycle 1, nurses' diverse workloads meant that only 73.33% of home visits were completed as scheduled, 66.67% of families attended all activities, and some pregnant women did not respond to messages in the LINE group. In the acting step, the instruments and processes were revised, teamwork and supervisory follow-up were strengthened, family activities were added, and a network with SHPHs was established. In Cycle 2, completed home visits increased to 93.33%, full family attendance increased to 86.67%, and the proportion of pregnant women replying in the LINE group within 24 hours increased from 60.00% to 86.67%. In the final step, standard practice guidelines and a manual were prepared for wider implementation.

3. Evaluation of Antenatal Care Quality Improvement

3.1 Scores before and after development Knowledge, skill, attitude, and self-care behavior scores in all groups were significantly higher than before development (p-value <0.001), with large effect sizes (dz = 1.71–2.30), as shown in Table 2. Results by cycle (n = 15) were in the same direction in both cycles. Satisfaction among nurses, families, and pregnant adolescents was at the highest level ($\bar{x}$±S.D. = 4.62±0.38, 4.53±0.45, and 4.59±0.41, respectively).

Table 2 Comparison of mean scores before and after development, by participant group (paired t-test)

Variable (full score)	Group	Before $\bar{x}$±S.D.	After $\bar{x}$±S.D.	$\bar{d}$ (95%CI)	t	dz
Knowledge (20)	Nurses (n=15)	12.40±2.10	17.20±1.52	4.80 (3.53, 6.07)	8.08*	2.09
Skills (30)	Nurses (n=15)	18.60±3.10	26.40±2.35	7.80 (5.92, 9.68)	8.89*	2.30
Knowledge (20)	Families (n=30)	11.30±2.45	16.90±1.88	5.60 (4.52, 6.68)	10.58*	1.94
Attitude (5)	Families (n=30)	3.42±0.51	4.38±0.38	0.96 (0.75, 1.17)	9.35*	1.71

Variable (full score)	Group	Before $\bar{x}$±S.D.	After $\bar{x}$±S.D.	$\bar{d}$ (95%CI)	t	dz
Knowledge (20)	Pregnant adolescents (n=30)	10.80±2.60	16.50±2.05	5.70 (4.54, 6.86)	10.07*	1.83
Behavior (50)	Pregnant adolescents (n=30)	31.40±4.80	42.60±3.90	11.20 (9.11, 13.29)	10.95*	2.00

*p-value <0.05

3.2 Comparison with the historical control group The development group had a higher mean number of antenatal visits than the fiscal year 2024 group (8.30±1.10 vs. 6.90±1.85 visits; t = 4.95, p-value <0.001) and a higher third-trimester hemoglobin level (11.20±1.05 vs. 10.30±1.40 g/dL; t = 3.69, p-value <0.001), whereas birth weight did not differ. Gestational age at the first antenatal visit was lower in the development group, but because this preceded enrollment in the model, it is reported as a baseline characteristic, as shown in Table 3.

Table 3 Comparison of antenatal care outcomes between the development group and the historical control group (Welch's t-test)

Variable	Development group (n=30) $\bar{x}$±S.D.	FY 2024 (n=86) $\bar{x}$±S.D.	Difference (95%CI)	t	p-value
Gestational age at first visit (weeks)[a]	10.40±2.85	14.60±4.20	−4.20 (−5.57, −2.83)	−6.09	<0.001*
Number of antenatal visits	8.30±1.10	6.90±1.85	1.40 (0.84, 1.96)	4.95	<0.001*
Third-trimester hemoglobin (g/dL)	11.20±1.05	10.30±1.40	0.90 (0.41, 1.39)	3.69	<0.001*
Birth weight (g)	3,085±385	2,940±450	145 (−26, 316)	1.70	0.095

*p-value <0.05; [a] The first antenatal visit occurred before enrollment in the model; shown to compare group characteristics, not as an effect of the model.

3.3 Antenatal care and birth outcomes In the development group, 70.00% completed eight antenatal visits, higher than in fiscal year 2024 (45.35%; RR = 1.54, χ^2 = 5.41, p-value = 0.020), meeting the indicator target (≥55%). Anemia, low birth weight (<2,500 g), and pregnancy complications (16.67% vs. 29.07%) decreased, but the differences were not statistically significant, as shown in Table 4.

Table 4 Comparison of antenatal care and birth outcomes between the development group and the historical control group

Outcome	Development group n/N (%)	FY 2024 n/N (%)	RR	χ^2	p-value
Completed 8 antenatal visits	21/30 (70.00)	39/86 (45.35)	1.54	5.41	0.020*
First visit ≤12 weeks[a]	22/30 (73.33)	30/86 (34.88)	2.10	13.29	<0.001*
Anemia	6/30 (20.00)	33/86 (38.37)	0.52	3.36	0.067
Birth weight <2,500 g	1/30 (3.33)	8/86 (9.30)	0.36	–	0.443[b]
Pregnancy complications	5/30 (16.67)	25/86 (29.07)	0.57	1.78	0.182

*p-value <0.05; chi-square test without Yates' correction; [a] occurred before enrollment in the model; [b] Fisher's exact test

Discussion

Regarding Objective 1, the main problems were a lack of proactive care targeted at this group, of a continuous follow-up system, of family participation, and of psychosocial assessment. This is consistent with a study in northeastern Thailand which found that parents were the primary caregivers of their pregnant adolescent daughters but faced confusion and needed support,[9] and with evidence that perceived social support predicts maternal role attainment among adolescents.[8] In addition, scheduled antenatal appointments meant that adolescents could not obtain timely help when physical or psychological problems or family conflicts arose; a continuous and easily accessible follow-up channel is therefore needed.

Regarding Objective 2, the "Youth Health Coaching" model developed through the PDCA cycle enabled nurses and families to learn together and solve problems systematically[12,13] by integrating a warm, non-judgmental therapeutic relationship based on Watson's caring theory,[17] empowerment through education and decision-making skills training,[14] self-efficacy enhancement,[18] and the linking of families with health personnel as a social support system.[15] The nurses' workload problem in Cycle 1 was resolved through teamwork and supervisory follow-up in Cycle 2, reflecting that continuous improvement is the key to sustainability.

Regarding Objective 3, knowledge, skill, attitude, and self-care behavior scores increased significantly, consistent with the principles of empowerment and self-efficacy.[14,18] The 24.65-percentage-point increase in completion of eight antenatal visits can be explained by proactive follow-up, home visits, and families reminding adolescents of appointments and

accompanying them to services, consistent with evidence that nurse home visits increase scheduled antenatal attendance among pregnant adolescents.[10,11] Anemia, low birth weight, and complications decreased but not significantly, possibly because of the small sample size. **Limitations** include the single-hospital setting; purposive sampling of volunteers, who may tend to have better outcomes than the control group, which comprised all registered cases; possible temporal confounding in the comparison with historical data; possible score inflation from repeated use of the same test; and a short postpartum follow-up period. The results should therefore be interpreted with caution.

Conclusion

The "Youth Health Coaching" model, comprising team development with families and the community, intensive care by a multidisciplinary team, and mentor-nurse capacity building, was implemented in two PDCA cycles. It significantly increased knowledge, skills, attitudes, and self-care behaviors; satisfaction was at the highest level; and completion of eight antenatal visits increased from 45.35% to 70.00%. Other clinical outcomes improved but did not reach statistical significance.

Recommendations

1. Recommendations for applying the findings: The "Youth Health Coaching" model should be adopted as a maternal and child health practice guideline, with support for mentor nurses' staffing and time. An information system for individual follow-up should be developed, links with village health volunteers and schools should be built to identify pregnant adolescents so that they begin antenatal care before 12 weeks, and the model should be expanded to SHPHs and community hospitals in the network.

2. Recommendations for further research: Quasi-experimental studies with a concurrent control group using the same inclusion criteria and an adequate sample size should be conducted, with follow-up through the postpartum period and maternal role attainment, together with a cost-effectiveness analysis of the model.

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Artificial Intelligence (AI) Disclosure

The author used an artificial intelligence tool (Claude, Anthropic) to help search for information sources and academic references. The author personally verified the accuracy of

every reference before use. Data analysis, interpretation of results, and discussion are entirely the author's own work. The AI did not participate as a co-author.

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RESEARCH ARTICLE

Development of an Influenza Vaccination Service Model for Children Aged 6 Months – 4 Years and 5 – 11 Years in Mueang District, Kalasin Province

Siwaboon Chaisongkram[1*]

1 Senior Professional Level Physician, Kalasin Hospital, Mueang District, Kalasin Province

*Corresponding author

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Abstract

This research and development study with a two-group pretest–posttest quasi-experimental design allocated by school aimed 1) to analyze the situation, 2) to develop an influenza vaccination service model for children aged 6 months – 4 years and 5 – 11 years, and 3) to evaluate its effects in Mueang District, Kalasin Province, Thailand, from January 2024 to December 2025. The sample comprised 160 parents or caregivers from six intervention and six control schools and child development centers (80 per group). The instruments were an integrated proactive vaccination service model (an 8-week program), a knowledge questionnaire, a health literacy questionnaire, and a vaccination record form. Data were analyzed using descriptive statistics, the paired t-test, the independent t-test, the chi-square test, and risk ratios (RR).

The model comprised five components: proactive school-based vaccination, hospital-based vaccination for special groups, parental health literacy enhancement, communication through community leaders, village health volunteers and online media, and network integration. After the intervention, the experimental group had a knowledge score of 8.65±1.12 and a health literacy score of 4.20±0.46, significantly higher than at baseline and than the control group (p-value <0.001). Uptake of at least one dose in the experimental group was 72.50% (6 months – 4 years) and 80.00% (5 – 11 years), compared with 30.00% and 37.50% in the control group (RR = 2.42 and 2.13; p-value <0.001), and full vaccination was 63.75% versus 23.75%. The model should be expanded to other areas through collaboration among hospitals, schools, and communities.

Keywords: Influenza vaccine, Service model, Children, School-based vaccination, Health literacy

Introduction

Seasonal influenza is an acute respiratory infection that occurs worldwide. The World Health Organization estimates approximately one billion cases annually, including 3 – 5 million severe cases and 290,000 – 650,000 respiratory deaths, with children under 5 years of age at high risk of severe illness and complications.[1] In Thailand, from 1 January to 8 November 2025, a cumulative 910,370 influenza cases were reported (1,402.46 per 100,000 population), with 100 deaths. The 5 – 9-year age group had the highest morbidity rate (4,602.60 per 100,000 population), followed by the 0 – 4-year group (3,957.69).[2] Vaccination is a key preventive measure; children under 9 years who have never been vaccinated require two doses in the first year.[3] The Department of Disease Control, together with the National Health Security Office (NHSO), supports vaccination for children aged 6 months to 2 years 11 months 29 days,[4] and on 3 November 2025 resolved to extend the target group to children aged 3 – 5 years.[5]

Mueang District, Kalasin Province, has experience in providing COVID-19 vaccination to children. Among children aged 5 – 11 years who received proactive school-based services, 81.15% received the first dose, whereas only 8.33% of children aged 6 months – 4 years, who had to attend health facilities, were vaccinated. For influenza in 2024, coverage of at least one dose in Mueang District was only 17.99% among children aged 6 months – 4 years and 5.99% among those aged 5 – 11 years, below the 70% target.

Studies in Thailand have found that influenza vaccine uptake among young children remains low despite national recommendations, with vaccination in the previous season and parental trust in information from health personnel being important factors.[6] Thai parents of children under 12 years showed greater hesitancy toward COVID-19 vaccines, mainly due to concerns about side effects and safety.[7] Systematic reviews have shown that school-located influenza vaccination is feasible and effective[8] and may confer indirect protection on others.[9] However, an integrated service model covering both young and school-aged children, combined with health literacy enhancement for parents and older caregivers, is still lacking in the district-level context.

This study therefore developed a model by applying lessons learned from COVID-19 vaccination, namely proactive school-based services, health literacy building, and communication through community leaders, village health volunteers (VHVs), and online media, to achieve comprehensive and cost-effective coverage while reducing vaccine wastage.

Research Objectives

1. To analyze the situation and problems of influenza vaccination services for children aged 6 months – 4 years and 5 – 11 years in Mueang District, Kalasin Province.
2. To develop an influenza vaccination service model for these groups of children.
3. To compare parental knowledge, health literacy, and children's vaccination coverage

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before and after the intervention and between the experimental and control groups.

Methods

This research and development study was conducted in three phases, as shown in Figure 1. Phase 1, situation analysis (January – March 2024), reviewed vaccination service data from the Health Data Center (HDC) system and conducted in-depth interviews/focus groups with 24 stakeholders, including health personnel, teachers, community leaders, VHVs, and parents; data were analyzed using content analysis. Phase 2 involved model development and quality assessment (April – December 2024), and Phase 3 involved implementation and evaluation (January – December 2025) using a two-group quasi-experimental design allocated by school (non-randomized cluster-controlled design). The intervention program lasted 8 weeks.

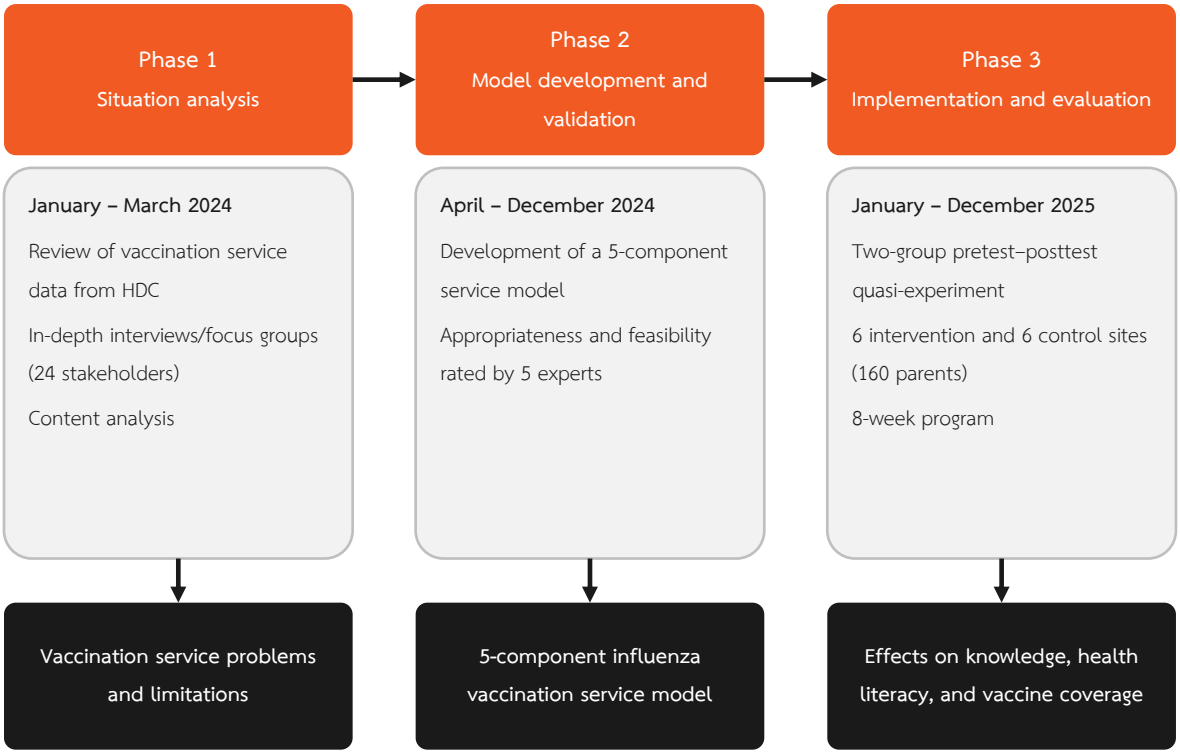


Figure 1 The three phases of the research and development process

Population

Parents and caregivers of children aged 6 months – 4 years (target: 3,663) and children aged 5 – 11 years (target: 8,226) in Mueang District, Kalasin Province, in 2025.

