

ORIGINAL RESEARCH

Insights from U.S. nursing pharmacology education: Implications for strengthening nursing pharmacology in Japan

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ABSTRACT

Objective: To explore the current state of nursing pharmacology education in the United States and identify implications for strengthening nursing pharmacology education in Japan.

Methods: Semi-structured interviews were conducted in July 2024 in Hawaii with three nursing professionals who had clinical and teaching experience in the United States. Thematic analysis was applied to categorize concepts related to nursing pharmacology education and clinical practice.

Results: Five components were identified as essential in nursing pharmacology education: assessment ability, integration with anatomy/physiology/pathophysiology, simulation-based learning, active learning, and clinical medication experience. In clinical settings, key competencies included assessment ability, documentation, interprofessional collaboration, communication skills, clinical judgment, and accountability for patient safety.

Conclusions: Findings from U.S. nursing pharmacology education suggest that strengthening assessment-centered, integrative, and experiential learning approaches may help enhance current nursing pharmacology education in Japan and prepare nurses to make safe medication-related clinical decisions.

Key Words: Assessment ability, Curriculum development, Education, Nursing pharmacology

1. INTRODUCTION

Pharmacotherapy is a critical component of undergraduate nursing education, as nurses play a central role in medication administration, monitoring, and patient safety. In Japan, however, nursing pharmacology education has traditionally focused on knowledge acquisition, such as drug mechanisms and side effects, with limited emphasis on clinical judgment, medication-related assessment, and accountability in practice. As a result, pharmacology is often perceived by nursing students as an abstract and difficult subject that is weakly

connected to clinical decision-making.

Nursing pharmacology education has often been perceived by students as difficult and abstract, particularly when learning is centered on theoretical knowledge without sufficient clinical integration.^[1] Recent studies have emphasized the need for educational strategies that actively engage students and link pharmacological knowledge with clinical decision-making.

In recent years, concerns regarding medication safety and

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nurses' preparedness for complex pharmacotherapy have increased in Japan, particularly in the context of an aging population, polypharmacy, and expanding nursing roles. Medication administration errors remain a persistent patient safety issue in healthcare settings, highlighting the need for nurses to develop assessment-based pharmacotherapy competencies.^[2] Despite these challenges, educational approaches that systematically integrate assessment ability, pathophysiology, and clinical reasoning into nursing pharmacology curricula remain underdeveloped. Pharmacology is a highly demanding interdisciplinary subject that requires significant effort from both educators and students to achieve meaningful learning outcomes.^[1]

In contrast, nursing education programs in the United States are reported to adopt more integrative and experiential learning approaches, such as simulation-based education, active learning, and clinical exposure related to medication practice. These approaches aim to support the development of medication-related competencies and professional responsibilities among nursing students. Simulation-based education has been widely recognized as an effective approach for enhancing nursing students' medication safety competencies. A recent systematic review demonstrated that clinical simulation consistently improved students' knowledge, skills, and safety behaviors related to medication administration.^[3] In particular, simulation-based education has been increasingly recognized as an important strategy for enhancing medication administration safety and supporting clinical judgment in nursing education.^[4] Recent nursing education frameworks emphasize competency-based education, identifying assessment ability and clinical judgment as core outcomes of undergraduate nursing programs.^[5]

However, how these educational approaches are perceived and implemented by nursing professionals, and which elements are considered essential for nursing pharmacology education and clinical practice, remain insufficiently explored, particularly from a qualitative perspective. Therefore, an interview-based qualitative study was conducted to examine nursing professionals' perspectives on nursing pharmacology education in the United States and to identify implications for strengthening nursing pharmacology education in Japan.

2. METHODS

2.1 Design

A qualitative descriptive design was used to produce a low-inference, practice-oriented account of current approaches to nursing pharmacology education. Qualitative approaches have been used to explore nursing students' and educators' perceptions of simulation-based medication education, particularly to capture experiential and contextual aspects of

learning.^[6] Accordingly, a qualitative descriptive design was considered appropriate for this study.

