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Original Article

Redesigned assessment enhances medication management competency in clinical pharmacy clerkship training

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ABSTRACT

Global health initiatives highlight the importance of having a skilled pharmacy workforce. Organizations like JCPP and WHO/FIP support better pharmacy education, which includes mandatory Medication Management System (MMS) clerkships in Thailand's Pharm.D. program. However, variations in clinical placements and learning objectives make it difficult to provide the best training. This study aimed to redesign the assessment for the clinical pharmacy clerkship training program to enhance this competency by incorporating clear learning objectives, structured activities, and effective evaluation methods. The research progressed in three phases: In Phase I, a document analysis of 277 existing project reports on medication management was conducted. The results revealed that only 50.2% of the projects met the learning outcomes. These findings served as input for clarifying new learning outcomes using a Delphi technique with 18 pharmacy faculty members from 19 universities. This process led to the identification of eight general outcomes and 19 specific outcomes, with a focus on safety and risk management. Phase II involved brainstorming sessions with 15 preceptors and 15 recent graduates to design structured learning and evaluation processes. In Phase III, a quasi-experimental design was used to analyze the revised clerkship model in real-world training. This involved measuring preceptors' review times, appraising student scores, and evaluating the usability of the model using the modified System Usability Scale (SUS). The revised clerkship manual improved assessment efficiency, reducing evaluation times from 4.33 to 3.33 minutes for experienced preceptors and from 5.08 to 2.75 minutes for novice preceptors. It was also user-friendly for both groups.

Keywords: Medication management system, Clerkship, Learning outcome, Pharmacy education

Introduction

The World Health Organization's (WHO) Global Strategy on Human Resources for Health: Workforce 2030 affirms that healthcare is impossible without a workforce, and a workforce is impossible without education [1]. Therefore, pharmacy education, as part of overall health services including sustainable pharmaceutical care that meets population needs, must focus on developing strong managerial skills and teamwork abilities. The International Pharmaceutical Federation (FIP) supports this by advocating for a needs-based approach to improving pharmacy education through its 21 Development Goals (DGs) [2]. Eleven out of the 21 FIP DGs were identified as priorities for all six WHO regional roadmaps. In Southeast Asia, including Thailand, DG5 (Competency Development) is prioritized as the key link between pharmaceutical education reform and population health needs [3]. A key strategy to advance workforce development and

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education aligned with DG5 is supporting professional career development by implementing comprehensive competency frameworks [2].

In the USA, the Joint Commission of Pharmacy Practitioners (JCPP) established a comprehensive medication management (CMM) framework integrating patient care processes and practice management systems into core pharmacy curricula [4]. With 98.7% of students demonstrating competency, the framework's patient-centered approach is clear [5-8]. While a pharmacist's clinical work differs from that of a physician or nurse, and general PPCP training is insufficient, the care process becomes specific to pharmacy when guided by a distinct philosophy and a robust management system [9-11]. This is further refined by unique assessments and a taxonomy pharmacists use to define and evaluate competency [12].

The Canadian Council for Accreditation of Pharmacy Programs (CCAPP) outlines accreditation standards for quality pharmacy education, preparing competent practitioners to effectively meet healthcare needs and contribute to multidisciplinary teams and practice management [13]. "Medication Management Systems (MMS)," on the other hand, represent a broader, often technology-driven approach to managing medications across healthcare organizations, encompassing the entire medication use process. While differing in scope and implementation, both play crucial roles in promoting safe and effective medication use, addressing the complexities of modern pharmacotherapy, and improving patient outcomes in diverse healthcare settings [14].

There is a need for pharmacists with sophisticated drug management skills, according to a review of pharmacy education in Thailand [15]. In response, the Pharmacy Council of Thailand established a 6-year PharmD program in 2018 [16], which includes a required Medication Management System (MMS) clerkship for students in the clinical specialty track [17] and 2,000 hours of practical experience [18]. Through workplace-based learning that emphasizes practical application, the MMS clerkship offers crucial practical experience in overseeing hospital medication systems [19, 20]. Closing disparities in pharmacy education requires this [14, 21]. This method satisfies the requirements stated by the CCAPP in Canada [13] and the Accreditation Council for Pharmacy Education (ACPE) in the United States [22]. The performance-based paradigm in Australia, which has been shown to be more successful in training pharmacists, is comparable to continuous evaluation and feedback [23]. However, because of difficulties obtaining clinical assignments, ambiguous learning objectives, and disparate preceptor experiences, the MMS clerkship is inconsistent among Thai institutions.