Sample

The sample comprised 160 parents or primary caregivers. Using G*Power for an independent t-test (effect size 0.50, α = 0.05, power 0.80), 64 participants per group were required; a check against the primary outcome, the proportion vaccinated (p1 = 0.18, p2 = 0.50), required 33 per group per age band. After

adjusting for a design effect of 1.2 and adding 20%, the sample was 80 per group (40 per age band). Sites were purposively selected by matching on size, location (urban/rural), and previous-year vaccine coverage, yielding six intervention and six control schools and child development centers located in different subdistricts to reduce contamination; participants were then selected by simple random sampling from name lists.

Inclusion Criteria

1) Being the father, mother, or primary caregiver of a child aged 6 months – 4 years or 5 – 11 years; 2) residing in Mueang District, Kalasin, for at least 6 months; 3) able to read and write Thai; and 4) consenting to participate.

Exclusion Criteria

1) The child had a contraindication to influenza vaccination according to Department of Disease Control guidelines; or 2) moving out of the area during the study or requesting withdrawal. Participants who did not complete all activities remained in the analysis (intention-to-treat).

Research Instruments

The instruments comprised: 1) the influenza vaccination service model (an 8-week program) with a manual and educational materials; vaccines for children not covered by the NHSO benefit were supported by Kalasin Hospital, and the control group had access to free vaccines under the same conditions at the hospital; 2) a 10-item knowledge test on influenza and vaccines (correct = 1, incorrect = 0; interpreted as low <6.00, moderate 6.00 – 7.99, high 8.00 – 10.00); 3) a 10-item vaccine health literacy questionnaire on a 5-point rating scale based on Nutbeam's framework (low 1.00 – 2.33, moderate 2.34 – 3.67, high 3.68 – 5.00); and 4) a vaccination record form based on the child health record book and verified against the HDC system. Five experts assessed content validity (IOC 0.80 – 1.00). A pilot test with 30 parents outside the sample yielded a KR-20 of 0.78 and a Cronbach's alpha of 0.86.

Data Collection

Trained research assistants who did not deliver the program collected data before (week 1) and after (week 8) the intervention in both groups during the same period. The experimental group received the program as shown in Table 1, while the control group received usual services. Vaccination status for both dose 1 and dose 2 was verified at week 8. Data collection took place from June to October 2025 (starting simultaneously at all 12 sites in June, with vaccination follow-up through October).

Data Analysis

Descriptive statistics included frequency, percentage, mean ($\bar{x}$), and standard deviation (S.D.). Inferential statistics included the paired t-test with effect size (dz) for within-group comparisons, the independent t-test with Cohen's d for between-group comparisons, and the chi-square test with risk ratios (95%CI) for vaccine coverage, with a sensitivity analysis using generalized estimating equations (GEE) with schools as clusters. The significance level was set at 0.05.

Research Ethics

This study adhered to the ethical principles of human research under the Declaration of Helsinki. The researcher explained the objectives and procedures to all parents, who gave voluntary written consent before participation, separate from the vaccination consent form. Data were kept confidential and results were presented in aggregate. Parents could withdraw at any time without affecting their access to services, and the control group received services according to the model after the study ended.

Results

1. Situation Analysis of Vaccination Services

1.1 Vaccination service performance

COVID-19 vaccination data as of 28 February 2023 showed that among children aged 6 months – 4 years (target: 3,663), 305 (8.33%) received the first dose, 84 (2.29%) the second dose, and 2 (0.05%) the third dose. Among children aged 5 – 11 years (target: 8,226), 6,675 (81.15%) received the first dose, 5,174 (62.90%) the second dose, and 54 (0.66%) the third dose. For influenza vaccination in 2024, 659 children aged 6 months – 4 years (17.99%) and 493 children aged 5 – 11 years (5.99%) received at least one dose, below the 70% target in both groups.

1.2 Service problems and limitations

Five key limitations were identified: 1) multi-dose vials require 8 – 10 recipients per vial opening to be cost-effective and reduce wastage; 2) parental consent is required, and many children live with older relatives who are worried and lack understanding while their parents work in other provinces; 3) building knowledge and reducing concerns takes time; 4) proactive outreach adds to routine workloads and requires coordination of network partners, equipment, budget, and the cold chain; and 5) previously unvaccinated children under 9 years need two doses,[3] requiring a continuous appointment and follow-up system.

2. Development of the Influenza Vaccination Service Model

The model comprises five components: 1) proactive school-based vaccination at schools and child development centers by a multidisciplinary team, to reach large numbers of children and reduce vaccine wastage; 2) hospital-based vaccination for children with chronic diseases and those who are home-schooled or outside the education system; 3) health literacy enhancement to address concerns and perceived disease severity among parents and older caregivers; 4) communication through community leaders, VHVs, village broadcast towers, the hospital's Facebook fan page, and parents' LINE groups; and 5) network integration, with the hospital director and school directors as the leadership team, as shown in Figure 2. Five experts rated the appropriateness and feasibility of the model at the highest level ($\bar{x}$±S.D. = 4.56±0.38). The 8-week implementation plan is shown in Table 1.

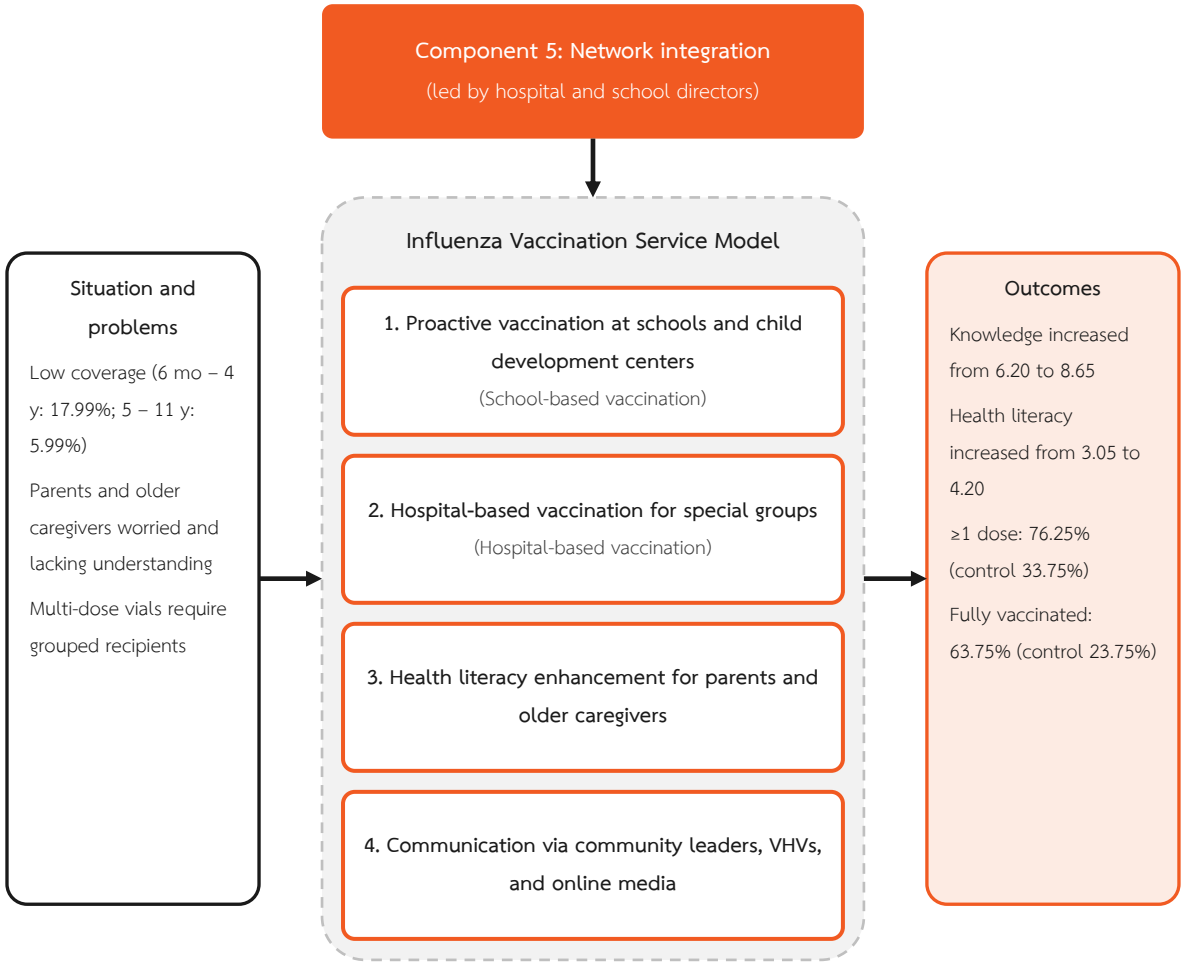


Figure 2 Influenza vaccination service model for children aged 6 months – 4 years and 5 – 11 years, Mueang District, Kalasin Province

Table 1 Implementation plan of the influenza vaccination service model for children (8 weeks)

Week	Activity/Content	Materials	Duration
1	Project briefing, informed consent, and pretest assessment	Information sheet, consent form, questionnaire	45 min
2	Education for parents and older caregivers on influenza, vaccine benefits, side effects, and post-vaccination care[7]	Slides, leaflets, short video clips	60 min

Week	Activity/Content	Materials	Duration
3	Dose 1 delivered proactively at schools/child development centers and at the hospital for special-group children; group appointments to reduce vaccine wastage[8]	Vaccine, cold box, appointment register	1 day/site
4	Telephone follow-up of post-vaccination symptoms; communication via VHVs, village broadcast towers, and LINE groups[6]	Symptom follow-up form	15 min/case
5	Q&A forum to address concerns, led by community leaders together with physicians	Video media, concern record form	45 min
6	Dose 2 appointment reminders for children under 9 years vaccinated for the first time[3]	Appointment register, reminder messages	15 min
7	Dose 2 (4 weeks after dose 1) at schools and the hospital[3]	Vaccine, cold box	1 day/site
8	Posttest assessment, vaccination status check, and summary of results with network partners	Questionnaire, child health record book	45 min

3. Implementation of the Service Model

3.1 General characteristics of the sample The 160 parents or caregivers (80 per group) had no withdrawals or losses to follow-up. They comprised 76 mothers (47.50%), 48 grandparents (30.00%), 24 fathers (15.00%), and 12 other relatives (7.50%), with a mean age of 41.80±11.26 years; 108 (67.50%) had less than a bachelor's degree, and 38 (23.75%) had previously taken their children for influenza vaccination (20 in the experimental group and 18 in the control group; χ^2 = 0.14, p-value = 0.710). The general characteristics of the two groups did not differ (p-value >0.05).

3.2 Within-group pre–post comparison In the experimental group, the knowledge score increased from 6.20±1.45 to 8.65±1.12 (from moderate to high), and the health literacy score increased from 3.05±0.58 to 4.20±0.46, both statistically significant (p-value <0.001) with large effect sizes (dz = 1.51 and 1.83). The control group showed no change (p-value = 0.259 and 0.224), as shown in Table 2.

Table 2 Comparison of mean parental knowledge and health literacy scores before and after the intervention (paired t-test, n = 80 per group)

Variable	Group	Before		After		Level	$\bar{d}$	95%CI	t	p-value
		$\bar{x}$	S.D.	$\bar{x}$	S.D.					
Knowledge (max 10)	Experimental	6.20	1.45	8.65	1.12	High	2.45	2.09, 2.81	13.55	<0.001*
Knowledge (max 10)	Control	6.15	1.50	6.35	1.40	Moderate	0.20	−0.15, 0.55	1.14	0.259
Health literacy (max 5)	Experimental	3.05	0.58	4.20	0.46	High	1.15	1.01, 1.29	16.35	<0.001*
Health literacy (max 5)	Control	3.08	0.60	3.16	0.55	Moderate	0.08	−0.05, 0.21	1.22	0.224

*Statistically significant at p-value <.05

3.3 Between-group comparison Before the intervention, scores did not differ between the groups (p-value = 0.831 and 0.748). After the intervention, the experimental group scored 2.30 points higher in knowledge (95%CI 1.90, 2.70) and 1.04 points higher in health literacy (95%CI 0.88, 1.20) than the control group, both statistically significant (p-value <0.001) with large effect sizes (Cohen's d = 1.81 and 2.05), as shown in Table 3.

Table 3 Comparison of mean knowledge and health literacy scores between the experimental and control groups (independent t-test, n = 80 per group)

Variable	Experimental group		Control group		$\bar{d}$	95%CI	t	p-value	Cohen's d
	$\bar{x}$	S.D.	$\bar{x}$	S.D.					
Knowledge, before (max 10)	6.20	1.45	6.15	1.50	0.05	−0.41, 0.51	0.21	0.831	0.03
Knowledge, after (max 10)	8.65	1.12	6.35	1.40	2.30	1.90, 2.70	11.47	<0.001*	1.81
Health literacy, before (max 5)	3.05	0.58	3.08	0.60	−0.03	−0.21, 0.15	−0.32	0.748	0.05
Health literacy, after (max 5)	4.20	0.46	3.16	0.55	1.04	0.88, 1.20	12.97	<0.001*	2.05

*Statistically significant at p-value <.05

3.4 Influenza vaccination coverage Within 8 weeks, 61 children (76.25%) in the experimental group received at least one dose, compared with 27 (33.75%) in the control group

(RR = 2.26, 95%CI 1.62, 3.14), both among children aged 6 months – 4 years (72.50% vs. 30.00%) and those aged 5 – 11 years (80.00% vs. 37.50%). Full vaccination was 63.75% vs. 23.75% (RR = 2.68). In the GEE analysis adjusting for clustering by school, the difference remained statistically significant (RR = 2.21, 95%CI 1.48, 3.30), as shown in Table 4.

