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Original Research

Improving medication safety in home enteral nutrition: Uncovering drug-related problems in patients using telepharmacy

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Abstract

Background: The complexity of drug administration via tube feeding makes home enteral nutrition (HEN) difficult. Telepharmacy was established to provide continuous pharmacological care to assure safety and efficacy of the patients at home care. **Objective:** To examine drug-related problems (DRPs) in patients receiving HEN, and a pharmacy-led intervention on optimizing medication administration via feeding tubes at home care settings. **Methods:** This cohort study was conducted between April 2021 and January 2024 involving adult patients on tube feeding who received pharmaceutical care via telepharmacy. Medication review, pharmaceutical consultation, documentation and follow-up planning were performed by pharmacists. During remote consultations, DRPs were identified, and recommendations were made based on current clinical guidelines and evidence-based resources. **Results:** A total of 90 patients were included, with a mean age of 81.5±14.5 years (63% females). During 153 telepharmacy sessions, pharmacists identified 189 DRPs in 85 patients (94.44%), involving 207 medications. The common drug categories involved in DRPs included gastrointestinal drugs (26.09%), cardiovascular drugs (9.18%), and micronutrients (7.25%). The most frequent DRPs were failure to receive drugs (38.10%), improper drug selection (14.28%), untreated indications (8.47%), and drug interactions (8.47%). Telepharmacy-based pharmaceutical counseling and management successfully resolved 134 from 189 DRPs (70.89%). Most issues were addressed through caregiver medication counseling, clarification of drug administration techniques, correction of inappropriate dosage forms, and adjustment of drug regimens in collaboration with physicians. Some problems remained unresolved due to factors beyond immediate pharmacist management, such as unavailable of appropriate dosage forms, or limited authority to modify therapy. **Conclusion:** These findings highlight the importance of telepharmacy services in optimizing pharmacotherapy and ensuring medication safety among patients receiving HEN.

Keywords: Enteral Nutrition, Home Care Services, Medication Errors, Pharmaceutical Services

INTRODUCTION

Home enteral nutrition (HEN) has become an essential component of long-term nutritional support for patients with chronic diseases who are unable to meet their nutritional requirements via oral intake. According to the 2020 European Society for Clinical Nutrition and Metabolism (ESPEN) guidelines, HEN is indicated in patients who are malnourished or at nutritional risk, have a functional gastrointestinal tract, and require ongoing nutritional therapy in a non-acute care setting[1]. Over recent decades, demographic shifts, particularly population aging, have led to a growing number of older adults who are bedridden, functionally dependent on activities of daily living, and unable to consume food orally due to dysphagia or other comorbid conditions. These patients frequently require prolonged HEN to maintain their nutritional status and quality of life[2-4].

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Despite the clinical benefits of HEN, medication management in this population presents several challenges. Older adults receiving HEN commonly require polypharmacy (multiple medications), and drug administration through enteral feeding tubes often necessitates crushing solid oral dosage forms and mixing them with water or an enteral formula[5]. However, certain medications are not suitable for crushing due to modified-release (MR) mechanisms, coating integrity, or physicochemical instability. The pharmacokinetics and pharmacodynamics of drugs can be changed through improper alteration of drug formulations or by using the wrong delivery procedures. This can lead to therapeutic failure or drug toxicity. Complications including tube occlusion, or diarrhea can be caused by improper administration methods of medications via enteral tube feeding. Furthermore, interactions between medications and enteral formulas may compromise drug absorption and efficacy, ultimately undermining the safety and efficacy of treatment[5,6]. Besides prescription errors, the lack of direct supervision and knowledge gaps among patients/caregivers represent key contributing factors.

Unlike hospitalized patients who receive regular medication review, patients in the home setting are at risk of fragmented care and suboptimal medication management. To ensure optimal medication use in patients receiving HEN, pharmaceutical care services must be tailored to the specific needs of individuals. Telepharmacy includes timely management of disease and medications, clinical counseling, monitoring, outcome

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evaluation, collaboration with other healthcare providers, and provision of drug information[7]. This approach has emerged as a promising method to provide remote, continuous pharmaceutical care, especially for older patients receiving long-term home care or during pandemic situations. However, pharmacy-led interventions by telepharmacy on optimizing medication administration via feeding tubes in home care settings remain limited. The objective of this study is to describe the common DRPs identified by pharmacists among Thai patients with HEN who receive pharmaceutical care through telepharmacy. This research aims to highlight practical challenges in medication administration via feeding tubes and contribute evidence for improving pharmaceutical care strategies for this vulnerable patient population. This study also emphasizes a pharmacy-led intervention which may minimize the complications involved in medication administration through enteral feeding tubes in home care settings.

MATERIALS AND METHODS

A retrospective cohort study was carried out in Thai patients receiving HEN who received telepharmacy services from pharmacists at the Ramathibodi Hospital, Bangkok, Thailand. This is a tertiary-care university hospital with over 1,000 beds for various specialties. The study was conducted between April 2021 and January 2024, during which healthcare teams, including home visiting nurses participated and referred some patients with medication management concerns to pharmacists. Pharmacists then delivered pharmaceutical care remotely via hospital-based telephone consultations with either caregivers or patients themselves. This study protocol was reviewed and approved by the Human Research Ethics Committee, Faculty of Medicine Ramathibodi Hospital, Mahidol University (no. MURA2024/249). This study was conducted in accordance with the Declaration of Helsinki together with the national and institutional standards. The requirement for informed consent was waived due to the retrospective nature of the study, no impact on patients' clinical management, and the protection of patient anonymity.

