Thai Health Sciences Frontiers
วารสารวิทยาศาสตร์สุขภาพไทยก้าวหน้า
THSF

RESEARCH ARTICLE

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

Nipaporn Suriyajak[1*]

[1] Registered Nurse, Professional Level, Outpatient Nursing Unit, Nursing Department, Banthi Hospital, Lamphun Province

* Corresponding author:

☐ **Received:** 1 August 2026 ✓ **Revised:** 15 August 2026 ☑ **Accepted:** 28 August 2026

Citation: Suriyajak N. Development of a seamless care management model for patients with chronic obstructive pulmonary disease in the district-to-provincial health service network, Banthi Hospital, Lamphun Province. Thai Health Sciences Frontiers. 2026;1(2):43-57.

Abstract

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

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

Introduction

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

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

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

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

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

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

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

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

Research Objectives

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

Methods

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

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

Population and Sample

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

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

Research Instruments

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

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

Data Collection

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

Data Analysis

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

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

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

Research Ethics

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

Results

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

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

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

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

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

the district-to-provincial health service network

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

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

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

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

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

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

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

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

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

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

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

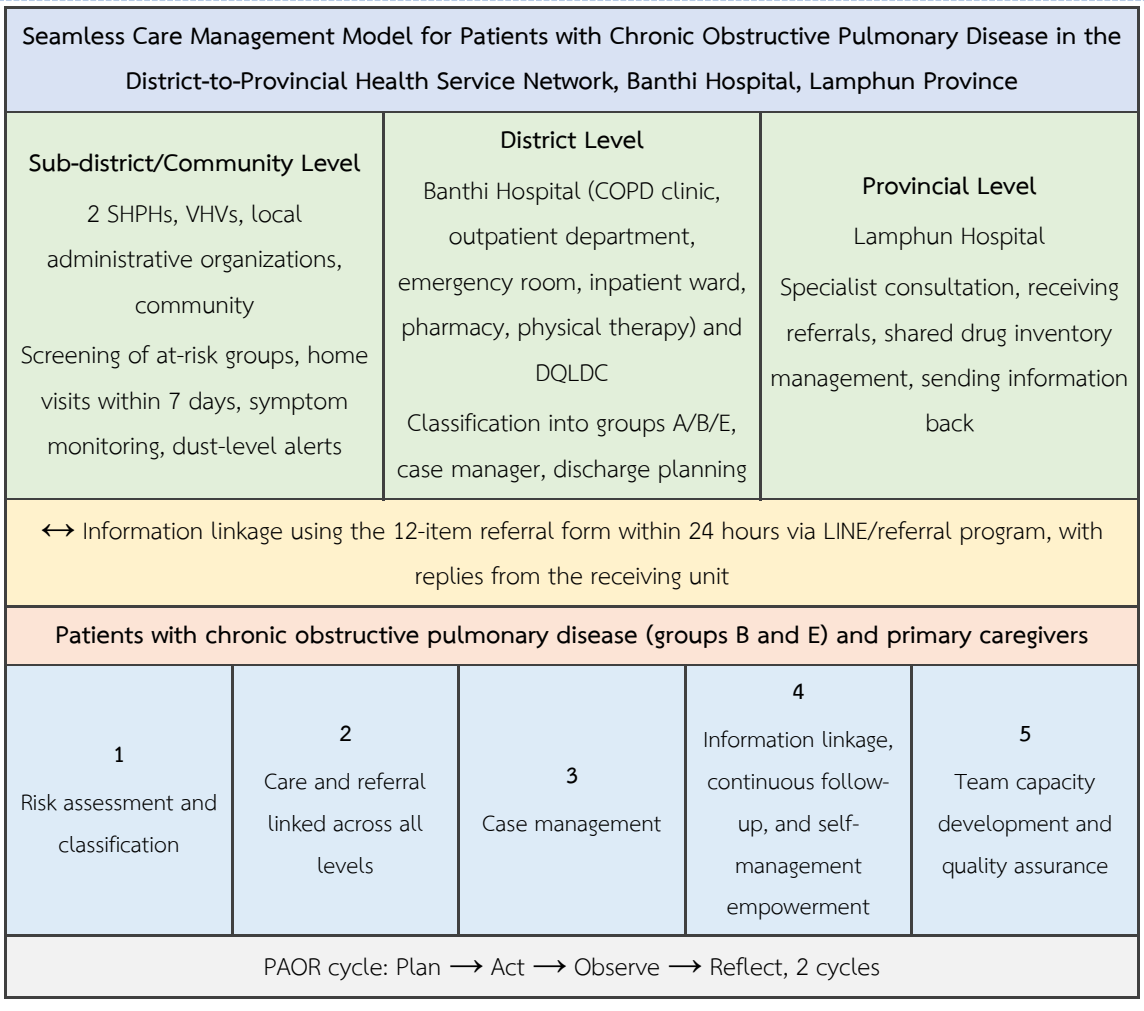
Table 1 Comparison of patient outcomes before and after implementation of the model (n = 54)

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

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

Note: *Statistically significant (p < .05)

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



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

Discussion

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

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

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

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

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

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

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

Conclusion

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

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

Recommendations

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

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

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

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

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

Acknowledgments

The researcher thanks all patients and primary caregivers in the sample; the interprofessional team and network partners of Banthi Hospital, the sub-district health promoting hospitals in the network, Lamphun Hospital, village health volunteers, and local administrative organizations for their excellent cooperation in every step of the research process; the experts for their advice and review of the quality of the research instruments; and the director of Banthi Hospital and the Lamphun Provincial Public Health Office for facilitating data collection until the research succeeded.