Aim

This research aims to develop and rigorously test a new workplace-based model that includes clear learning objectives, structured activities, and effective evaluation methods. The goal is to ensure consistent, high-quality learning outcomes and to better prepare pharmacists to meet the diverse healthcare needs in Thailand.

Ethics approval

The Ethical Research Committee, Faculty of Pharmacy, Chiangmai University, authorized Study Protocol No.004/2564/F.

Materials and Methods

This research is structured into three phases to achieve its specific objectives.

Phase I (March–August 2021) aimed to clarify learning outcomes using document analysis [24] and a Delphi approach [25]. 18 Thai pharmacy faculty members, especially course directors of MMS clerkships, participated. We analyzed student reports from the 2019 academic year across 6 universities to assess current MMS clerkship practices and identify weaknesses. Two researchers independently compared this data to the Thailand Healthcare Accreditation (HA) Standard 4th Edition (2019) [26] and the PECT MMS clerkship manual [27]. This informed a three-round online Delphi survey: first, participants listed MMS clerkship learning outcomes; second, they rated the validity of each outcome on a 5-point scale; and third, they reviewed the results and adjusted their ratings until reaching a final consensus.

Phase II (November 2021-May 2022) employed qualitative data gathered through online brainstorming sessions [28] to finalize learning outcomes, evaluation processes, and insights for improving the MMS clerkship manual. Eighteen preceptors with over three years of MMS clerkship experience and eighteen recent pharmacy graduates were purposively selected from nineteen Thai pharmacy schools. Three levels of agreement and their significance were identified based on the quantile deviation (QD) values: a high level of agreement is represented by a QD of 0.5 or less, with a median score of 4 or higher, indicating high importance; a moderate level of agreement is represented by QD values between 0.5 and 1.0, with a median score of 3.5 or less, indicating low importance; and a QD greater than 1.0 indicates low or no consensus [25].

Phase III (March-October 2023) used a quasi-experimental design to implement and evaluate the revised MMS clerkship learning outcomes. Pharmacy preceptors were purposively selected from various Thai hospitals, including one with MMS clerkship experience and one with clinical (non-MMS) experience per hospital [29-31]. Data collection involved (1) recording preceptors' self-reported reading times for both the existing and new MMS clerkship manuals; (2) observing evaluations of two voluntary trainees' MMS project presentations; (3) conducting follow-up interviews and administering the Modified System Usability Scale (SUS) questionnaire [32] to assess manual usability; and (4) comparing preceptors' evaluations of student learning outcomes to assess the effectiveness of both clerkship manuals.

Results and Discussion

Phase I: Clarifying learning outcomes

The study independently analyzed the "Scope of Work for MMS" from 277 student reports across six universities, conducted by two researchers. The results indicated that most practice sites were in the Northern region, primarily within Ministry of Public Health hospitals **(Figure 1)**.