2.2 Participants

Participants were selected through convenience sampling and consisted of three nursing professionals licensed in the United States (U.S.) who had experience in both clinical practice and nursing education. Their educational and professional backgrounds varied: one held a Doctor of Nursing Practice degree as a Family Nurse Practitioner (DNP-FNP), one held a master's degree as a Family Nurse Practitioner (FNP), and one held a PhD in nursing. All participants were qualified registered nurses (RNs) and had academic appointments at either a state university or a private university in the U.S. Among the three participants, two were also responsible for teaching nursing pharmacology courses in their respective programs.

2.3 Data collection

Data were collected through semi-structured, face-to-face interviews conducted in July 2024 in Hawaii, U.S. The interviews explored participants' experiences and perspectives related to nursing pharmacology education, including course structure, teaching strategies, expectations for students' medication-related competencies, and clinical experiences relevant to pharmacotherapy. Each interview lasted approximately 45 to 60 minutes. Detailed notes and summaries were prepared immediately following each interview to ensure accurate capture of participant accounts.

2.4 Data analysis

Data were analyzed using a thematic analysis approach. The interview summaries were first read repeatedly to obtain an overall understanding of participants' accounts. Meaningful statements related to nursing pharmacology education and medication-related practice were then identified and grouped into preliminary codes. These codes were compared, refined, and organized into subcategories based on conceptual similarity. Subcategories were subsequently abstracted into broader categories that represented key elements of nursing pharmacology education and clinical competency. To ensure the trustworthiness of the findings, multiple members of the research team reviewed coding decisions, discussed discrepancies until consensus was reached, and documented analytic decisions throughout the process to enhance credibility and confirmability.

2.5 Use of illustrative composite quotes

Alongside verbatim participant quotations, we incorporated a limited number of illustrative composite quotes to represent typical language that recurred across interviews regarding

assessment-centered pharmacology instruction, simulation practices (pre-brief/debrief), and interprofessional communication. Each composite was inductively derived from multiple convergent meaning units identified during coding and memoing, and did not introduce any ideas beyond the coded dataset. Composites were drafted by the first author, independently reviewed by two team members against the underlying excerpts, and revised until consensus to ensure credibility and fidelity to the data. Their function was expository—to improve readability and highlight cross-cutting patterns—while verbatim quotes remain the primary evidentiary basis anchor-

ing each theme and subtheme.

3. RESULTS

Analysis yielded two overarching categories that described essential elements of nursing pharmacology education and medication-related competencies in the United States: (1) core components of nursing pharmacology education; and (2) competencies required for clinical medication practice (see Table 1). Cross-cutting observations are presented separately because they were identified across both categories rather than constituting a distinct third category.

Table 1. Core components of nursing pharmacology education and competencies required for clinical medication practice

Theme	Subcategory	Representative quote from interviews
1. Core components of nursing pharmacology education	Assessment ability	“Before and after medication administration, nurses are expected to conduct assessments to detect therapeutic effects and adverse reactions.”
	Integration with anatomy, physiology, and pathophysiology	“It is essential to learn pharmacology in connection with anatomy, physiology, and pathophysiology rather than as a stand-alone subject.”
	Simulation-based learning	“Simulation-based learning allows students to safely practice decision-making and medication management before entering clinical settings.”
	Active learning	“Active learning strategies help students think critically rather than simply memorize medication content.”
	Clinical medication-related experiences	“Students begin administering medications as early as the first year, which increases responsibility and deepens pharmacologic understanding.”
2. Competencies required for clinical medication practice	Assessment ability	“Assessment is inseparable from medication; observing patient responses is a necessary component of safe medication management.”
	Documentation	“Documentation must include rationale, monitoring items, and communication with pharmacists or physicians regarding medication decisions.”
	Interprofessional collaboration	“Medication decisions are made collaboratively with pharmacists and physicians rather than by nurses alone.”
	Communication	“Communication with patients is essential to support adherence and ensure safety, particularly during care transitions such as discharge.”
	Clinical judgment	“Nurses often make clinical judgments about whether medication should be administered or modified based on patient assessment.”
	Accountability for patient safety	“Professional accountability for patient safety in medication therapy requires comprehensive understanding of pharmacology, pathophysiology, patient assessment, and appropriate decision-making.”

Note. Quotes have been slightly edited for clarity while preserving the original meanings.