Table 4 Comparison of influenza vaccination between the experimental and control groups by age group

Vaccination	Experimental n/N (%)	Control n/N (%)	RR (95%CI)	χ^2	p-value
≥1 dose					
6 months – 4 years	29/40 (72.50)	12/40 (30.00)	2.42 (1.45, 4.03)	14.46	<0.001*
5 – 11 years	32/40 (80.00)	15/40 (37.50)	2.13 (1.39, 3.28)	14.91	<0.001*
Total	61/80 (76.25)	27/80 (33.75)	2.26 (1.62, 3.14)	29.19	<0.001*
Fully vaccinated[a]					
6 months – 4 years	24/40 (60.00)	8/40 (20.00)	3.00 (1.54, 5.86)	13.33	<0.001*
5 – 11 years	27/40 (67.50)	11/40 (27.50)	2.45 (1.42, 4.24)	12.83	<0.001*

*p-value <0.05; chi-square test without Yates' correction; [a] previously unvaccinated children under 9 years who received two doses, or one dose for previously vaccinated children/those aged ≥9 years

Discussion

Regarding objective 1, vaccine coverage among children aged 6 months – 4 years was markedly lower than among those aged 5 – 11 years in the COVID-19 vaccination program (8.33% vs. 81.15%). This is consistent with Thai studies showing low influenza vaccine uptake among young children and the importance parents place on information from health personnel.[6] Most young children live with older caregivers who are unaware of the severity of the disease and worried about side effects, consistent with the safety-related vaccine hesitancy of Thai parents,[7] whereas school-aged children are easily reached through proactive school-based services.

Regarding objective 2, the model used proactive school-based vaccination as its core strategy, together with health literacy enhancement and communication through community leaders. This is consistent with systematic reviews concluding that school-located vaccination is feasible and effective[8] and may provide indirect protection to others,[9] which is important because the 5 – 9-year age group had the highest morbidity rate in 2025.[2] However, such services are resource-intensive,[9] requiring network integration led by hospital and school administrators.

Regarding objective 3, the experimental group had higher knowledge, health literacy, and vaccine coverage than the control group,

indicating that education, addressing concerns through health personnel and community leaders, and reducing the travel burden through proactive services made it easier for parents to decide to vaccinate.[6] Vaccine uptake of 30.00 – 37.50% in the control group, higher than the full-year coverage in 2024, may reflect the severe epidemic in 2025 and district-level communication reaching both groups, suggesting that the observed difference is likely an underestimate. **Limitations** include non-random allocation of the experimental and control groups, a single-district setting, recruitment of young children from child development centers, which may not cover children staying at home with older caregivers, a short follow-up of 8 weeks, self-reported knowledge, and baseline data partly derived from COVID-19 vaccination, which differs in context from influenza vaccination.

Conclusion

Vaccine coverage among children aged 6 months – 4 years was lower than among those aged 5 – 11 years, with limitations related to parental consent, health literacy, and resources for proactive outreach. The developed five-component model significantly increased parental knowledge and health literacy and increased both at-least-one-dose and full vaccination coverage among children in both age groups.

Recommendations

1. Recommendations for applying the findings Hospitals and district health offices should adopt the model to deliver proactive vaccination at schools and child development centers, with hospital and school directors as the leadership team; schedule group appointments to reduce vaccine wastage; provide communication channels accessible to parents and older caregivers; and use VHVs to identify young children not enrolled in child development centers, especially as free vaccination is extended to children aged 3 – 5 years.[5]

2. Recommendations for future research Cluster randomized trials should be conducted in multiple districts, with follow-up over the entire season to assess influenza morbidity and hospitalization, and the cost-effectiveness of the model should be evaluated.

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AI Disclosure

The author used an artificial intelligence tool (Claude, Anthropic) to assist in searching for information sources and academic references. The author personally verified the accuracy of all references before use. Data analysis, interpretation of results, and discussion are

entirely the author's own work. The AI did not contribute as a co-author.

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RESEARCH ARTICLE

Effects of the Namon Hospital Herbal Poultice Sheet on Patients with Knee Pain, Namon Hospital, Kalasin Province

Wanwisa Phrommetta[1*]

[1] Senior Thai Traditional Medicine Practitioner, Thai Traditional Medicine Department, Namon Hospital, Namon District, Kalasin Province

*Corresponding author

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Abstract

This quasi-experimental study, using a one-group pretest–posttest design, aimed 1) to describe a Thai traditional medicine service model based on the Namon Hospital herbal poultice sheet, 2) to compare knee pain before and after use, and 3) to assess patient satisfaction. It was conducted at the Thai Traditional Medicine Clinic, Namon Hospital, Kalasin Province, from January to December 2025. The sample comprised 40 patients with knee pain from osteoarthritis recruited consecutively. Each participant received a poultice sheet containing five local herbs (mature ginger, plai, khat mon, tamarind leaves, and kaffir lime peel), applied once at the clinic and six times at home over two weeks. The instruments were the poultice sheet, the Numeric Rating Scale (NRS) for pain, and a satisfaction questionnaire. Data were analyzed using descriptive statistics, the paired t-test, and the Wilcoxon signed-rank test.

The mean NRS score fell from 6.55±1.40 to 3.40±1.55 (mean difference 3.15, 95%CI 2.49–3.81, t = 9.66, p-value <0.001, dz = 1.53). Pain decreased in 85.00% of the patients, and 72.50% achieved a clinically meaningful reduction of at least 2 points. Good to very good satisfaction was reported by 92.50% ($\bar{X}$ = 4.48±0.64), and one patient had mild itching. The poultice sheet relieved knee pain in the short term, was convenient, and supported self-care, and may serve as an option in Thai traditional medicine services. Because there was no control group, controlled studies with long-term follow-up are recommended.

Keywords: Herbal poultice sheet, Knee pain, Knee poultice, Herbal medicine, Thai traditional medicine

Introduction

Knee osteoarthritis is the most common form of osteoarthritis and a major cause of chronic pain and impaired mobility in older adults. A global burden of disease analysis estimated that approximately 595 million people were living with osteoarthritis in 2020,[1] and a pooled analysis of population-based studies reported a prevalence of knee osteoarthritis of 22.9% among people aged 40 years and older.[2] In Thailand, which is becoming an aged society, knee pain from osteoarthritis is a common problem in primary care units. The National Health Security Office board has approved a knee poultice service for older adults with knee osteoarthritis under the Universal Coverage Scheme at a rate of 100 baht per session, up to 5 sessions within 2 weeks.[3]

The Thai Traditional Medicine Clinic at Namon Hospital, Namon District, Kalasin Province, found that patients wanted convenient and fast services because of the working conditions of people in the community. In fiscal year 2024, 312 patients presented with knee pain, accounting for 18.50% of all clinic visits; most were older adults and farmers. Knee poulticing with fresh herbs requires long preparation and waiting times, which prevents some patients from attending continuously.

In Thai traditional medicine, knee pain in patients with knee osteoarthritis is associated with Lom Jab Pong Khao, a condition caused by obstruction of wind (lom) in the knee joint that results in stiffness and pain; treatment therefore aims to relieve the obstruction of wind around the knee.[4] Herbal knee poulticing is a long-established procedure. Ginger extract has been reported to reduce knee pain in patients with osteoarthritis,[5] a Thai herbal compress containing plai relieved knee pain comparably to ibuprofen,[6] herbal knee poultice combined with acupressure reduced knee pain and stiffness,[4,7] and the effectiveness of knee poultices for knee osteoarthritis and Lom Jab Pong Khao has been reported in Thai health services.[8,9] However, no study has examined a poultice sheet made from five locally available herbs (mature ginger, plai, khat mon, tamarind leaves, and kaffir lime peel) prepared as a sheet that patients can use at home. This study therefore aimed to evaluate the effects of the herbal poultice sheet on knee pain and patient satisfaction, to inform the development of Thai traditional medicine services and promote the use of local herbs.

Research Objectives

1. To describe a Thai traditional medicine service model using the Namon Hospital herbal poultice sheet that enables patients to receive convenient, fast services and to care for themselves.
2. To compare knee pain levels before and after use of the herbal poultice sheet in

patients with knee osteoarthritis (Lom Jab Pong Khao) attending the Thai Traditional Medicine Clinic.

3. To assess patient satisfaction and adverse events.

Methods

This quasi-experimental study used a one-group pretest–posttest design and was conducted at the Thai Traditional Medicine Clinic, Namon Hospital, from January to December 2025. It comprised a preparation and formulation phase (January–March), a data collection phase (April–October), and a data analysis phase (November–December). Each patient participated in the program for 2 weeks, as shown in Figure 1 and detailed below.

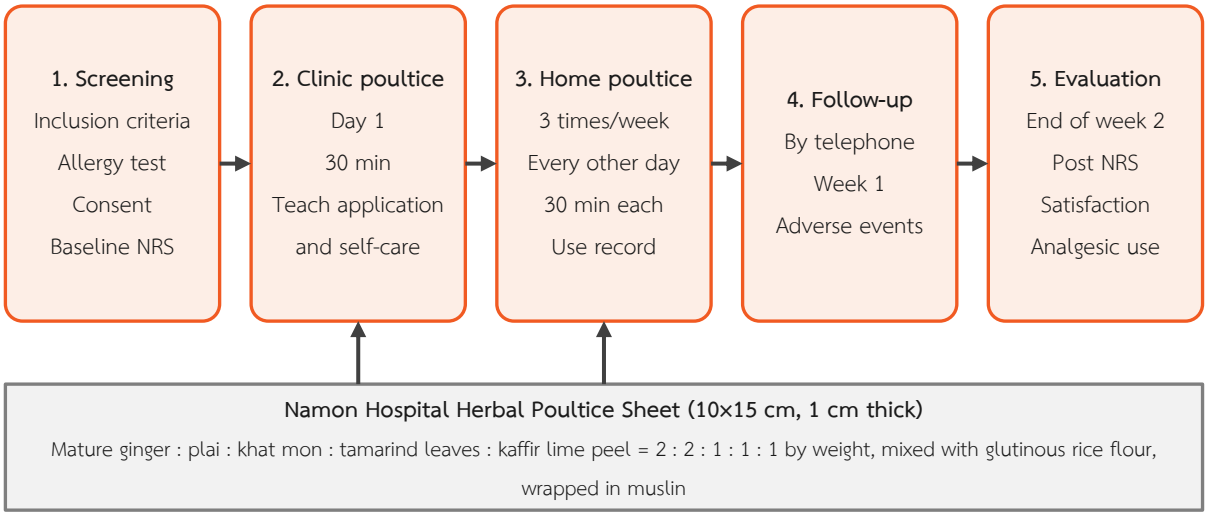


Figure 1 Service model of the Namon Hospital herbal poultice sheet for patients with knee pain

Population

Approximately 150 patients with knee pain who attended the Thai Traditional Medicine Clinic, Namon Hospital, between April and October 2025.

Sample

Forty patients with knee pain were recruited by consecutive sampling according to the eligibility criteria. The sample size was calculated with G*Power for a paired t-test, using an effect size of 0.80 based on a previous study,[9] a significance level of 0.05, and a power of 0.95, giving a minimum of 23 participants. Data were collected from 40 patients to compensate for possible dropout and to improve the precision of estimates.

Inclusion Criteria

Age 40 years or older; diagnosis of knee osteoarthritis or Lom Jab Pong Khao by a Thai traditional medicine practitioner, together with the American College of Rheumatology clinical criteria;[10] pain in at least one knee for more than 3 months; an NRS pain score of 1 or higher; normal skin over the knee; ability to

communicate in Thai; and consent to participate.

Exclusion Criteria

Allergy to any herbal ingredient or a positive allergy test on the inner forearm; wounds or dermatitis on the knee; acute knee inflammation (swelling, redness, warmth) or fever; intra-articular knee injection within the past 3 months; or pregnancy. Withdrawal criteria were an adverse event or a request to withdraw. Participants who did not complete all applications remained in the analysis (intention-to-treat).

Research Instruments

The instruments were: 1) the Namon Hospital herbal poultice sheet, made from mature ginger (Zingiber officinale Roscoe), plai (Zingiber montanum (J.Koenig) Link ex A.Dietr.), khat mon (Sida rhombifolia L.), tamarind leaves (Tamarindus indica L.), and kaffir lime peel (Citrus hystrix DC.), grown in Namon District and authenticated by a Thai traditional medicine practitioner. The fresh herbs were coarsely ground in a weight ratio of 2:2:1:1:1 (200 g per sheet), mixed with glutinous rice flour and a little water, and wrapped in muslin to form a 10×15 cm sheet, 1 cm thick. Patients received 3 sheets per week, stored them in a refrigerator, and used them within 5 days of receipt; 2) a general information form and a record form for poultice and analgesic use; 3) the Numeric Rating Scale (NRS) for pain, scored 0–10 and interpreted as no pain (0), mild (1–3), moderate (4–6), and severe pain (7–10);[11] a reduction of at least 2 points or 30% was defined as clinically meaningful;[12] and 4) a 5-item satisfaction questionnaire on a 5-point rating scale, with mean scores interpreted as 4.51–5.00 = very good, 3.51–4.50 = good, 2.51–3.50 = moderate, 1.51–2.50 = low, and 1.00–1.50 = very low. Content validity was reviewed by 3 experts (IOC 0.67–1.00), and a pilot test in 30 patients with similar characteristics yielded a Cronbach's alpha of 0.86.

Data Collection

The researcher screened patients against the criteria, explained the project, obtained consent, and assessed the baseline NRS. Each patient received one 30-minute knee poultice application at the clinic with instruction on use, followed by self-application at home 3 times per week (every other day) for 30 minutes each time for 2 weeks. Patients were followed up by telephone in week 1. At the end of week 2, the NRS, satisfaction, adverse events, and concomitant analgesic use were assessed by a research assistant who was not involved in treatment. Details are shown in Table 1.

Table 1 Activities for using the Namon Hospital herbal poultice sheet in patients with knee pain

Week	Activity	Instruments	Duration
1 (Day 1)	Screening against criteria, allergy test, informed consent, baseline NRS assessment[11]	General information form, NRS	15 min
1 (Day 1)	Clinic knee poultice application (1 session); instruction on application, storage, and self-care[5,6]	Poultice sheet, knee wrap, user manual	30 min
1–2	Home self-application 3 times/week (every other day); telephone follow-up in week 1[4,7]	Poultice sheet, use record form	30 min/session
2 (End)	Assessment of NRS, satisfaction, adverse events, and concomitant analgesics	NRS, satisfaction questionnaire	15 min

Data Analysis

Descriptive statistics, including frequency, percentage, mean ($\bar{x}$), and standard deviation (S.D.), were used. Pre- and post-intervention NRS scores were compared using the paired t-test with effect size (dz). Normality of the differences was checked with the Shapiro–Wilk test, and the results were confirmed with the Wilcoxon signed-rank test because the NRS is ordinal. 95%CIs are reported, and the significance level was set at 0.05.

Research Ethics

This study adhered to the principles of ethics in human research and was conducted in accordance with the Declaration of Helsinki. The researcher explained the objectives and procedures and obtained signed consent. Data were kept confidential using codes instead of names and reported only in aggregate. Participants were advised to stop use and contact the clinic immediately if a rash, itching, or burning occurred, and could withdraw at any time without affecting their treatment.