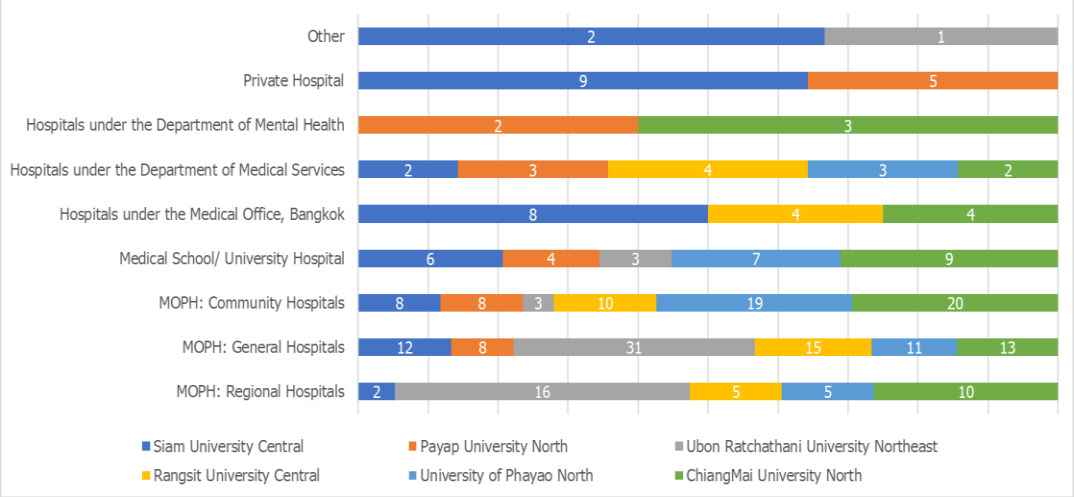

Figure 1. The types of practice sites that served as sources for the 293 student reports from the MMS clerkship in the academic year 2019.

The projects demonstrated a strong focus on preventing medication errors (128 projects), addressing adverse drug events (98 projects), and evaluating appropriate antimicrobial usage (69 projects). However, only 139 reports (50.2%) effectively met the learning outcomes established by PECT [27] by synthesizing suitable problem-solving processes.

The study's background and the analysis of MMS reports were shared with 18 faculty members from 19 universities, primarily assistant professors and lecturers. In the first round, participants were asked to list the "learning outcomes" of the MMS clerkship based on their experiences. This process resulted in a consensus on 8 general outcomes (GN) and 19 subject-specific outcomes (SP). Each participant individually rated their agreement with these outcomes, revealing varying levels of consensus and importance. High median scores indicated strong support for SP-1, SP-3, SP-4, SP-6, SP-7, SP-10, SP-11, SP-12, SP-13, SP-14, GN-1, GN-2, GN-3, GN-4, GN-6, and GN-7. SP-17 and GN-5 received moderate agreement with scores of 4, while SP-16 scored below 3.5, suggesting it should be excluded **(Table 1)**.

Table 1. Median and Quartile Deviation from the Delphi Process on Specific Learning Outcomes of the MMS Clerkship.

Learning Outcomes	Learning outcomes	The 2nd Round Delphi				The 3rd Round Delphi			
		Quartile deviation	Level of consensus	Median	Level of importance	Quartile deviation	Level of consensus	Median	Level of importance
SP-1	Describe standards for MMS emphasizing patient safety in hospitals.	0	High	5	High	0	High	5	High
SP-2	Define risk management, including a hospital incident reporting system prioritized by severity and identifying key weaknesses in reporting and documentation.	0.5	High	4	High	0.5	High	5	High
SP-3	Outline the key functions of the MMS, including preventing drug allergies, reducing medication errors, evaluating prescriptions, ensuring inpatient orders, and managing high-risk medications.	0	High	5	High	0	High	5	High
SP-4	Comprehend the role of pharmacists in the MMS.	0.5	High	5	High	0	High	5	High
SP-5	Create a flowchart linking MMS safety throughout the hospital.	0.5	High	4	High	0.5	High	4	High
SP-6	Identify risks in the hospital's MMS that could impact patient safety.	0.5	High	5	High	0.5	High	5	High
SP-7	Link project risks to the entire MMS.	0.5	High	5	High	0.5	High	5	High
SP-8 *	Identify the impacts of risks in the hospital MMS.	0.5	High	5	High				
SP-9	Analyze the causes of risks in the hospital's MMS affecting patient safety.	0	High	5	High	0	High	5	High
SP-10†	Apply management, pharmacoeconomics, pharmacoepidemiology, social sciences, and drug supply chain analysis to identify risks in MMS and propose safety measures.	0.5	High	4	High				