3.1 Core components of nursing pharmacology education

3.1.1 *Emphasis on assessment ability*

Across all interviews, participants framed assessment ability as the foundation of pharmacology learning, linking medication decisions to the patient’s evolving condition.

“We want students to develop the ability to judge the effects and risks of medications based on the patient’s condition, rather than simply memorizing drugs.” (Participant A)

“Before administering a medication, they must know how to interpret vitals and symptoms. Without assessment, you cannot make medication decisions.” (Participant C)

“Students start seeing pharmacology as patient care—not just drug lists—once they are asked, ‘What do you expect to change in this patient after the dose, and what would make you hold it?’” (illustrative composite quote)

Several participants reported that assessment-centered pharmacology increases student confidence and reduces task-oriented medication behavior during clinical placements.

3.1.2 *Integration with anatomy, physiology, and pathophysiology*

Pharmacology was consistently taught in tandem with foundational sciences to support mechanism-based reasoning and anticipation of adverse effects.

“When we teach beta blockers, for example, we always review cardiovascular physiology and pathology. The goal is for students to explain why a particular drug is appropriate for a specific patient.” (Participant B)

“You can’t truly understand pharmacology in isolation. Without understanding the underlying pathology, you cannot anticipate adverse effects.” (Participant A)

“Concept maps linking pathophysiology → receptor action → expected response help students predict rather than recall.” (illustrative composite quote)

3.1.3 Simulation-based learning as a safety bridge

All three participants described simulation as indispensable for rehearsing medication preparation, administration, monitoring, and safety checks before clinical placements.

“Simulation provides a safe space where students can practice everything—from medication preparation to monitoring patient responses—without risking patient safety.” (Participant C)

“Since students often cannot handle medications directly during clinical placements, simulation becomes an indispensable learning environment.” (Participant B)

“A structured pre-brief and debrief make the ‘five rights’ come alive—students can tell us exactly why they would withhold or escalate.” (illustrative composite quote)

Participants noted that repeated, scenario-based simulation promotes anticipatory thinking (e.g., recognizing early signs of adverse reactions) and strengthens safety habits (double-check, clarification calls).

3.1.4 Active learning in the classroom

Active learning (case discussions, team tasks) was described as routine and effective for engaging students in clinical reasoning rather than passive recall.

“Rather than listening passively, students analyze cases and think through what is happening with the patient.” (Participant A)

“The learning process matters—small group discussions are standard practice in pharmacology courses.” (Participant C)

“Quick ‘dose to response’ huddles and peer teaching bursts keep the room active and normalize speaking up about safety.” (illustrative composite quote)

3.1.5 Clinical medication-related experiences

Participants emphasized providing opportunities for students to observe and participate in medication checks and patient education alongside clinical nurses, which consolidates classroom learning.

“We try to create opportunities where students can participate in medication checks and patient education with clinical nurses.” (Participant B)

“Clinical experience helps students understand how pharmacology connects to real patient care.” (Participant C)

“When students counsel a patient (with supervision) about why we’re changing a dose, they remember the mechanism far better than from slides.” (illustrative composite quote)

3.2 Competencies required for clinical medication practice

3.2.1 Clinical judgment anchored in assessment

Participants characterized clinical judgment as indispensable, requiring nurses to integrate assessment findings with pharmacology and pathophysiology to decide when to give, hold, or escalate.

“If medication administration were only a task, a machine could do it. Nurses must judge whether the medication is truly appropriate for that patient.” (Participant A)

“When an adverse reaction occurs, nurses need to understand why by linking pathology and pharmacology.” (Participant C)

“We train students to say the judgment out loud—‘Given the BP trend and renal function, I would hold and call.’ Confidence follows practice.” (illustrative composite quote)

3.2.2 Documentation, communication, and interprofessional collaboration

Accurate documentation of effects and side effects, clear communication, and proactive collaboration with physicians and pharmacists were repeatedly cited as safety-critical.

“Patient safety depends heavily on how precisely nurses document patients’ responses and medication effects.” (Participant B)

“When a medication adjustment seems necessary, nurses consult collaboratively with physicians and pharmacists.” (Participant A)

“Early clarification calls are framed as safety behaviors here—students practice the script so it’s easier to do on the floor.” (illustrative composite quote)

3.2.3 Accountability for patient safety

Participants highlighted accountability as a professional expectation beyond task completion—nurses must anticipate risks, monitor outcomes, and explain their decisions.