Results

1. General Characteristics of the Sample

Of 52 patients screened, 44 were eligible and 4 declined; 40 participated and all were analyzed. There were 29 women (72.50%) and 11 men (27.50%), with a mean age of 61.45±8.12 years (range 45–78). Twenty-four were farmers (60.00%), 10 were homemakers or not employed (25.00%), and 6 had other occupations (15.00%). Twenty-one had pain in both knees (52.50%), 10 in the right knee (25.00%), and 9 in the left knee (22.50%); in those with bilateral pain, the more

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painful knee was treated. The mean duration of pain was 3.80±2.15 years, and the mean body mass index was 25.40±3.20 kg/m².

2. Service Model (Objective 1)

The service model consisted of screening, a clinic application with instruction, home self-application, telephone follow-up, and outcome assessment (Figure 1). The mean time spent at the clinic was 35.20±6.40 minutes. Thirty-eight patients (95.00%) applied the poultice correctly at home, 36 (90.00%) used all 6 applications, and 12 (30.00%) used analgesics during the study. No serious adverse events occurred; 1 patient (2.50%) had mild skin itching that resolved spontaneously. The conceptual framework of the proposed mechanisms is shown in Figure 2.

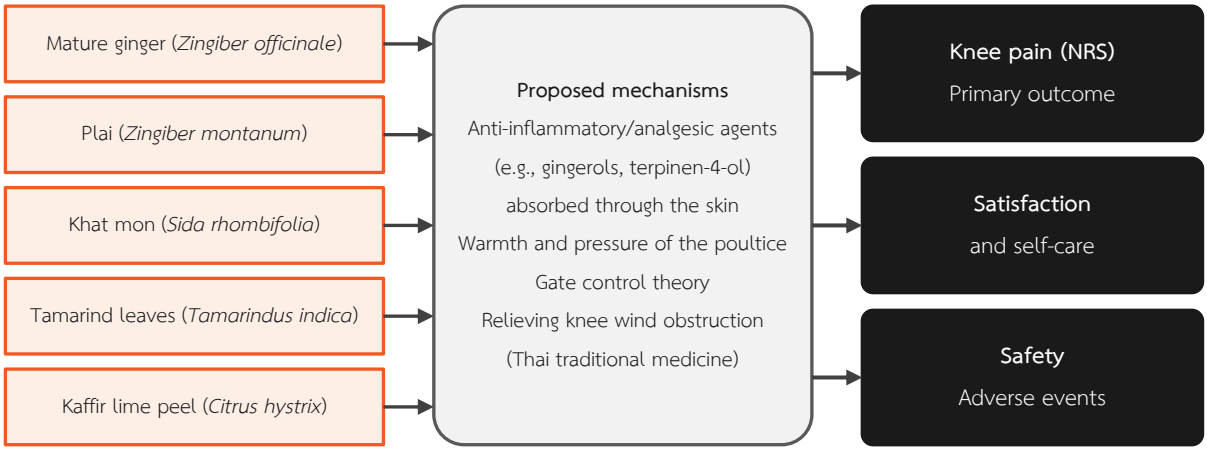


Figure 2 Conceptual framework: the five herbs, proposed mechanisms, and outcomes

3. Effects on Knee Pain and Satisfaction (Objectives 2 and 3)

3.1 Knee pain scores The mean NRS score decreased from 6.55±1.40 to 3.40±1.55, a mean reduction of 3.15 points (95%CI 2.49–3.81), which was statistically significant (t = 9.66, df = 39, p-value <0.001) with a large effect size (dz = 1.53). The Wilcoxon signed-rank test gave consistent results (Z = −5.05, p-value <0.001), as shown in Table 2.

Table 2 Comparison of knee pain scores (NRS) before and after use of the herbal poultice sheet (n = 40)

Variable	Before $\bar{x}$±S.D.	After $\bar{x}$±S.D.	$\bar{d}$ (95%CI)	t	p-value	dz
NRS pain score (0–10)	6.55±1.40	3.40±1.55	3.15 (2.49, 3.81)	9.66	<0.001*	1.53

*p-value <0.05 (Paired t-test)

3.2 Changes in pain level Pain decreased in 34 patients (85.00%), of whom 29 (72.50%) had a reduction of at least 2 points and 28 (70.00%) a reduction of at least 30%. Pain was unchanged in 5 patients (12.50%) and increased in 1 (2.50%). The

proportion with severe pain fell from 55.00% to 2.50% (Stuart–Maxwell test, p-value <0.001), as shown in Table 3.

Table 3 Knee pain levels of the sample before and after use of the herbal poultice sheet (n = 40)

Pain level (NRS)	Before, n (%)	After, n (%)
No pain (0)	0 (0.00)	3 (7.50)
Mild (1–3)	2 (5.00)	18 (45.00)
Moderate (4–6)	16 (40.00)	18 (45.00)
Severe (7–10)	22 (55.00)	1 (2.50)
Total	40 (100.00)	40 (100.00)

3.3 Satisfaction Overall, 92.50% of patients reported good to very good satisfaction, with an overall mean score of 4.48±0.64 (good): very good in 22 patients (55.00%), good in 15 (37.50%), and moderate in 3 (7.50%). The highest-rated item was the convenience and speed of service, as shown in Table 4.

Table 4 Patient satisfaction with the herbal poultice sheet (n = 40)

Item	$\bar{x}$±S.D.	Level
Convenience and speed of service	4.55±0.60	Very good
Ability to self-apply and self-care at home	4.50±0.64	Good
Relief of knee pain	4.43±0.68	Good
Comfort and suitability of the sheet (odor, warmth)	4.40±0.67	Good
Beneficial use of local herbs	4.50±0.62	Good
Overall	4.48±0.64	Good

Discussion

Service model The five-herb poultice sheet made from local herbs allowed patients to receive convenient, fast treatment and to apply it themselves at home, meeting the needs of community members whose time is limited by work. Ninety-five percent of patients applied the poultice correctly, consistent with international guidelines that

emphasize education and self-management in knee osteoarthritis[13] and with the policy supporting knee poultice services under the Universal Coverage Scheme.[3] The model also reduced hospital visits for poulticing from 5 under the previous approach to 1, although patients still needed to collect sheets weekly and return for assessment at the end of the study.

Effects on knee pain The NRS score decreased by a mean of **3.15** points, exceeding the threshold for a clinically meaningful change.[12] This is consistent with quasi-experimental studies showing that herbal knee poultice combined with acupressure reduced pain,[4,7] a randomized trial showing that a Thai herbal compress reduced knee pain comparably to ibuprofen,[6] and a randomized trial in Thai government hospitals showing that adding a knee poultice to Thai massage reduced pain and stiffness and improved knee function more than massage alone.[14] These effects may be explained by the analgesic and anti-inflammatory properties of ginger and plai;[5,6] tamarind, a herbal compress ingredient with reported analgesic activity;[6] and active constituents of plai oil such as terpinen-**4-**ol, which penetrate the skin,[15] together with the warmth and pressure of the poultice, which may inhibit pain transmission according to the gate control theory.[16] However, there is no clinical evidence for khat mon or kaffir lime peel in relieving knee pain, and this study did not measure inflammation; these are therefore only proposed mechanisms.

Satisfaction and limitations The mean satisfaction score of 4.48±0.64 was similar to that reported for herbal knee poultice combined with acupressure (4.47±0.65),[4] as the sheet is easy to use and reduces waiting time. Limitations include the single-group design without a control group, so the effects of the herbs could not be separated from the effects of perceived treatment, the natural course of the disease, regression to the mean (patients often seek care when pain is severe), and concomitant analgesic use. Pain was self-reported, the NRS ≥1 inclusion threshold was low, follow-up lasted only 2 weeks, the study was conducted at a single site, knee function was not measured, and the contribution of each herb could not be determined.

Conclusion

The Namon Hospital herbal poultice sheet, containing mature ginger, plai, khat mon, tamarind leaves, and kaffir lime peel, provided patients with convenient, fast service and enabled self-care. Knee pain scores decreased significantly from 6.55±1.40 to 3.40±1.55 (p-value <0.001), and most patients experienced a clinically meaningful short-term reduction in pain. Satisfaction was good to very good, and only 1 mild adverse event occurred. The herbal poultice sheet is therefore an option in Thai traditional medicine services for patients with knee pain.

Recommendations

1. Recommendations for applying the findings: The herbal poultice sheet service should be extended to knee osteoarthritis clinics and sub-district health promoting hospitals in the network, with standardized formulation, production, and storage procedures; screening for herbal allergy and knee wounds before use; and continuous monitoring of adverse events.

2. Recommendations for future research: Randomized controlled trials (e.g., against conventional knee poulticing) should be conducted, with knee function outcomes (e.g., WOMAC), long-term follow-up, recording of concomitant analgesic use, and analysis of active constituent content and formulation stability.

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AI Disclosure

The author used an artificial intelligence tool (Claude, Anthropic) to assist in searching for information sources and academic references. The author personally verified the accuracy of every reference before use. Data analysis, interpretation of results, and discussion are entirely the author's own work. AI did not participate as a co-author.

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RESEARCH ARTICLE

Improving Accuracy in Postpartum Blood Loss Assessment from Visual Estimation to Gravimetric Method in the Labor Ward, Namon Hospital, Kalasin Province

Pornnapat Chaiyakarn[1*]

[1] Registered Nurse (Professional Level), Labor Room Unit, Namon Hospital, Namon District, Kalasin Province

*Corresponding author

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Abstract

This action research, guided by the PAOR cycle, with a before–after comparison among staff and a non-concurrent comparison of mothers, aimed 1) to examine the situation, 2) to develop, and 3) to evaluate the use of the gravimetric method in place of visual estimation for assessing postpartum blood loss in the labor ward of Namon Hospital, Kalasin Province, from January 2025 to February 2026. Participants were 10 multidisciplinary team members (3 physicians and 7 registered nurses) and 38 mothers who delivered vaginally (16 in the pre-development visual estimation group and 22 in the post-development gravimetric group). The instruments comprised a care bundle guideline and training program, a knowledge test, a skills checklist, and a blood loss record form. Data were analyzed using descriptive statistics, the paired t-test, Welch's t-test, the chi-square test, Fisher's exact test, and Bland–Altman analysis.

Before development, visual estimation underestimated blood loss by 25.78%. After training, staff knowledge and skill scores increased by 6.00 and 8.20 points (p-value <0.001). The gravimetric group had a lower absolute error than the visual estimation group (6.84±4.12% vs 31.52±17.36%, p-value <0.001), higher accuracy (86.36% vs 31.25%, p-value <0.001), and fewer incorrect clinical decisions (0.00% vs 25.00%, p-value = 0.025). The gravimetric method developed through the PAOR cycle improved the accuracy of postpartum blood loss assessment, consistent with the 2025 WHO recommendation for objective measurement, and is suitable for community hospital labor wards. It should be adopted as hospital policy and expanded.

Keywords: Postpartum hemorrhage, Blood loss assessment, Visual estimation, Gravimetric method, Labor ward

Introduction

Postpartum hemorrhage (PPH) is a major obstetric complication and a leading cause of maternal death worldwide. The 2025 consolidated guideline of the World Health Organization, the International Federation of Gynecology and Obstetrics, and the International Confederation of Midwives sets the threshold for initiating treatment at a quantitatively measured blood loss of ≥300 mL with abnormal vital signs or ≥500 mL within 24 hours after birth, and recommends quantitative measurement of blood loss instead of visual estimation.[1] PPH accounts for more than 20% of maternal deaths, about 80% of which occur in sub-Saharan Africa and South Asia, and 54–93% of these deaths are preventable.[2] Its global incidence is approximately 1–10% of births.[3] In the United States, it accounts for about 11.20% of maternal deaths,[4] and inaccurate assessment of blood loss is a major cause of delayed response.[5]

In Thailand, a study in 14 hospitals found an incidence of 1.40–10.60%, with community hospitals having a 14-fold higher likelihood than regional hospitals.[6] A community hospital on the Thai–Myanmar border reported 5.55%,[7] and Siriraj Hospital reported an increase in incidence from 2.8% to 8.5% after switching to drapes with calibrated blood collection bags, reflecting that visual estimation fails to detect many cases of hemorrhage.[8] The incidence in Kalasin Province in 2024 was 8.6%. The labor ward of Namon Hospital, a community hospital, had 37 and 32 deliveries in 2023 and 2024, with 4 and 3 cases of PPH (10.81% and 9.38%),[9] and the incidence decreased after the introduction of Active Management of the Third Stage of Labor (specify year and denominator). However, visual estimation is still the main method, and a preliminary assessment found an error of approximately 25–35% compared with weighing, while the ward is staffed by 3 permanent nurses, 4 rotating nurses, and 3 physicians.

Visual estimation is widely used because it is convenient and quick,[10] but it typically underestimates actual blood loss by about 30%.[5] A study at Siriraj Hospital found that visual estimation yielded 178.6±133.1 mL, lower than measurement with a calibrated drape (259.0±174.9 mL).[11] In contrast, the gravimetric method, which weighs absorbent materials before and after use and calculates the difference, has an error of 4.00±2.70% compared with 34.70±32.10% for visual estimation,[12] and 3 hours of online training combined with 1 month of implementation enabled midwives to understand and apply this method in a low-resource setting.[13] Evidence on applying the care bundle concept[14] and quality improvement cycles[15] together with the PAOR cycle[16] to develop the gravimetric method in community hospitals with limited staff remains scarce.

Improving the accuracy of blood loss assessment is therefore necessary for rapid diagnosis and management and for reducing unnecessary referrals, in line with recommendations for quantitative measurement[1,17] and the WHO roadmap for 2023–2030.[18]

Research Objectives

1. To examine the situation and problems of postpartum blood loss assessment in the labor ward of Namon Hospital, Kalasin Province.
2. To develop a guideline for blood loss assessment using the gravimetric method in place of visual estimation in the labor ward of Namon Hospital.
3. To evaluate the effects of the gravimetric method on staff knowledge and skills, assessment accuracy, and clinical decision-making.

Methods

This action research followed the PAOR cycle of Plan, Action, Observe, and Reflect,[16] combined with a before–after comparison among staff and a non-concurrent comparison of two groups of mothers. It was conducted in the labor ward of Namon Hospital from January 2025 to February 2026 in three phases, as shown in Figure 1 and detailed below.

