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RESEARCH ARTICLE

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

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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%.

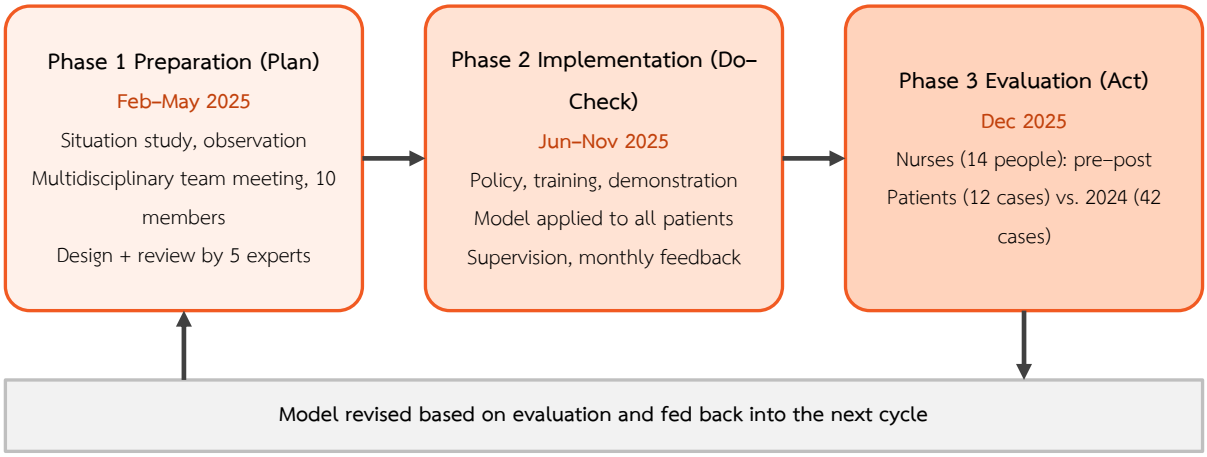

Figure 1 Three-phase research and development process following the PDCA cycle

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.

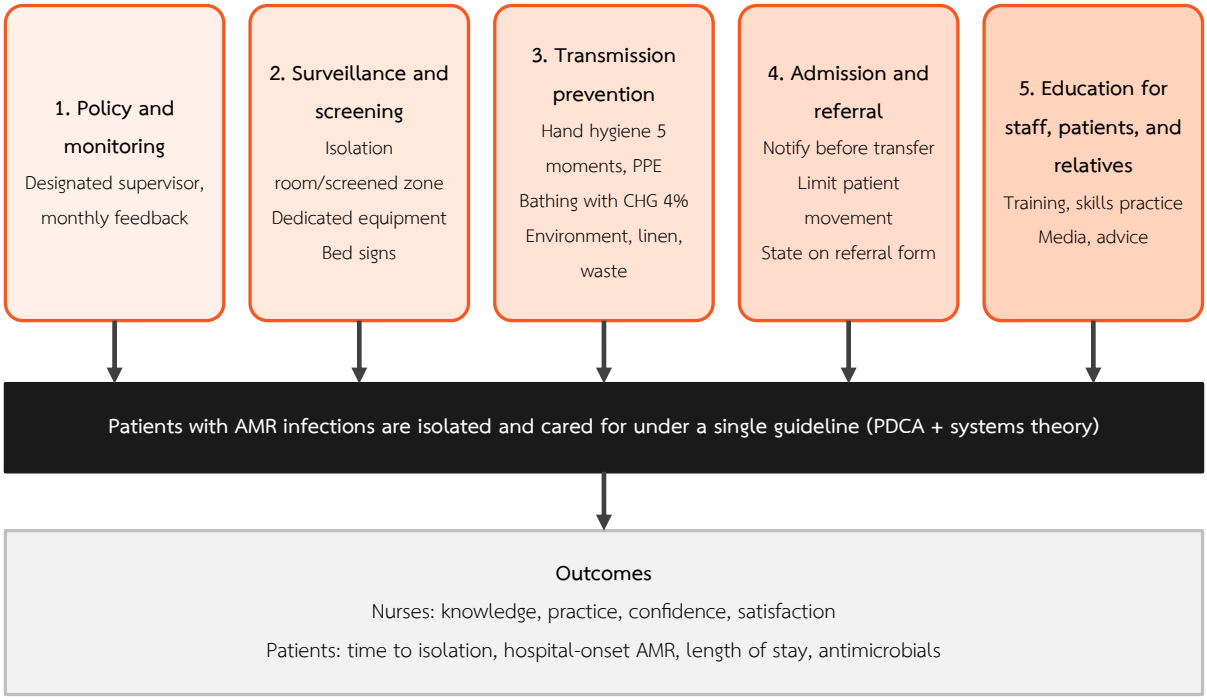

Figure 2 Five-component care model for patients with AMR infections, Donchan Hospital

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.

Acknowledgments

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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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