SP-11	Choose the right tools for developing the medication management system.	0.5	High	5	High	0.5	High	5	High
SP-12§	Create processes to address risks in the pharmaceutical system for each hospital's context.	0.5	High	4	High				
SP-13	Explain the PDCA cycle within the MMS.	0	High	5	High	0	High	5	High
SP-14	Define process measurement guidelines and implement effective improvements.	0.5	High	5	High	0.5	High	5	High
SP-15	Deliver proposed solutions or prevention strategies to stakeholders for practical execution.	0.5	High	5	High	0.5	High	4	High
SP-16‡	Assess personnel satisfaction in solving the problem (VAS score >6/10).	0.5	High	3	Low				
SP-17	Demonstrate skills related to pharmaceutical care and the MMS in real-world problem-solving.	1	Moderate	4	High	0.5	High	4	High
SP-18	Work collaboratively within health systems, medication systems, and consumer protection.	0	High	4	High	0.5	High	4	High
SP-19	Serve as a hospital pharmacist to enhance MMS quality and ensure proper use and ethics.	0.5	High	4	High	0.5	High	5	High
GN-1	Collaborate effectively in a multidisciplinary team.	0.5	High	5	High	0.5	High	5	High
GN-2	Communicate creatively and appropriately with multidisciplinary professionals.	0	High	5	High	0.5	High	5	High
GN-3	Demonstrate creativity.	0.5	High	5	High	0.5	High	5	High
GN-4	Demonstrate research skills, critical thinking, and problem-solving.	0	High	5	High	0	High	5	High
GN-5	Recognize pharmacists' roles, responsibilities, and ethical practices toward patients.	1	Moderate	4	High	0.5	High	5	High
GN-6	Display a dedication to continuous education.	0.5	High	5	High	0.5	High	5	High
GN-7	Competent in the appropriate use of information technology for work-related tasks.	0.5	High	5	High	0.5	High	5	High
GN-8¶	Conduct statistical calculations on collected data, analyze results, and draw conclusions.					0.5	High	4	High

*****merge with SP-9, †part of the RCA process already, ‡Median < 3.5, QD < 0.5, then exclude §merge with SP-15, ¶add from the 2nd round

Phase II: Designing learning and evaluation processes

A brainstorming session was conducted online with 15 hospital pharmacists who had MMS experience ranging from 1 to over 10 years, including more than 5 years as preceptors. Three main topics were discussed for the MMS clerkship learning process: (1) giving pharmacy students a basic understanding of the medication system from pharmacy school; (2) encouraging lifelong learning by having them complete at least two rotations during the placement; and (3) clearly defining task expectations in evaluation methods to gauge learning outcomes.

Phase III: Implementing and evaluating through a quasi-experimental study

Twelve experienced pharmacy preceptors (Ex-P) and twelve novice preceptors (Na-P), along with their trainees, evaluated the MMS clerkship during the last week of each rotation. Data showed that both groups improved their evaluation efficiency with the new manual: Ex-P reduced their evaluation time from 4.33 minutes to 3.33 minutes, while Na-P went from 5.08 minutes to 2.75 minutes. Experienced preceptors improved their scores from 46.67 to 70.00, while novice preceptors had variable scores ranging from 36.67 to 70.00, consistently lower than experienced preceptors using the existing manual. Both groups improved, but experienced preceptors benefited more consistently from the new manual **(Table 2)**.

Table 2. Scores from Existing and New MMS Manuals with Differences Between Experienced and Novice Preceptors.

Pharmacist preceptor (evaluator)	Pharmacy student (trainee)	Evaluation score from the existing MMS manual				Evaluation score from the new MMS manual			
		Experienced pharmacist preceptor	Novice pharmacist preceptor	Difference in score	% difference	Experienced pharmacist preceptor	Novice pharmacist preceptor	Difference in score	% difference
P1	S1	54.6	53.4	1.2	2.0	56.7	53.3	3.3	4.8
P1	S2	48.0	43.2	4.8	8.0	50.0	36.7	13.3	19.0
P2	S1	60.0	49.8	10.2	17.0	70.0	46.7	23.3	33.3
P2	S2	60.0	50.4	9.6	16.0	70.0	46.7	23.3	33.3
P3	S1	46.2	55.8	-9.6	-16.0	46.7	70.0	-23.3	-33.3