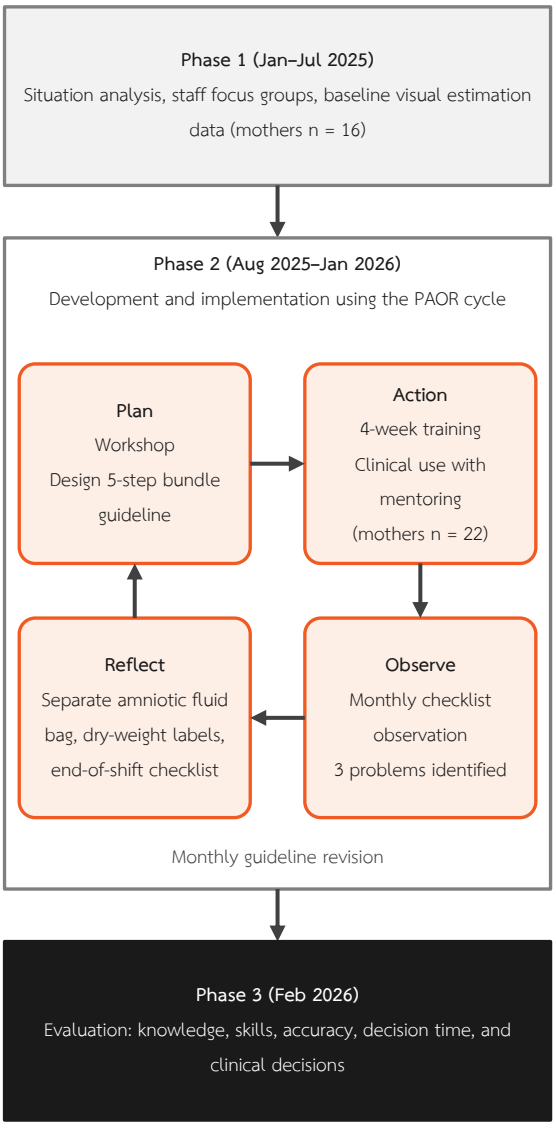


Figure 1 Steps of the action research based on the PAOR cycle

Population

1) The multidisciplinary team caring for women in labor in the labor ward, comprising 3 physicians and 7 registered nurses (3 permanent and 4 rotating), and 2) 44 mothers who gave birth between March 2025 and January 2026.

Sample

All 10 staff members were included. Mothers were selected by consecutive sampling according to the criteria. The sample size was

calculated using G*Power with an effect size (d) of 1.20 based on the difference in error reported in a previous study,[12] a significance level of 0.05, and a power of 0.80, yielding at least 12 per group. Of the 44 mothers, 4 had cesarean deliveries and 2 had incomplete data, leaving 16 in the visual estimation group (March–July 2025) and 22 in the gravimetric group (September 2025–January 2026).

Inclusion Criteria

Staff: working in the labor ward for at least 6 months and consenting to participate. Mothers: singleton pregnancy, gestational age ≥37 weeks, vaginal delivery, and consenting to participate.

Exclusion Criteria

Staff: on leave or transferred during the study, or attending less than 80% of the training. Mothers: cesarean delivery, coagulation disorders, or requesting withdrawal.

Research Instruments

The instruments comprised: 1) a 5-step care bundle guideline (Figure 2) and a 4-week training program (Table 1), using a digital scale with 1-gram resolution calibrated before each use, collection bags, record forms, and a checklist, with 1 gram of blood defined as 1 mL; 2) a record form for general data and blood loss (estimated value, reference value, and decision time); 3) a 20-item knowledge test; 4) a 20-point skills checklist; and 5) staff and maternal satisfaction questionnaires on a 5-point rating scale.[19] Three experts assessed content validity (IOC 0.67–1.00). The reliability of the knowledge test (KR-20) was 0.82, and that of the satisfaction questionnaire (Cronbach's alpha) was 0.89.

Data Collection

In Phase 1, the delivering nurse visually estimated blood loss and the researcher recorded the value, while the reference value was measured within 2 hours after birth by another verifying nurse blinded to the estimate, by weighing absorbent materials and measuring blood in the under-buttocks drape bag after separating amniotic fluid. In Phase 2, staff completed the knowledge test and skills assessment before and after training and then applied the gravimetric method to the second group of mothers, with an independent verifier measuring the reference value using the same method. In Phase 3, satisfaction and clinical outcomes were collected. Accuracy was defined as an error within 15% of the reference value. An incorrect decision was defined as administering medication, calling for help, or referral inconsistent with the reference blood loss according to the guideline. Decision time was measured from the first blood loss assessment to the recorded decision (medication, continued monitoring, or reporting to a physician).

Data Analysis

Frequency, percentage, mean ($\bar{x}$), and standard deviation (S.D.) were used. Pre–post training knowledge and skill scores of all 10 staff were compared using the paired t-test with effect size (dz). Groups of mothers were compared using Welch's t-test because of unequal variances, with Cohen's d, and the chi-square test or Fisher's exact test when expected counts were less than

5. Agreement with the reference value was assessed using Bland–Altman analysis.[20] The significance level was set at 0.05, and knowledge and skill scores of ≥80% were interpreted as high.[21]

Research Ethics

This study adhered to the ethical principles of human research under the Declaration of Helsinki. The researcher explained the objectives, procedures, benefits, and risks, and participants signed informed consent. Mothers were asked for consent on admission in the first stage of labor, before contractions became strong. Data were kept confidential using codes instead of names and presented in aggregate, and participants could withdraw at any time without affecting their treatment or work.

Results

1. Situation and Problems of Blood Loss Assessment

1.1 General characteristics Of the 10 staff members, 7 were registered nurses (70.00%) and 3 were physicians (30.00%), with a mean age of 38.40±7.12 years and mean work experience of 12.30±6.85 years; 6 (60.00%) had received training on PPH. Mothers in the visual estimation and gravimetric groups had mean ages of 27.31±5.84 and 26.77±6.12 years, gestational ages of 38.69±1.01 and 38.77±0.97 weeks, birth weights of 3,050±310 and 3,085±325 g, primiparity of 43.75% and 40.91%, and reference blood loss of 284.63±112.47 and 291.20±121.30 mL, with no statistically significant differences (p-value = 0.739–1.000).

1.2 Situation and problems before development The labor ward relied mainly on visual estimation and had no standard guideline. In 16 mothers, the mean reference blood loss was 284.63±112.47 mL, but visual estimation yielded 211.25±96.14 mL, 25.78% lower than the reference value. Blood loss was underestimated in 12 mothers (75.00%), with a mean absolute error of 31.52±17.36%, a mean difference (bias) of −73.38 mL, and 95% limits of agreement of −240.8 to 94.0 mL. Two mothers (12.50%) lost ≥500 mL, one of whom was estimated below the threshold. Staff focus groups identified three problems: lack of a scale and standard record forms, familiarity with visual estimation, and concern about increased workload.

2. Development of the Gravimetric Method Guideline

2.1 Guideline and training program The multidisciplinary team participated in a workshop and designed a 5-step care bundle guideline: preparing the scale and collection bag, weighing absorbent materials before and after use, converting weight to volume, recording on the form, and notifying the physician within 5 minutes when blood loss was ≥500 mL or ≥300 mL with abnormal vital signs according to the new criteria,[1] with all steps required (all-or-none approach),[14] as shown in Figure 2. A 4-week training program was also organized, as shown in Table 1.

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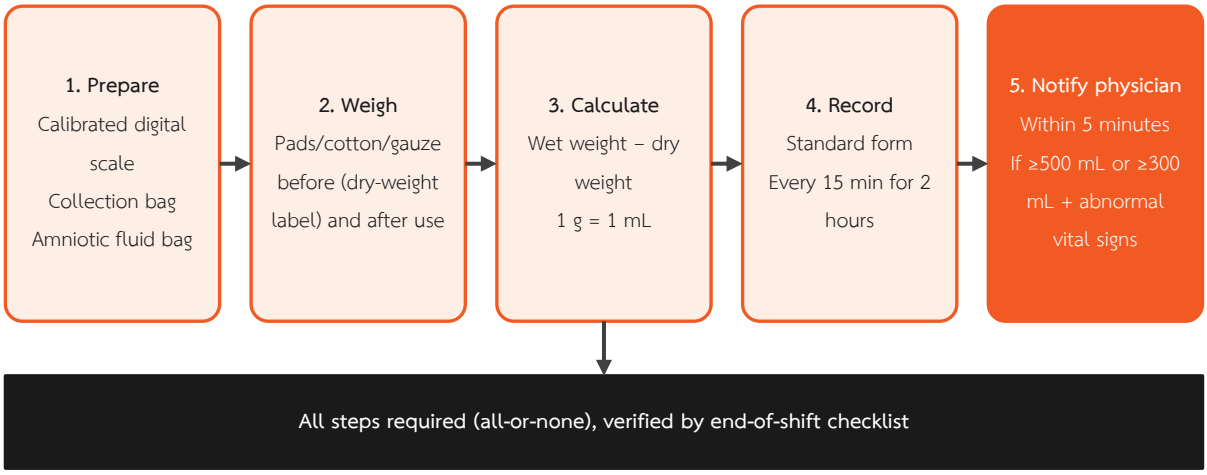


Figure 2 Five-step care bundle guideline for postpartum blood loss assessment using the gravimetric method

Table 1 Staff training program for blood loss assessment using the gravimetric method

Week	Activity	Materials	Duration
1	Workshop on PPH, errors of visual estimation, and principles of the gravimetric method; pre-training test[5,12]	Slides, knowledge test	90 min
2	Practice weighing absorbent materials, converting weight to volume, and recording in simulated scenarios[13]	Scale, plastic bags, record form	90 min
3	Clinical use with mentoring, observed using a checklist	Guideline, checklist	30 min/case
4	Reflection, feedback, guideline revision, and post-training test[16]	Test, skills checklist	60 min

2.2 Improvement through the PAOR cycle The researcher observed and reflected with the team monthly and identified three problems: absorbent materials mixed with amniotic fluid, failure to weigh dry pads before use, and incomplete recording. The team therefore separated amniotic fluid collection bags, labeled dry pad weights on delivery sets, and added an end-of-shift checklist, resulting in full adherence in 21 of 22 mothers (95.45%).

3. Effects of the Gravimetric Method

3.1 Staff knowledge, skills, and satisfaction All 10 staff members showed a mean increase of 6.00 points in knowledge (95%CI 4.85, 7.15) and 8.20 points in skills (95%CI 6.74, 9.67), both statistically significant (p-value <0.001). Nine of 10 (90.00%) achieved knowledge scores of

≥80%, and mean satisfaction with the gravimetric method was 4.58±0.36 (highest level), as shown in Table 2.

Table 2 Comparison of staff knowledge and skill scores before and after training

Variable (max 20)	Group	Before $\bar{x}$±S.D.	After $\bar{x}$±S.D.	$\bar{d}$ (95%CI)	t	p-value
Knowledge	Nurses (n=7)	11.43±2.15	17.57±1.40	6.14 (4.42, 7.86)	8.73	<0.001
	Physicians (n=3)[a]	12.67±1.53	18.33±1.15	5.67	–	–
	Total (n=10)	11.80	17.80	6.00 (4.85, 7.15)	11.81	<0.001*
Skills	Nurses (n=7)	9.86±2.61	18.43±1.13	8.57 (6.44, 10.70)	9.86	<0.001
	Physicians (n=3)[a]	10.33±2.08	17.67±1.53	7.34	–	–
	Total (n=10)	10.00	18.20	8.20 (6.74, 9.67)	12.65	<0.001*

*p-value <0.05 (paired t-test); [a] presented descriptively because n = 3; post-training scores in all groups were at a high level (≥80%)

3.2 Error and decision time The gravimetric group had an absolute error of 6.84±4.12%, significantly lower than the visual estimation group (31.52±17.36%) (p-value <0.001, Cohen's d = 2.12). The bias relative to the reference value was −4.2 mL, with 95% limits of agreement of −53.6 to 45.2 mL. The time from assessment to decision was 4.49 minutes shorter, and maternal satisfaction was higher (p-value = 0.039), as shown in Table 3.

Table 3 Comparison of error, decision time, and maternal satisfaction between the gravimetric and visual estimation groups (Welch's t-test)

Variable	Gravimetric (n=22) $\bar{x}$±S.D.	Visual (n=16) $\bar{x}$±S.D.	Difference (95%CI)	t	p-value	d
Absolute error (%)	6.84±4.12	31.52±17.36	−24.68 (−34.06, −15.30)	−5.57 (16.2)	<0.001*	2.12
Absolute error (mL)	21.50±13.80	96.40±58.20	−74.90 (−106.33, −43.47)	−5.05 (16.2)	<0.001*	1.92
Assessment-to-decision time (min)	4.82±1.65	9.31±3.42	−4.49 (−6.42, −2.56)	−4.86 (20.1)	<0.001*	1.77
Maternal satisfaction (max 5)	4.46±0.41	4.12±0.52	0.34 (0.02, 0.66)	2.17 (27.6)	0.039*	0.74

*p-value <0.05; difference = gravimetric − visual estimation; d = Cohen's d (absolute value)

3.3 Accuracy and clinical decision-making The gravimetric group achieved accurate assessment in 19/22 mothers (86.36%), higher than the visual estimation group at 5/16 (31.25%) (χ^2 = 12.09, p-value <0.001). Incorrect treatment decisions decreased from 4/16 (25.00%) to 0 (p-value = 0.025), while unnecessary referrals decreased from 18.75% to 4.55%, although the difference was not statistically significant (p-value = 0.291), as shown in Table 4.

Table 4 Comparison of accuracy, incorrect treatment decisions, and unnecessary referrals

Item	Gravimetric n/N (%)	Visual n/N (%)	χ^2	p-value
Accurate (error ≤15%)	19/22 (86.36)	5/16 (31.25)	12.09	<0.001*
Incorrect treatment decision	0/22 (0.00)	4/16 (25.00)	–[a]	0.025*
Unnecessary referral	1/22 (4.55)	3/16 (18.75)	–[a]	0.291

*p-value <0.05; chi-square test without Yates' correction; [a] Fisher's exact test because expected counts were less than 5

Discussion

Regarding objective 1, visual estimation before development was 25.78% lower than the reference value, consistent with studies showing that providers underestimate blood loss by about 30%[5] and a Thai study in which visual estimation yielded lower values than measurement with a calibrated drape.[11] Errors arise from the assessor's experience, the type of absorbent material, and the volume of blood loss, with underestimation increasing as bleeding increases.[22] Although pictorial aids can improve accuracy,[10,23] errors persist when they are not used consistently. This finding reflects the risk of delayed response in community hospitals with limited staff, which have a higher likelihood of PPH than higher-level hospitals.[6]

Regarding objective 2, development through the PAOR cycle combined with an all-or-none care bundle[14,16] engaged the multidisciplinary team from planning through reflection and adapted the guideline to the context, achieving full adherence in 95.45%. Short training combined with coaching suits labor wards with few staff, consistent with reports that midwives accepted this method after training in low-resource settings.[13] Contamination of materials with amniotic fluid is a previously reported limitation,[22] which was addressed by using separate amniotic fluid bags. In addition, the 2025 WHO guideline recommends calibrated drapes for all vaginal births;[1] combining the gravimetric method with calibrated bags is therefore a consistent approach.