References

1. World Health Organization. Chronic obstructive pulmonary disease (COPD) [Internet]. Geneva: World Health Organization; 2026. Available from: https://www.who.int/news-room/fact-sheets/detail/chronic-obstructive-pulmonary-disease-(copd)
2. Global Initiative for Chronic Obstructive Lung Disease. Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease: 2025 report [Internet]. 2025. Available from: https://goldcopd.org/2025-gold-report/
3. Manager Online. Warning: COPD, a silent killer claiming 20,000 Thai lives each year; exacerbations triple the risk of heart disease [Internet]. 2025 Nov 19. Available from: https://mgronline.com/qol/detail/9680000110732 (in Thai)
4. Sumetwanich P. PM2.5 exposure and exacerbations in patients with chronic obstructive pulmonary disease at Ko Kha Hospital, Lampang Province. Journal of Health Sciences Scholarship. 2023;10(2):31-43. Available from: https://he01.tci-thaijo.org/index.php/johss/article/view/261437 (in Thai)
5. Wagner EH. Chronic disease management: what will it take to improve care for chronic illness? Eff Clin Pract. 1998;1(1):2-4.
6. Haggerty JL, Reid RJ, Freeman GK, Starfield BH, Adair CE, McKendry R. Continuity of care: a multidisciplinary review. BMJ. 2003;327(7425):1219-21. doi:10.1136/bmj.327.7425.1219
7. Wong-inta L, Prathumthong K, Dunyakiat W, Prakirana P, Chanthanui K. Development of a care management and seamless referral model for psychiatric emergency patients in the Yang Sisurat District Health Service Network, Maha Sarakham Province. Journal of Environmental Education Medical and Health. 2026;11(3):1460-73. (in Thai)
8. Kemmis S, McTaggart R, Nixon R. The action research planner: doing critical participatory action research. Singapore: Springer; 2014. doi:10.1007/978-981-4560-67-2
9. Chumphuthep S, Meesiri P, Chatmontri J. Effects of a discharge planning program for patients with chronic obstructive pulmonary disease on exacerbation and readmission rates at Li Hospital, Lamphun Province. The Journal of Faculty of Nursing Burapha University. 2025;33(2):52-62. Available from: https://he02.tci-thaijo.org/index.php/Nubuu/article/view/272609 (in Thai)
10. Banthi Hospital. Clinical quality summary: COPD, fiscal year 2024 [unpublished presentation]. Lamphun: Banthi Hospital; 2024. (in Thai)
11. Sangmanthon K, Krachaiklang S, Wansaen P. Development of a care model for patients with chronic obstructive pulmonary disease at Surin Hospital. Medical Journal of Srisaket Surin Buriram Hospitals. 2021;36(2):327-42. Available from: https://he02.tci-thaijo.org/index.php/MJSSBH/article/view/252847 (in Thai)

12. Piyanan T. Development of care guidelines for patients with chronic obstructive pulmonary disease at Ban Phai Hospital, Khon Kaen Province. Journal of Education, Health and Environmental Management. 2026;11(1):208-18. Available from: https://he03.tci-thaijo.org/index.php/ech/article/view/5295 (in Thai)

13. Junlasuk P. Effects of an individualized care plan on knowledge, self-care behaviors, and readmission rates among patients with chronic obstructive pulmonary disease. Journal of Research and Health Innovative Development. 2026;7(2):327-38. Available from: https://he01.tci-thaijo.org/index.php/jrhi/article/view/290786 (in Thai)

14. Faul F, Erdfelder E, Lang AG, Buchner A. G*Power 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences. Behav Res Methods. 2007;39(2):175-91. doi:10.3758/BF03193146

15. Jones PW, Harding G, Berry P, Wiklund I, Chen WH, Kline Leidy N. Development and first validation of the COPD Assessment Test. Eur Respir J. 2009;34(3):648-54. doi:10.1183/09031936.00102509

16. Bestall JC, Paul EA, Garrod R, Garnham R, Jones PW, Wedzicha JA. Usefulness of the Medical Research Council (MRC) dyspnoea scale as a measure of disability in patients with chronic obstructive pulmonary disease. Thorax. 1999;54(7):581-6. doi:10.1136/thx.54.7.581

17. Best JW. Research in education. 3rd ed. Englewood Cliffs (NJ): Prentice-Hall; 1977.

18. Lincoln YS, Guba EG. Naturalistic inquiry. Beverly Hills (CA): Sage Publications; 1985.

19. Banthi Hospital. Clinical quality summary: COPD, fiscal year 2025, and self-assessment report (SAR) part IV [unpublished document]. Lamphun: Banthi Hospital; 2025. (in Thai)

20. Licskai C, Hussey A, Rowley V, Ferrone M, Lu Z, Zhang K, et al. Quantifying sustained health system benefits of primary care-based integrated disease management for COPD: a 6-year interrupted time series study. Thorax. 2024;79(8):725. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC11287652/

21. Hussey AJ, Wing K, Ferrone M, Licskai CJ. Integrated disease management for chronic obstructive pulmonary disease in primary care, from the controlled trial to clinical program: a cohort study. Int J Chron Obstruct Pulmon Dis. 2021;16:3449-64. doi:10.2147/COPD.S338851

22. Zhuang M, Hassan II, Ahmad WMAW, Kadir AA, Liu X, Li F, et al. Effectiveness of digital health interventions for chronic obstructive pulmonary disease: systematic review and meta-analysis. J Med Internet Res. 2025;27:e76323. doi:10.2196/76323