“Nurses must be able to explain what happened to the patient and why they made certain clinical decisions.” (Participant C)

“Medication management is not just performing tasks—it involves decisions that directly impact patient safety.” (Participant B)

“Students begin to own the why—not just the what—when they reflect on near misses in debriefs.” (illustrative composite quote)

3.3 Cross-cutting observations (student-perceived benefits)

Across components and competencies, participants associated the above approaches with greater student confidence, improved transfer of learning from classroom to clinic, and a stronger safety mindset around medication practices. These perceived outcomes were reported as emerging particularly when assessment-centered teaching, integrated basic sciences, and simulation with structured debriefing were combined within the curriculum.

“By the final term, students are less ‘dose-centric’ and more ‘patient-centric’—they check indications, trends, and teach back as a routine.” (illustrative composite quote)

4. DISCUSSION

This study identified key components of nursing pharmacology education and medication-related competencies in the United States, with assessment ability emerging as a foundational element across both educational and clinical contexts. These findings provide important implications for strengthening nursing pharmacology education in Japan.

4.1 Assessment ability as the foundation of pharmacotherapy

Assessment ability was consistently emphasized by participants as the core of safe and effective pharmacotherapy. In U.S. nursing education, pharmacological knowledge is closely linked to patient assessment, enabling nurses to evaluate medication effects, detect adverse reactions, and adjust care accordingly. This integration reflects the expanded scope of nursing practice in the United States, where nurses are expected to make autonomous clinical judgments related to medication management.

Assessment ability was consistently identified as a foundation of safe pharmacotherapy. However, previous studies have reported significant gaps in nurses’ knowledge of high-risk medications, suggesting that pharmacology education needs to be more clinically oriented and closely linked to patient assessment and safe decision-making.^[7] Clinical judgment has been conceptualized as a complex cognitive process that integrates patient assessment, professional knowledge, and decision-making in nursing practice.^[8]

Clinical judgment has been identified as a core outcome of simulation-based education in nursing. Simulation provides opportunities for students to integrate assessment findings with pharmacological knowledge, thereby supporting the development of clinical judgment and safe decision-making.^[9]

In Japan, physical assessment is often taught primarily within basic nursing courses, and its connection to pharmacology

education may be insufficiently emphasized. Strengthening assessment-focused pharmacology education may enhance nurses’ ability to connect patient conditions, pathophysiology, and medication responses, thereby improving clinical judgment and medication safety.

4.2 Integration with anatomy, physiology, and pathophysiology

In this context, pharmacology education requires an integrative approach that links foundational sciences with clinical decision-making. Pharmacology is widely recognized as a highly interdisciplinary subject, requiring the integration of foundational sciences to support meaningful learning and clinical application.^[11] Integrated pharmacology education frameworks emphasize linking drug knowledge with pathophysiology and patient assessment to support safe clinical decision-making.^[10]

In the present study, participants emphasized the importance of integrating pharmacology with anatomy, physiology, and pathophysiology as a core element of nursing pharmacology education. Such integration enables nurses to understand mechanisms of action, anticipate potential adverse effects, and evaluate patients’ responses to medications based on their underlying conditions.

Participants noted that without a clear connection between pharmacological knowledge and patients’ physiological and pathological states, medication-related decision-making becomes fragmented and task-oriented. In contrast, an integrated approach supports nurses in applying pharmacological knowledge to patient assessment and clinical reasoning, thereby enhancing safe and appropriate medication practice.

For nursing education in Japan, strengthening curricular integration between pharmacology and foundational sciences may help bridge the gap between theoretical knowledge and clinical application. Emphasizing this integration could support the development of nurses’ clinical judgment and preparedness for complex pharmacotherapy in increasingly diverse clinical settings.