Regarding objective 3, staff knowledge and skills increased, and the gravimetric group had a lower error than the visual estimation group, similar to the report by Zhang et al. (4.00±2.70% vs 34.70±32.10%).[12] Greater accuracy enabled decisions 4.49 minutes faster and reduced incorrect decisions, consistent with

recommendations for quantitative measurement.[1,17] Implementation of evidence must consider the context and staff readiness.[24] **Limitations** include the following: the reference value was measured by weighing, the same method as in the gravimetric group, so the error in this group reflects inter-rater agreement rather than accuracy against the true value, and hemoglobin decline was not used as an independent reference standard; the study was conducted in a single labor ward with a small number of mothers, with only 2 mothers losing ≥500 mL in the pre-development group; the comparison groups were non-concurrent and non-randomized; and independent verifiers may not have been fully blinded. The results should therefore be interpreted with caution.

Conclusion

Before development, the labor ward of Namon Hospital relied mainly on visual estimation, which underestimated blood loss by 25.78% relative to the reference value. Development through the PAOR cycle produced a 5-step gravimetric care bundle guideline and a 4-week training program, which increased staff knowledge and skills and, compared with visual estimation, significantly reduced error, increased accuracy, and reduced incorrect treatment decisions.

Recommendations

1. Recommendations for applying the findings The gravimetric method should be adopted as hospital policy and incorporated into the clinical pathway; physician notification criteria should be updated according to the 2025 WHO guideline; scales and forms should be continuously supplied; new staff should be trained and skills refreshed periodically; adherence should be monitored with the checklist; and the approach should be extended to community hospitals in similar contexts.

2. Recommendations for future research Multicenter studies with larger samples and concurrent comparison groups should be conducted, using postpartum hemoglobin decline as an independent reference standard and assessing skill retention, costs and cost-effectiveness, and maternal outcomes.

Acknowledgments

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AI Disclosure

The author used an artificial intelligence tool (Claude, Anthropic) to assist in searching for information sources and academic references. The author personally verified the accuracy of all references before use. Data analysis, interpretation of results, and discussion are entirely the author's own work. The AI did not contribute as a co-author.

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RESEARCH ARTICLE

Development of an Elderly School Model Using Community Participation, Namon Hospital, Kalasin Province

Priyawadee Boonchaiyo[1*]

[1] Registered Nurse (Professional Level), Health Insurance, Strategy and Medical Information Group, Namon Hospital, Namon District, Kalasin Province, Thailand

*Corresponding author

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Abstract

This research and development study, guided by the PDCA cycle and combined with a two-group pretest–posttest quasi-experimental design, aimed 1) to examine the situation, 2) to develop, and 3) to evaluate an elderly school model based on community participation in Namon District, Kalasin Province, from January to December 2025. Thirty-five registered nurses took part in model development, and 64 older adults formed the sample (32 each in the experimental Namon sub-district and the control Yod Kaeng sub-district). The instruments were the elderly school model and handbook, a knowledge test, the WHOQOL-BREF-THAI, the Thai Geriatric Depression Scale, and a satisfaction questionnaire. Data were analyzed using descriptive statistics, the paired t-test, the independent t-test, ANCOVA, and Fisher's exact test.

The model comprised five components (group, committee, rules, activities, and fund) with a 12-week curriculum integrating local wisdom. After the program, the experimental group had significantly higher knowledge ($\bar{x}$±S.D. = 16.84±1.97) and quality-of-life scores (104.19±8.72) than at baseline and than the control group (p-value <0.001). Depression was less frequent in the experimental group than in the control group (6.25% vs 25.00%), but the difference was not statistically significant (p-value = 0.082). Satisfaction was at the highest level ($\bar{x}$ = 4.62±0.38). The model suited the community context and should be expanded to other sub-districts in line with the 2026 national criteria for elderly schools, with local government support and continuous monitoring of sustainability.

Keywords: Elderly school, Community participation, PDCA cycle, Older adults

Introduction

Thailand became a complete aged society in 2022, with people aged 60 years and over accounting for 20% of the total population, or about 13 million people,[1,2] and it is expected to become a super-aged society, with older adults exceeding 28%, within about the next 10 years.[2] The Department of Older Persons has therefore promoted the development of older adults' potential through elderly schools,[3] which are learning spaces created through the participation of local communities and network partners. There are currently more than 2,456 elderly schools, and the government aims to expand them to cover all areas.[4] Academic articles indicate that elderly schools promote lifelong learning and self-care skills, leading to a good quality of life.[5]

Kalasin Province is ethnically diverse and rich in health care wisdom, and has a prototype elderly school in Kalasin Town Municipality attended by more than 200 older adults.[6] Namon District has 5 sub-districts and 67 villages, with 8,450 and 8,720 older adults in 2023 and 2024 (24.2% and 25.1% of the population).[7] The number of older adults receiving continuous services at Namon Hospital increased from 1,850 to 2,120, most with chronic diseases.[8] A survey in Namon District found that 44.56% had walking difficulties, 69.58% were not dependent, and 80.45% had no depression.[9] However, Namon District does not yet have an official elderly school, and village-level elderly clubs still lack systematic organization and a clear curriculum.

The concepts of successful and active ageing,[10,11] adult learning theory,[12] self-care theory,[13] and self-efficacy[14] form the basis for designing learning for older adults, while the concepts of community nursing,[15] primary health care,[16] and participation[17] emphasize community involvement in decision-making and implementation, and the PDCA cycle is a quality improvement mechanism applicable to health services.[18] Most recently, the Department of Older Persons announced the 2026 criteria for establishing elderly schools as a single national standard, allowing local government organizations and communities to establish them.[19] However, empirical evidence evaluating models developed by community hospitals together with communities using PDCA is still lacking. This study therefore developed an elderly school model using community participation suited to the context of Namon Hospital, so that nurses would have a shared practice guideline, older adults would gain knowledge and a better quality of life, and the model could serve as a prototype for expansion.

Research Objectives

1. To study the situation and needs for establishing an elderly school in Namon District, Kalasin Province

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2. To develop an elderly school model using community participation, Namon Hospital, Kalasin Province
3. To evaluate the outcomes of the elderly school model in terms of self-care knowledge, quality of life, depression, and satisfaction

Methods

This research and development study followed the PDCA cycle combined with a two-group pretest–posttest quasi-experimental design and was conducted in Namon District from January to December 2025, as shown in Figure 1. The 12-week curriculum was implemented from June to August 2025.

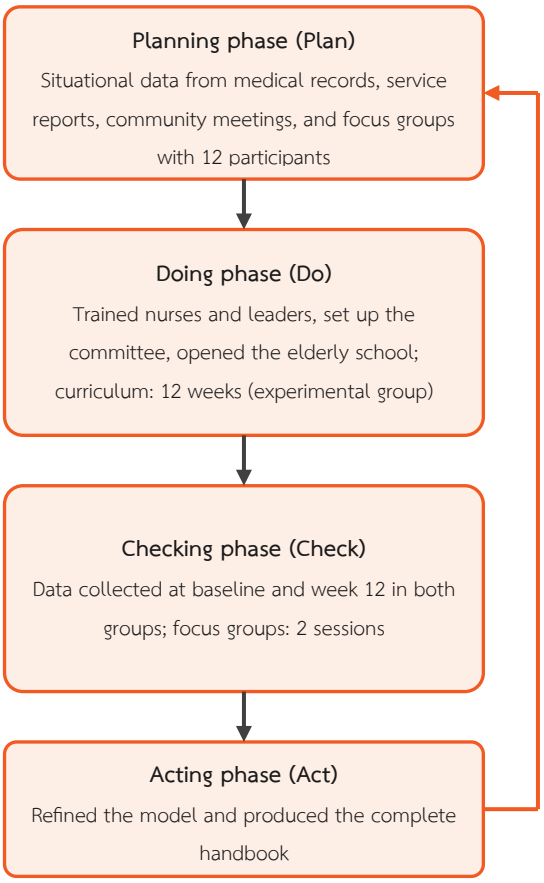


Figure 1 Research and development process following the PDCA cycle

Population

1) 35 registered nurses at Namon Hospital and the sub-district health promoting hospitals (SHPHs) in Namon District, and 2) 8,720 older adults aged 60 years and over in Namon District.[7]

Sample

All 35 registered nurses took part in developing the model and assessing its feasibility. For older adults, the sample size was calculated using G*Power[20] for the independent t-test, with an effect size of 0.80 based on previous studies, a significance level of 0.05, and a power of 0.80, giving 26 per

group, which was increased by 20% to 32 per group. Sub-districts were selected purposively: Namon sub-district as the experimental group and Yod Kaeng sub-district as the control group, as they are similar in size and rural context and far enough apart to reduce contamination. Participants were then selected by simple random sampling from the list of older adults in each sub-district.

Inclusion Criteria

Nurses: worked in the area for at least 1 year. Older adults: aged 60 years and over, independent in daily living (Barthel Index ≥12 points), able to communicate in Thai, resident in the area for at least 1 year, and willing to participate.

Exclusion Criteria

Older adults with dementia on TMSE screening (≤23 points), severe illness preventing participation in activities, relocation, or withdrawal. Participants who did not attend all activities remained in the analysis (intention-to-treat).

Research Instruments

The instruments comprised 1) the elderly school model and handbook based on five management principles (group, committee, rules, activities, and fund) and a 12-week curriculum, once a week for 120 minutes per session (Table 1); 2) a general information questionnaire; 3) a 20-item self-care knowledge test, interpreted as high ≥16 points (80%), moderate 12–15 points, and low <12 points;[21] 4) the 26-item WHOQOL-BREF-THAI[22,23] (26–60 poor, 61–95 moderate, 96–130 good); 5) the Thai Geriatric Depression Scale (TGDS)[24] (more than 12 points = depression); 6) the Barthel ADL Index;[25] 7) a 5-level satisfaction questionnaire; and 8) a focus-group guide. The knowledge test, satisfaction questionnaire, and focus-group guide were checked for content validity by three experts (IOC 0.67–1.00). A tryout with 30 older adults gave a KR-20 of 0.82 for the knowledge test and Cronbach's alpha coefficients of 0.84 and 0.89 for the quality of life and satisfaction assessments.

Data Collection

In the planning phase, situational data were collected from medical records, service reports, community meetings, and a focus group with 12 nurses and community leaders. In the doing phase, nurses and community leaders were trained, a committee was established, and the elderly school was opened for the experimental group, while the control group received usual services. Four research assistants who were not involved in delivering activities collected knowledge, quality of life, and depression data from both groups at the same time points, before the program began and at week 12. In the checking phase, two focus groups were held.

Data Analysis

Frequency, percentage, mean ($\bar{x}$), and standard deviation (S.D.) were used. Within-group comparisons used the paired t-test with effect size (dz), and between-group comparisons used the independent t-test and ANCOVA adjusted for pretest scores. Categorical variables were analyzed using the chi-square test, or Fisher's exact test when expected counts were less than 5 or n was small. The significance level was set at 0.05, and qualitative data were analyzed using content analysis.

Research Ethics

This research adhered to the principles of human research and was conducted in accordance with the Declaration of Helsinki. The researcher explained the objectives and procedures and obtained signed consent before participation. Data were kept confidential and reported in aggregate, and participants could withdraw at any time without affecting their services. Those screened positive for depression were referred for care, and the control group was offered the opportunity to join the elderly school after the study ended.

Results

1. Situation and Needs for Establishing an Elderly School

1.1 General information Of the 35 registered nurses, 94.29% were female, with a mean age of 38.74±7.62 years and mean work experience of 13.46±7.91 years. Of the 64 older adults, 62.50% were female, with a mean age of 68.42±5.87 years; 71.88% had chronic diseases, most commonly hypertension (45.31%). No participants withdrew from either group.

1.2 Situation and needs Older adults in Namon District had walking difficulties but were mostly still independent, and the area has local wisdom such as Lam Mai Phong, Bas Lob, Ram Muay Thai (Thai boxing dance), the 11-companion herbal oil, and Mor Lam Stroke.[9] A focus group with 12 nurses and community leaders identified four needs: a clear and continuous curriculum; exercise and health care based on local wisdom; a learning venue close to home in cooperation with the sub-district administrative organization, temples, and village health volunteers (VHVs); and a sustainable budget or fund, as in the statement "The curriculum in the community is not clear" (Leader 03).

2. Elderly School Model Using Community Participation

The model comprises five components based on the principles of

elderly school management:[26] group (core and learner older adults), committee (representatives of the hospital, SHPHs, the local government organization, VHVs, community leaders, and older adults), rules, activities, and fund, implemented through the PDCA cycle with nurses as facilitators, as shown in Figure 2. Five experts rated its appropriateness at the highest level ($\bar{x}$±S.D. = 4.58±0.36), and the 35 nurses rated its feasibility at a high level (4.46±0.41). Older adults in the experimental group attended an average of 89.06% of all sessions, and the community contributed an initial fund of 20,000 baht. In the Act phase, the model was refined and a complete handbook was produced.