P3	S2	48.6	55.8	-7.2	-12.0	46.7	70.0	-23.3	-33.3
P4	S3	52.2	55.8	-3.6	-6.0	46.7	70.0	-23.3	-33.3
P4	S1	57.0	57.0	0.0	0.0	56.7	70.0	-13.3	-19.0
P5	S2	56.4	57.0	-0.6	-1.0	56.7	70.0	-13.3	-19.0
P5	S1	48.0	48.6	-0.6	-1.0	43.3	46.7	-3.3	-4.8
P6	S1	57.6	58.2	-0.6	-1.0	56.7	60.0	-3.3	-4.8
P6	S2	55.8	57.6	-1.8	-3.0	53.3	63.3	-10.0	-14.3
Mean		53.7	53.6	0.2	0.3	54.5	58.6	-4.2	-6.0
SD		4.9	4.6	5.9	9.8	8.7	12.1	17.0	24.3

The usability evaluation of the new MMS clerkship manual found no consistent link between preceptor experience and student performance. Both assessment forms showed fluctuating scores, with average performances appearing similar. Ratings from the SUS indicated that while the new manual is generally user-friendly and easy to learn, improvements are needed in areas such as cumbersomeness and support. Mixed responses regarding the need for technical assistance suggest that some users may struggle without help **(Figure 2)**.

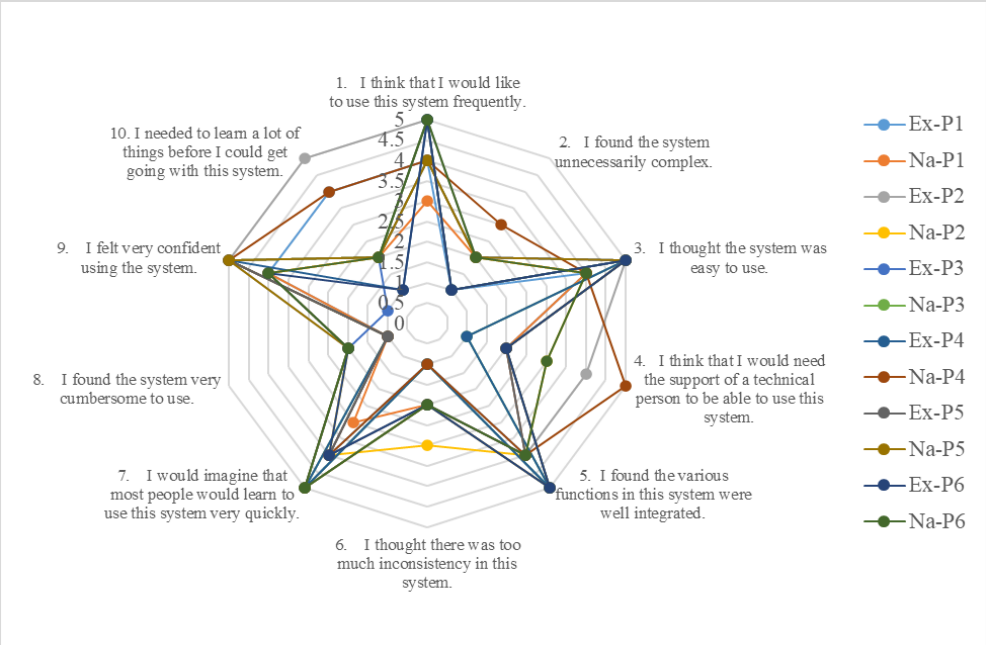

Figure 2. Responses to the System Usability Scale (SUS) questions for evaluating the new MMS clerkship manual

A SWOT analysis of the FIP Development Goals (DG) highlights that the Southeast Asian region benefits from an abundance of pharmacy students for education [33-35]. However, there is room for improvement in pharmacy practice education, particularly in patient-centered care, clinical pharmacy, and interprofessional education [3]. This study addressed a key gap in Thai pharmacy education by developing a competency framework and aligning the curriculum with clear learning outcomes for a workplace-based model of the Medication Management System (MMS). This approach aligns with ACPE's recognition of the need to train pharmacy students in comprehensive pharmaceutical care [3, 22]. This comprehensive framework encompasses a variety of systems and practices for managing medications in healthcare settings [13]. It takes a broader approach than the focus on optimizing medication use seen in Medication Therapy Management (MTM) and Medication Management Review (MMR) [22, 23].