4.3 Simulation-based learning and active learning

Simulation-based learning was identified as a key educational strategy for bridging the gap between theory and practice. Simulation-based learning has been widely adopted in nursing education as an effective strategy for enhancing clinical competence and patient safety.^[11] The effectiveness of simulation-based learning in medication education has been further supported by a recent systematic review focusing on nursing students’ safe medication administration. This review demonstrated that clinical simulation consistently improved medication safety, safety knowledge, and compe-

tence in medication administration among nursing students across multiple studies.^[3] Simulation provides a realistic yet risk-free environment in which students can practice clinical judgment, decision-making, and psychomotor skills related to pharmacotherapy before entering real clinical settings. The findings of this study are consistent with previous quantitative research demonstrating that simulation-based medication education improves nursing students' medication safety competence and confidence.^[12] These results suggest that simulation plays an important role in bridging pharmacological knowledge and clinical practice.

Active learning approaches, including case-based discussions and group work, were also central to U.S. nursing pharmacology education. These strategies encourage critical thinking and engagement, contrasting with lecture-centered approaches that remain common in Japan. Incorporating simulation and active learning into Japanese nursing pharmacology curricula may enhance students' practical skills and confidence.

The importance of active and experiential learning identified in this study is consistent with recent quantitative evidence on pharmacology education. A large network meta-analysis involving 6,447 students demonstrated that new media teaching strategies—such as flipped classrooms and multimedia-based learning—were particularly effective among nursing students, resulting in higher academic performance, learning interest, self-learning ability, and satisfaction compared with other disciplines.^[13] These findings support the present qualitative results, suggesting that learner-centered and technology-enhanced approaches are especially well suited to nursing pharmacology education.

4.4 Clinical medication experience and professional competencies

Participants emphasized that direct medication-related experiences during clinical practicums are essential for developing competence. In clinical settings, nurses are required to integrate assessment ability with accurate documentation, interprofessional collaboration, and communication skills. These competencies support shared decision-making and patient-centered care.

Clinical judgment and accountability for patient safety were described as indispensable professional responsibilities. Previous research has shown that simulation-based medication training can strengthen nursing students' clinical judgment, sense of professional responsibility, and attitudes toward medication safety, including their intention to report medication errors.^[4]

Accountability extends beyond task completion to include

responsibility for anticipating risks, monitoring outcomes, and explaining clinical decisions. Within the Japanese context, patient safety and medication safety education have been emphasized in nursing education, reflecting ongoing concerns about medication-related incidents among nurses and the need to strengthen patient safety competencies.^[14,15] Because nursing students in Japan are legally restricted from administering medications during clinical practicums, educational strategies that foster professional accountability through simulation and reflective learning may be particularly important for preparing students for future medication-related responsibilities.

4.5 Implications for nursing pharmacology education in Japan

Taken together, these findings provide practical guidance for the future development of nursing pharmacology education in Japan. In particular, they support curriculum development that emphasizes assessment ability, interdisciplinary integration, and experiential learning while adapting these educational strategies to the Japanese educational and clinical context. Further research is needed to evaluate the effectiveness of these approaches in improving nursing students' pharmacological competencies and medication safety outcomes.

4.6 Limitation

This study has several limitations. First, the interview survey involved only three participants, which limits the extent to which the findings reflect nursing pharmacology education in the United States. Second, the findings were based on participants' self-reported experiences and perspectives, which may be influenced by individual contexts and interpretations. However, the findings provide preliminary insights that may inform nursing pharmacology education in Japan. Future research should include a larger and more diverse sample to validate and extend the findings and to enhance their transferability to broader educational contexts.

5. CONCLUSION

This study identified assessment ability as the foundational component of U.S. nursing pharmacology education and highlighted the importance of integrating pharmacology with anatomy, physiology, pathophysiology, simulation-based learning, active learning, and clinical medication experiences to support safe medication-related clinical judgment. These findings suggest that strengthening assessment-centered nursing pharmacology education, together with integrative, experiential, and competency-based educational approaches, may help bridge the gap between pharmacological knowledge and clinical practice in Japan and ultimately contribute to safer

medication management and improved patient care.

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AUTHORS CONTRIBUTIONS

Michiko Tanaka conceived and designed the study, conducted the interviews, analyzed the data, and drafted the manuscript. Hiroe Yamamoto, Haruka Kurihara, and Taketo Yoshitake contributed to data interpretation, critically revised the manuscript, and approved the final version for publication.

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The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

INFORMED CONSENT

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DATA SHARING STATEMENT

No additional data are available.

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