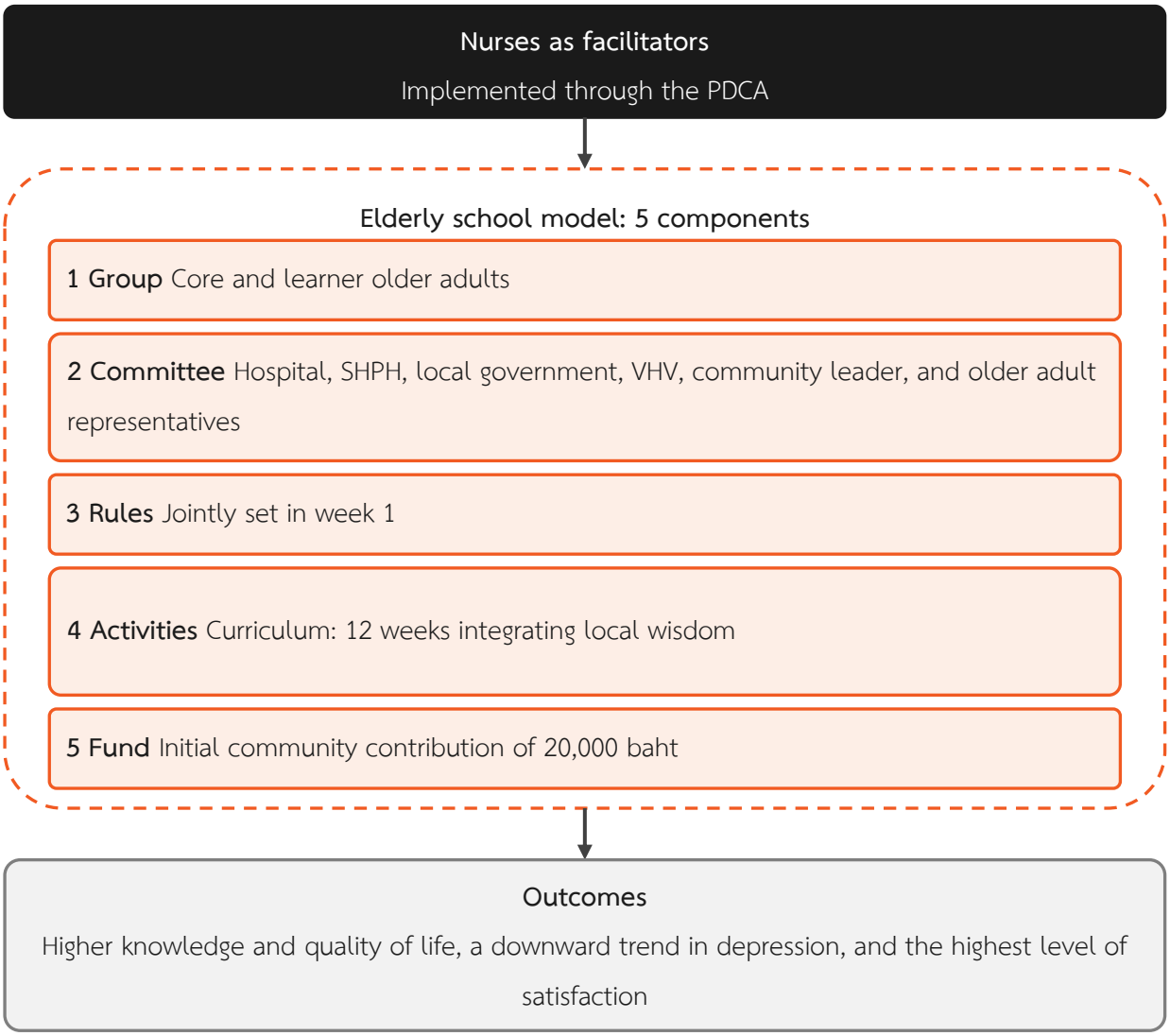


Figure 2 Elderly school model using community participation, Namon Hospital

Table 1 Learning plan of the 12-week elderly school curriculum

Week	Activities/content	Materials	Duration
1	Orientation, school opening, setting rules, selecting the committee and core members[17]	School handbook, pretest	120 min
2	Chronic diseases, diet, and safe medication use[13]	Slides, food samples, medicine packets	120 min
3	Wisdom-based exercise: Lam Mai Phong, Bas Lob, aerobics[11]	Exercise equipment, music	120 min
4	Fall prevention, gait and balance training[9]	Gait assessment form, walking track	120 min
5–6	Mental health, stress relief, Mor Lam Stroke[12]	Mor Lam media, TGDS	120 min
7–8	Local herbs, 11-companion herbal oil, and self-massage[14]	Herbs, demonstration equipment	120 min
9–10	Ram Muay Thai, group and volunteer activities[10]	Music, dance props	120 min
11	School activity and fund planning by older adults[15]	Activity plan form	120 min
12	Evaluation, lessons learned, and graduation ceremony[18]	Posttest, satisfaction questionnaire	120 min

3. Evaluation of the Elderly School Model

3.1 Within-group comparison In the experimental group, knowledge scores increased from 11.25±2.41 to 16.84±1.97 points (t = 11.88, p-value <0.001, dz = 2.10) and quality of life increased from 92.44±9.86 to 104.19±8.72 points (t = 6.79, p-value <0.001, dz = 1.20), whereas the control group showed no change (p-value = 0.216 and 0.417), as shown in Table 2.

Table 2 Comparison of knowledge and quality of life scores before and after the program, by group (paired t-test, n = 32 per group)

Variable	Group	Before		After		Level	$\bar{d}$	95%CI	t	p-value
		$\bar{x}$	S.D.	$\bar{x}$	S.D.					
Knowledge (20)	Experimental	11.25	2.41	16.84	1.97	High	5.59	4.63, 6.55	11.88	<0.001*
Knowledge (20)	Control	11.38	2.52	12.03	2.30	Moderate	0.65	−0.40, 1.70	1.26	0.216
Quality of life (130)	Experimental	92.44	9.86	104.19	8.72	Good	11.75	8.22, 15.28	6.79	<0.001*

Variable	Group	Before		After		Level	$\bar{d}$	95%CI	t	p-value
		$\bar{x}$	S.D.	$\bar{x}$	S.D.					
Quality of life (130)	Control	93.06	10.21	94.50	9.77	Moderate	1.44	−2.13, 5.01	0.82	0.417

*Statistically significant at p-value <0.05

3.2 Between-group comparison Before the intervention, the two groups did not differ (p-value = 0.834 and 0.806). After the intervention, the experimental group had significantly higher knowledge scores than the control group by 4.81 points (95%CI 3.74, 5.88) and higher quality of life by 9.69 points (95%CI 5.06, 14.32) (p-value <0.001), with large effect sizes (Cohen's d = 2.25 and 1.05). The results were the same after adjusting for pretest scores with ANCOVA (adjusted differences 4.85 and 10.01 points, p-value <0.001), as shown in Table 3.

Table 3 Comparison of knowledge and quality of life scores between the experimental and control groups (independent t-test)

Variable	Experimental group		Control group		d	$\bar{d}$	95%CI	t	p-value
	$\bar{x}$	S.D.	$\bar{x}$	S.D.					
Knowledge, before (full score 20)	11.25	2.41	11.38	2.52	0.05	−0.13	−1.36, 1.10	−0.21	0.834
Knowledge, after (full score 20)	16.84	1.97	12.03	2.30	2.25	4.81	3.74, 5.88	8.98	<0.001*
Quality of life, before (full score 130)	92.44	9.86	93.06	10.21	0.06	−0.62	−5.64, 4.40	−0.25	0.806
Quality of life, after (full score 130)	104.19	8.72	94.50	9.77	1.05	9.69	5.06, 14.32	4.19	<0.001*

*Statistically significant at p-value <0.05; d = Cohen's d

3.3 Depression Before the intervention, 4 participants (12.50%) in the experimental group and 5 (15.63%) in the control group had depression. After the intervention, 2 (6.25%) in the experimental group and 8 (25.00%) in the control group had depression; the proportion tended to be lower but did not differ significantly (Fisher's exact test, p-value = 0.082), as shown in Table 4.

Table 4 Depression (TGDS >12 points) before and after the intervention, by group

Time point	Experimental group n (%)	Control group n (%)	p-value[a]
Before intervention	4 (12.50)	5 (15.63)	1.000
After intervention	2 (6.25)	8 (25.00)	0.082

[a] Fisher's exact test

3.4 Success indicators Older adults in the experimental group attended an average of 89.06% of activities (target ≥70%), the retention rate was 100% (target ≥80%), and mean satisfaction with the model was 4.62±0.38, at the highest level (92.40% of the full score), meeting all indicator targets.

Discussion

Regarding Objective 1, older adults in Namon District had a high rate of walking difficulties but remained independent, consistent with the active ageing concept, which emphasizes health, participation, and lifelong learning.[11] The absence of an official elderly school in the district, combined with strong local wisdom,[9] created an opportunity for community nurses to work in partnership with the community from the needs assessment onward.[15]

Regarding Objective 2, the developed model enabled the community to participate in decision-making, implementation, benefits, and evaluation,[17] and used the PDCA cycle as a mechanism for continuous improvement.[18] The committee component involving the local government organization and the community-contributed fund are consistent with the 2026 criteria for establishing elderly schools, which allow local government organizations and communities to establish schools systematically,[19] thereby promoting practicality and shared ownership.

Regarding Objective 3, the experimental group had higher knowledge and quality of life than the control group. This can be explained by the curriculum being organized according to adult learning principles based on experience and hands-on practice,[12] promoting self-efficacy[14] and self-care,[13] while group activities helped reduce loneliness, consistent with the view that elderly schools strengthen older adults' potential and quality of life.[5] Depression tended to decrease but not significantly, possibly because most older adults had no depression at baseline and the sample size was not calculated for this outcome. Limitations include non-random group allocation, assessors who were not blinded to group, follow-up only at the end of the program, and the researcher being a nurse in the area; the results should therefore be applied to other contexts with caution.

Conclusion

An elderly school model using community participation for Namon Hospital was developed, comprising five components (group, committee, rules, activities, and fund) and implemented through the PDCA cycle. Older adults in the experimental group showed significant increases in knowledge and quality of life, which were higher than in the

control group; depression tended to decrease; and satisfaction was at the highest level.

Recommendations

1. **Recommendations for applying the findings** The hospital should adopt the model as a policy and assign responsible nurses, coordinate with the local government organization, SHPHs, and VHVs to support budget and venues, register the school under the 2026 criteria, and expand the model to other sub-districts of Namon District.

2. **Recommendations for further research** Future studies should include long-term follow-up of 6–12 months, cluster randomization with a sample size adequate for depression, cost-effectiveness analysis, and evaluation of the sustainability of the elderly school fund.

Acknowledgments

The author thanks the director of Namon Hospital, the experts, the registered nurses and SHPH personnel, VHVs, community leaders, and all older adults in Namon District who participated in developing this model. This research received no funding.

Artificial Intelligence (AI) Disclosure

The author used an artificial intelligence tool (Claude, Anthropic) to help search for information sources and academic references. The author personally verified the accuracy of every reference before use. Data analysis, interpretation of results, and discussion are entirely the author's own work. The AI did not participate as a co-author.

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RESEARCH ARTICLE

Development of a Nursing Care Model for Patients with Antimicrobial-Resistant Infections at Donchan Hospital, Kalasin Province

Sirina Rangklin[1*]

[1] Professional Nurse (Professional Level), Inpatient Nursing Unit, Nursing Group, Donchan Hospital, Donchan District, Kalasin Province

*Corresponding author

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Abstract

This research and development study aimed 1) to investigate the situation, 2) to develop, and 3) to evaluate a nursing care model for patients with antimicrobial-resistant (AMR) infections in the inpatient department of Donchan Hospital, Kalasin Province, from February to December 2025, in three phases following the PDCA cycle. Nurses were evaluated with a one-group pretest–posttest design, and patients were compared with historical controls. Participants were 14 professional nurses and 12 patients with AMR infections, compared with 42 patients from 2024. Instruments were the care model, a knowledge test, a practice observation checklist, confidence and satisfaction questionnaires, and a patient outcome record form. Data were analyzed using descriptive statistics, the paired t-test, Welch's t-test, and the chi-square test.

The model comprised five components: policy and monitoring, surveillance and isolation, infection prevention and control, patient transfer and referral, and education for staff, patients, and relatives. After implementation, nurses' knowledge scores increased from 12.36±2.10 to 17.43±1.74 ($t = 8.11$, p-value <0.001) and practice scores from 29.86±3.52 to 36.57±2.28 ($t = 8.10$, p-value <0.001), with the highest level of satisfaction (4.52±0.38). The time from culture result to isolation fell from 9.60 to 3.25 hours (p-value <0.001); length of stay, antimicrobial cost, and antimicrobial days also decreased significantly. The proportion of inpatients with AMR organisms fell from 2.37% to 1.15% (RR = 0.49, 95%CI 0.26–0.92). The model improved nurses' knowledge and practice and was associated with faster isolation. It should be implemented continuously and extended to other community hospitals.

Keywords: Antimicrobial-resistant infection, Nursing care model, Infection prevention and control, Professional nurses

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Introduction

Antimicrobial resistance (AMR) is a major public health problem at both global and national levels. The Global Burden of Disease study found that in 2021 AMR directly caused 1.14 million deaths, and a cumulative 39 million deaths are projected between 2025 and 2050 without further measures.[1] In Thailand, about 88,000 people are infected with drug-resistant organisms each year, and about 38,000 die.[2] The main cause is unnecessary antibiotic use, which leads to the use of expensive drugs, longer treatment, and high mortality, and resistant organisms also spread to other patients and the community.[3] Transmission in hospitals occurs through direct and indirect contact, patient transfers, diagnostic procedures across units, and the environment. Key measures are clear practice guidelines and encouraging staff to adhere strictly to them.[3,4]

The Kalasin Provincial Public Health Office reported that Kalasin Hospital had an incidence of methicillin-resistant Staphylococcus aureus (MRSA) of 9.26 per 1,000 patients, with resistant Acinetobacter baumannii found in 90.23% and MRSA in 41.16% of ward isolates.[5] Donchan Hospital, which opened inpatient services in January 2023, had 1,462 and 1,775 inpatients in 2023 and 2024, of whom 25 and 42 had drug-resistant organisms (1.71% and 2.37%).[6] Some patients had no appropriate drug available at the community hospital level and had to be referred to Kalasin Hospital, and when referred back for continued treatment, more multidrug-resistant organisms (MDROs) were found.

Preventing and controlling the spread of drug-resistant organisms relies on staff knowledge and skills in isolation precautions, use of personal protective equipment (PPE), hand hygiene, and environmental management.[7,8] The World Health Organization has established a global action plan to reduce infection through infection prevention and control measures.[9] Thai studies have developed models to promote nurses' practice,[10] an e-book,[11] a clinical care plan,[12] and the implementation of transmission prevention,[13] but most were conducted in tertiary hospitals with better isolation facilities. A model covering screening, care, referral, and follow-up in the community hospital context is therefore still lacking. This study applied systems theory[14,15] together with the PDCA quality cycle[16,17] to develop a care model for patients with AMR infections, so that nurses follow the same guideline and safety is ensured for patients and staff.

Research Objectives

1. To study the situation and problems in caring for patients with AMR infections at Donchan Hospital, Kalasin Province

2. To develop a care model for patients with AMR infections at Donchan Hospital, Kalasin Province
3. To evaluate the outcomes of the model in terms of professional nurses' knowledge, practice, confidence, and satisfaction, and patients' clinical outcomes

Methods

This research and development study evaluated nurses with a one-group pretest–posttest design and patients by comparison with a historical control group, in the inpatient nursing unit of Donchan Hospital from February to December 2025, in three phases following the PDCA cycle,[16,17] as shown in Figure 1 and Table 1.

Population

1) 14 professional nurses in the inpatient nursing unit in 2025, and 2) inpatients with AMR infections: 42 from January to December 2024 and 12 from June to December 2025.

Sample

All eligible professional nurses (14) and all eligible patients were included. Because the population was small, no sampling or sample size calculation was performed. In addition, a multidisciplinary team of 10 (physicians, pharmacists, infection control nurses, microbiology laboratory staff, and epidemiology staff) took part in developing the model, and 5 experts reviewed it.

Inclusion Criteria

Professional nurses: worked in the inpatient nursing unit for at least 6 months and consented to participate. Patients: aged 15 years or older, with culture-confirmed AMR organisms (e.g., MRSA, MDR-Acinetobacter baumannii), and hospitalized for at least 24 hours. Hospital-onset cases were defined as cultures positive ≥48 hours after admission.

Exclusion Criteria

Professional nurses: continuous leave of more than 1 month during the study, transfer, or withdrawal. Patients: referred out within 24 hours or incomplete medical records.