A three-phase mixed-methods approach was used, with the first two phases employing Delphi techniques and brainstorming sessions. Eighteen experts from 19 Thai pharmacy schools reached consensus on learning outcomes for the MMS clerkship. While Delphi studies typically involve 10-50 participants, this number was determined by geographical and resource factors, with an 80% response rate targeted to account for attrition, aligning with literature reporting median rates of 88-90% [25]. Compared to the Pharm.D program at the University of Arkansas [26], the learning outcomes in this study now emphasize patient safety and risk management (SP-1 to SP-3). This change reflects a shift in Thai pharmacy education, aligning with the approaches of the Australian Pharmacy Council (APC) [23] and the Canadian Council for Accreditation of Pharmacy Programs (CCAPP) [13]. Specifically, outcomes SP-1 and SP-2 highlight the need to prioritize safety and manage risks by effectively reporting incidents and identifying vulnerabilities in the MMS.

One challenge of DG5 (Competency Development) is integrating pharmacists into healthcare teams for safety and risk management while avoiding role overlap and communication barriers that could affect teamwork [3]. This redesigned

pharmacy clerkship will support national or placement policies by tracking pharmacy trends through medication management research. Collaborative workplace-based research with interprofessional teams will strengthen institutional cooperation, improve clinical outcomes, and drive action on DG5.

The focus on information technology (GN-7), research skills, and statistical analysis (GN-4, GN-8) highlights the integration of technology and evidence-based practice in modern pharmacy education. Advanced IT application in pharmacy is also stated in the Pharm2Pharm model, which began in Hawai'i [14]. This system enables pharmacists to access comprehensive medication histories, facilitating informed decision-making across care settings. It demonstrates how technology integration can enhance medication management, improve patient safety, and streamline pharmacist workflows, underscoring the importance of IT competency in modern pharmacy practice.

The final step was a quasi-experimental study to assess the clerkship manual's usability and user satisfaction using the System Usability Scale (SUS) [25] in a real-world setting. SUS scores range from 0 to 100, with scores above 85 indicating excellent usability and below 70 indicating poor usability [36]. The results showed that experienced users rated the manual highly, while novice users' scores were inconsistent. Although the overall SUS score was positive, further research with larger samples is needed to confirm its effectiveness. Future research should look at the long-term effects of preceptor training, focusing on how well it helps new preceptors and improves performance inconsistencies. Research on healthcare policy and elder drug access yields conflicting outcomes. While prescription drug coverage improved between 1998 and 2015, both insured and uninsured seniors experienced significant financial difficulty due to medication expenses. These findings underline the need for taking a complete approach to pharmaceutical education and healthcare policy, taking into account the relationship between education, practical skills, and real-world policy consequences on patient care and medicine availability. Meanwhile, the APhA Medication Therapy Management Digest focuses on increasing pharmacists' involvement in patient care, pushing for provider status, and eliminating systemic hurdles. In contrast, the learning outcomes prioritize a skills-based curriculum for operating a hospital's Medication Management System (MMS), with an emphasis on technical competence and internal processes [33]. The Digest discusses the why and background, whereas the learning outcomes describe how. This confirms Belmont University's research, which found that including drug management instruction in the core curriculum improved student abilities and confidence in complicated healthcare settings [20].

Conclusion

This study addressed a gap in Thai pharmacy education by redesigning the Medication Management System (MMS) clerkship with a three-phase mixed-methods approach. The new workplace-based model improved medication management training by clarifying learning objectives and providing a more user-friendly manual, enhancing student outcomes and real-world practice alignment. While effective, the model highlighted the need for standardized preceptor training to ensure consistent, high-quality instruction. This research advocates for integrating medication management education into the core pharmacy curriculum, aligning with international standards and emphasizing patient safety and risk management. Future studies should examine the impact of preceptor training on student competencies and patient care outcomes, improving medication management in Thailand.

Impact statements

This study transforms pharmacy education by redesigning a workplace-based model for the Medication Management System (MMS) clerkship, addressing key gaps in FIP DG5 (Competency Development). By integrating clear learning objectives and structured activities, the model enhances pharmacists' practical skills in managing complex medication regimens. Aligning with international accreditation standards, this research promotes patient safety and effective medication management, ultimately improving patient care.

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Conflict of interest: None

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Ethics statement: None

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