Research Instruments

The instruments comprised 1) the AMR patient care model, including a nursing manual and practice guidelines, a flowchart, bedside signs, referral guidelines, and a training plan; 2) a general information form; 3) a 20-item knowledge test; 4) a 40-point practice observation form; 5) a 5-item confidence assessment; 6) a 15-item satisfaction questionnaire on a 5-point scale; and 7) a patient outcome record form. Five experts examined content validity (IOC 0.80–1.00). A tryout with 30 nurses at a nearby hospital gave a KR-20 of 0.82 for the knowledge test and Cronbach's alpha coefficients of 0.84 and 0.91 for the

confidence and satisfaction assessments, and the practice observation form had an inter-rater agreement of 90%.

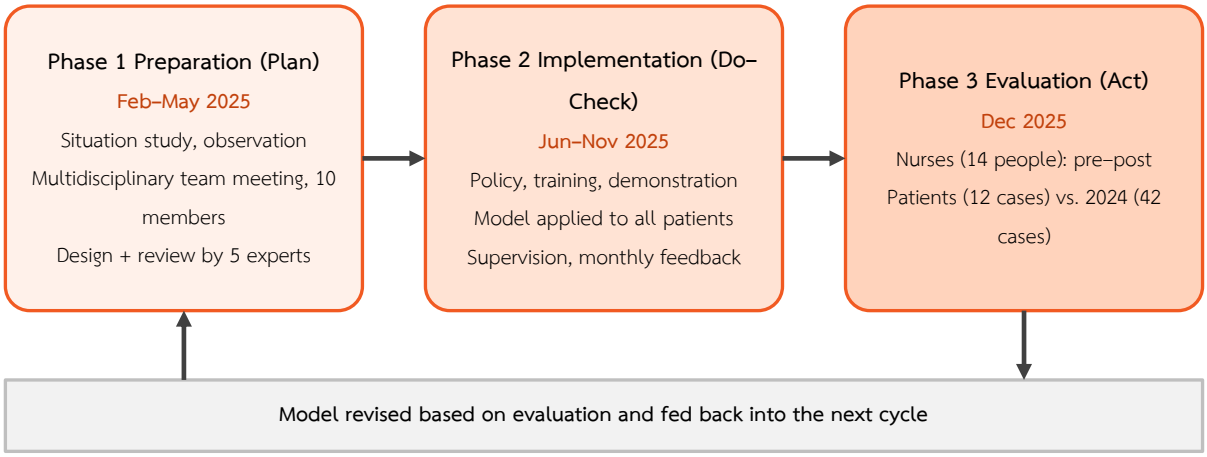


Figure 1 Three-phase research and development process following the PDCA cycle

Table 1 Steps and activities in developing and implementing the AMR patient care model

Phase/Month	Activities	Instruments	Duration
Feb–Mar	Studied context and problems, observed practice, analyzed AMR indicators (Plan)[17]	Observation form, questionnaire, surveillance data	8 weeks
Apr	Searched for evidence, designed the model with the multidisciplinary team[14]	Academic documents, meeting minutes	4 weeks
May	Expert review, development of manual and guidelines, assignment of roles	Assessment form, manual	4 weeks
Jun	Set policy, workshop, demonstration, posted flowcharts, informed patients and relatives[11]	Manual, flowchart, posters, bed signs	1 day
Jun–Nov	Applied the model to all patients, supervision, monitoring, monthly feedback (Do–Check)[10]	Observation form, outcome record form	24 weeks
Dec	Evaluation, satisfaction, model revision (Act)[16]	Test, assessment forms	4 weeks

Data Collection

The researcher and an infection control nurse collected situational data in February–March 2025 through observation, group meetings, and AMR surveillance data. Nurses completed the knowledge test and confidence assessment and were observed in practice before training in June, and were reassessed with the same instruments, together with satisfaction, in December 2025.

Hand hygiene was observed using the WHO method (39 opportunities in each period). Patient data were collected from medical records and AMR surveillance data.

Data Analysis

Frequency, percentage, mean ($\bar{x}$), and standard deviation (S.D.) were used. Nurses' pre–post scores were compared using the paired t-test with effect size (dz). Patient outcomes between the two periods were compared using Welch's t-test because group sizes and variances were unequal, with Cohen's d, and proportions were compared using the chi-square test with risk ratio (RR). Normality was checked with the Shapiro-Wilk test, and the significance level was set at 0.05.

Research Ethics

The research adhered to ethical principles for human research and was conducted in accordance with the Declaration of Helsinki. The researcher explained the objectives, procedures, and benefits to the nurses and obtained signed consent. Patient data from medical records were exempt from consent, were coded instead of named, kept confidential, and reported in aggregate. Participants could withdraw at any time without affecting their work or performance evaluation.

Results

1. Situation and Problems in Caring for Patients with AMR Infections

1.1 General information of nurses Of the 14 nurses, 13 (92.86%) were female, with a mean age of 34.57±6.82 years and mean inpatient experience of 7.14±3.65 years. All held a bachelor's degree, and 6 (42.86%) had received infection prevention and control training within the past year.

1.2 Situation and problems Patients with drug-resistant organisms increased from 1.71% in 2023 to 2.37% in 2024[6] (not statistically significant, p-value = 0.192). Observation and group meetings revealed four problems: 1) there was no unified practice guideline; 2) isolation and hand hygiene were inconsistent, with hand hygiene performed at the five indicated moments in only 24/39 opportunities (61.54%), and isolation rooms were limited; 3) only 6 nurses (42.86%) had a good level of knowledge; and 4) communication and referral with Kalasin Hospital lacked continuity.

2. Care Model for Patients with AMR Infections

The model comprised five components (Figure 2): 1) policy and monitoring; 2) surveillance and patient screening, with isolation rooms or designated screened zones (2 isolation rooms and a 4-bed isolation zone), cohorting of patients with the same organism

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when isolation rooms were insufficient, dedicated equipment, and bedside signs; 3) prevention of transmission, including hand hygiene at the five moments, PPE use, daily bathing with 4% chlorhexidine soap, environmental cleaning, and management of linen and infectious waste;[12] 4) patient admission and referral, notifying the receiving unit before transfer, limiting patient movement, and stating the AMR infection on the referral form or by telephone;[13] and 5) education for staff, patients, and relatives.[11] Five experts rated its appropriateness at a mean of 4.46±0.41, and it was revised according to three suggestions.

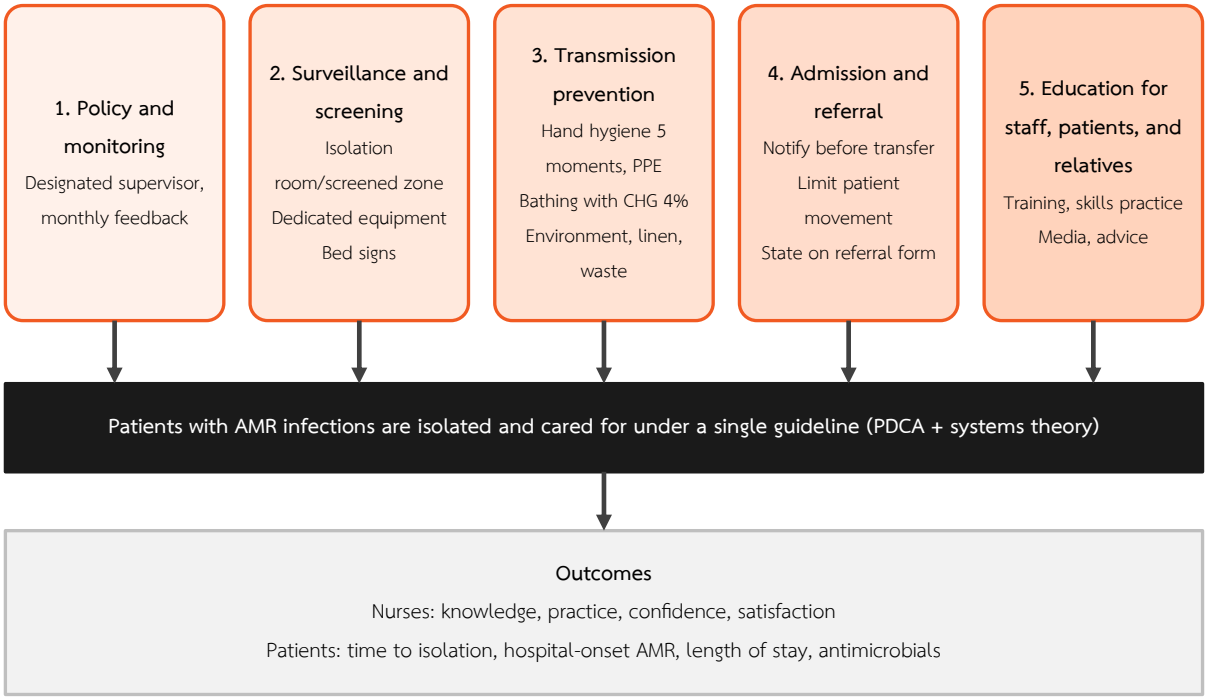


Figure 2 Five-component care model for patients with AMR infections, Donchan Hospital

3. Evaluation of the Model

3.1 Professional nurses After implementation, knowledge, practice, and confidence scores were significantly higher than before (p-value <0.001, dz = 2.07–2.17), as shown in Table 2. Thirteen nurses (92.86%) had a good level of knowledge (≥80%), practice according to the model was 91.43% correct, hand hygiene compliance increased from 61.54% to 87.18% (34/39 opportunities; χ^2 = 6.72, p-value = 0.010), and mean satisfaction with the model was 4.52±0.38 (highest level), meeting the defined success indicators.

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Table 2 Comparison of professional nurses' knowledge, practice, and confidence scores before and after implementation (paired t-test, n = 14)

Variable (full score)	Before $\bar{x}$±S.D.	After $\bar{x}$±S.D.	$\bar{d}$ (95%CI)	t (df = 13)	p-value	dz
Knowledge (20)	12.36±2.10	17.43±1.74	5.07 (3.72, 6.42)	8.11	<0.001*	2.17
Practice (40)	29.86±3.52	36.57±2.28	6.71 (4.92, 8.50)	8.10	<0.001*	2.16
Confidence (5)	3.21±0.58	4.36±0.41	1.15 (0.83, 1.47)	7.76	<0.001*	2.07

*p-value <0.05

3.2 Patient outcomes Compared with patients from 2024 (n = 42), who had similar age, comorbidities, and organism types, patients cared for under the model (n = 12) had significantly shorter time from culture result to isolation, shorter length of stay, lower antimicrobial cost, and fewer antimicrobial days, as shown in Table 3.

3.3 Proportion of inpatients with AMR organisms After implementation, 12 of 1,040 inpatients (1.15%) had AMR organisms, lower than in 2024 (42/1,775; 2.37%), RR = 0.49 (95%CI 0.26, 0.92), a reduction of 51.24%. Of these, 2 and 11 cases, respectively, were hospital-onset, as shown in Table 4.

Table 3 Comparison of outcomes of patients with AMR infections after (n = 12) and before (n = 42) implementation (Welch's t-test)

Variable	After $\bar{x}$±S.D.	Before $\bar{x}$±S.D.	Difference (95%CI)	t (df)	p-value	d
Length of stay (days)	6.58±2.94	9.12±4.35	−2.54 (−4.76, −0.32)	−2.35 (26.3)	0.027*	0.62
Antimicrobial cost per case (thousand baht)	8.23±3.69	11.54±5.31	−3.31 (−6.08, −0.54)	−2.46 (25.5)	0.021*	0.66
Time from culture result to isolation (h)	3.25±1.75	9.60±5.40	−6.35 (−8.31, −4.39)	−6.52 (51.0)	<0.001*	1.31
Antimicrobial days (days)	8.17±2.76	10.64±3.61	−2.47 (−4.48, −0.46)	−2.54 (22.9)	0.018*	0.72

*p-value <0.05; d = Cohen's d (absolute value)

Table 4 Comparison of the proportion of inpatients with AMR organisms before and after implementation

Item	After n/N (%)	Before n/N (%)	RR (95%CI)	χ^2	p-value
All inpatients with AMR organisms	12/1,040 (1.15)	42/1,775 (2.37)	0.49 (0.26, 0.92)	5.12	0.024*

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Item	After n/N (%)	Before n/N (%)	RR (95%CI)	χ^2	p-value
Hospital-onset (≥48 h)	2/1,040 (0.19)	11/1,775 (0.62)	0.31	–	0.150[a]

*p-value <0.05; chi-square test without Yates' correction; [a] Fisher's exact test

Discussion

Regarding Objective 1, patients with drug-resistant organisms at Donchan Hospital increased from 1.71% to 2.37%, consistent with the provincial situation of high AMR rates in wards.[5] The key problem was inconsistent practice, especially hand hygiene and isolation, consistent with studies showing that nurses' practice depends on multiple factors[8,10] and that resistant organisms spread when staff do not follow measures continuously,[3] compounded by the limited isolation rooms and antimicrobials in community hospitals.

Regarding Objective 2, the model used systems theory, which views patients, staff, and the environment as interconnected components,[14,15] together with the PDCA cycle of continuous monitoring and improvement,[16] covering policy, screening, transmission prevention, referral, and education. Involving the multidisciplinary team from the design stage made the model suited to the context, consistent with approaches to developing models that promote nursing staff practice.[10]

Regarding Objective 3, nurses' knowledge, practice, and confidence increased, consistent with studies using educational media and clinical care plans,[11,12] owing to hands-on workshops, demonstration and return demonstration, flowcharts, and monthly supervision with feedback. For patients, the time to isolation was clearly shortened, which is a key measure in controlling AMR.[4,7] The reduction in the overall proportion of patients with AMR organisms should be interpreted with caution because it includes patients infected in the community or referred back from other hospitals, which is not a direct effect of in-hospital measures. **Limitations** include the single community hospital setting, small numbers of nurses and patients, unequal comparison periods (7 vs. 12 months), no concurrent control group, observers who were also model developers, and no assessment of rational antimicrobial use, which affects drug costs and antimicrobial days; it therefore cannot be concluded that the changes resulted from the model alone.

Conclusion

The care model for patients with AMR infections at Donchan Hospital comprised five components and was developed using the PDCA cycle and systems theory. After implementation, nurses' knowledge, practice, and confidence increased, satisfaction was at the highest level, patients were isolated more

quickly, and the proportion of inpatients with AMR organisms decreased from 2.37% to 1.15%.

Recommendations

1. Recommendations for applying the findings The hospital should adopt the model as policy and use it continuously in all units caring for patients with AMR infections, provide refresher training at least once a year, regularly monitor hand hygiene and isolation, link it with the rational antimicrobial use system, and extend it to nearby community hospitals.

2. Recommendations for further research Studies with a concurrent control group should be conducted, using the hospital-onset AMR rate per 1,000 patient-days as the primary outcome, with long-term follow-up and economic evaluation.

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Artificial Intelligence (AI) Disclosure

The author used an artificial intelligence tool (Claude, Anthropic) to help search for information sources and academic references. The author personally verified the accuracy of every reference before use. Data analysis, interpretation of results, and discussion are entirely the author's own work. The AI did not participate as a co-author.

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