The inclusion criteria were patients of all ages who received HEN either via nasogastric (NG) tube or percutaneous endoscopic gastrostomy (PEG). The healthcare team closely monitored these patients during the transitional period from institutional to home care. During home visits, the nurse will comprehensively monitor the overall treatment and observe further if the patient has multiple medications. Consequently, this group of patients will be referred to pharmacists for pharmaceutical care via telepharmacy during the study period. Patients were eligible only if the remote contact via telephone or messaging application could be performed. Patients who were hospitalized and those lacking home medication information in their medical records were excluded from the study.

Telepharmacy protocol

Pharmaceutical care provided through telepharmacy consisted of three key components.

All pharmacists providing telepharmacy had completed the certified Telepharmacy Training Program accredited by the Pharmacy Council of Thailand. The service followed a national framework to ensure standardized practice and patient safety.

1) Medication review: pharmacists accessed patients' electronic medical records (EMRs) to review prescribed medications and identify potential risks associated with enteral drug administration. This review focused on identifying medications requiring special preparation or administration techniques for tube feeding, clinically significant drug–drug interactions (DDIs), and potential medications with known adverse drug reaction (ADR) profiles. Standardized drug information databases were applied to support clinical decision-making.

2) Pharmaceutical care through telepharmacy: Pharmacists directly conducted structured, two-way telephone interviews with caregivers or patients. The main goals of discussion were to review actual medication administration practices, confirm the compliance, assess any possible ADRs, and clarify issues related to drug preparation or incompatibility with enteral feeding. Each session began with pharmacist self-introduction as part of the healthcare team, verification of patient identity, and obtaining patient consent before consultation. Patients or caregivers' perspectives on difficulties or concerns in preparing medications for administration through a feeding tube were recorded. When necessary, pharmacists provided immediate counseling for management and collaborated with physicians or nurses to manage clinically urgent concerns. Share decision-making among teams regarding treatment rationale, therapeutic goals, and monitoring plan was made. Many telepharmacy consultations may be offered depending on the patient's ongoing pharmaceutical issues, scheduled medical appointments, or convenience. All recommendations made by pharmacists and staff responses were recorded.

3) Documentation and follow-up planning**:** all interventions, identified problems, and recommendations were documented systematically in EMRs. Follow-up schedules were planned based on the assessed severity and type of each DRP to ensure continuity of care.

Classification of drug-related problems

Since polypharmacy was common in this population, we may find more than one DRP per patient. Identified DRPs were categorized using the framework developed by Hepler, et al.[8] and Basger, et al[9] which classifies DRPs into nine categories: (1) untreated indications, (2) improper drug selection, (3) subtherapeutic dose, (4) failure to receive drugs, (5) overdose, (6) adverse drug reactions, (7) drug interactions, (8) drug use without indication, and (9) others, for causes that cannot be classified into one of the preceding eight categories. This classification provided a systematic approach for identifying and interpreting DRPs in the context of enteral nutrition, which often involves altered pharmacokinetics due to formulation manipulation (e.g., crushing tablets), drug–nutrient interactions, and tube site-specific absorption variability.

To ensure the accuracy and inter-rater reliability of DRPs

identification, a two-pharmacist validation process was employed. The first pharmacist conducted a comprehensive medication review using electronic medical records (EMRs) to summarize the patient's clinical status, medication list, potential DRPs, and preliminary care plan in the Home Health Care (HHC) patient record. The second pharmacist subsequently reviewed these findings, performed telepharmacy consultations with caregivers or patients, verified suspected DRPs, and finalized the classification and management plan. All identified DRPs, interventions, and follow-up actions were documented systematically in both the HHC records and hospital EMRs. This sequential review process enabled internal cross-validation of DRP identification and enhanced data reliability.

Medication reviews and classification decisions were based on current clinical guidelines and evidence-based resources. Standard references included **Lexicomp®** Drug Information Handbook, **Micromedex®,** Guides of drug administration via enteral feeding tubes[10-12], package inserts, case reports, published articles[13,14], and disease-specific practice guidelines.

Statistical analysis

Sample size calculation was based on the prevalence of medication errors in elderly patients with feeding tubes at home care settings were 93.4%[5]. Using a 95% confidence level (Z = 1.96) and a significant level of 0.05, the required sample size for this study was 90 patients. A purposive sampling technique was used. All data were entered into Microsoft Excel. Descriptive statistics were used to describe patient characteristics, the number of DRP events, the list of involved medications, and management by pharmacists. Means and standard deviations were calculated for continuous data, while frequencies and percentages were calculated for categorical data. The resolved rate is defined as the proportion of DRPs detected by a pharmacist and resolved by evidence review, or physician or healthcare team consultation, as well as share-decision making with patients/caregivers. The information is synthesized, and the patient receives problem-solving advice via telepharmacy. Unresolved DRPs refer to non-serious issues in which treatment outcomes or the likelihood of adverse events can be monitored, or problems that do not require urgent intervention. This approach protects patients from misinterpreting their treatment plan.

RESULTS

Of the 2,821 patients who received home visits from registered nurses and were referred to pharmacists for medication review, 90 patients were eligible. Most of them were females (63%) with average age 81.5±14.5 years (range from 1 year to 101 year) (Figure 1, Table 1). The most represented age group were 75 years and older (75.56%), and 60-74 years (18.89%). Hypertension, dyslipidemia, and diabetes were the most prevalent comorbidities. The route of administration was mainly NG tube (87%). During the study period, a total of 153 telepharmacy sessions were provided with a median number of 1 session per patient (min – max; 1 – 6 sessions).

Overall, pharmacists identified 189 DRPs, involving 207 medications (Table 2, Table 3) among 85 patients (94.44%). The most common drug categories of potential medications included gastrointestinal drugs (26.09%), cardiovascular drugs (9.18%), and micronutrients (7.25%). A detail of gastrointestinal drugs revealed that drug-related issues were predominant

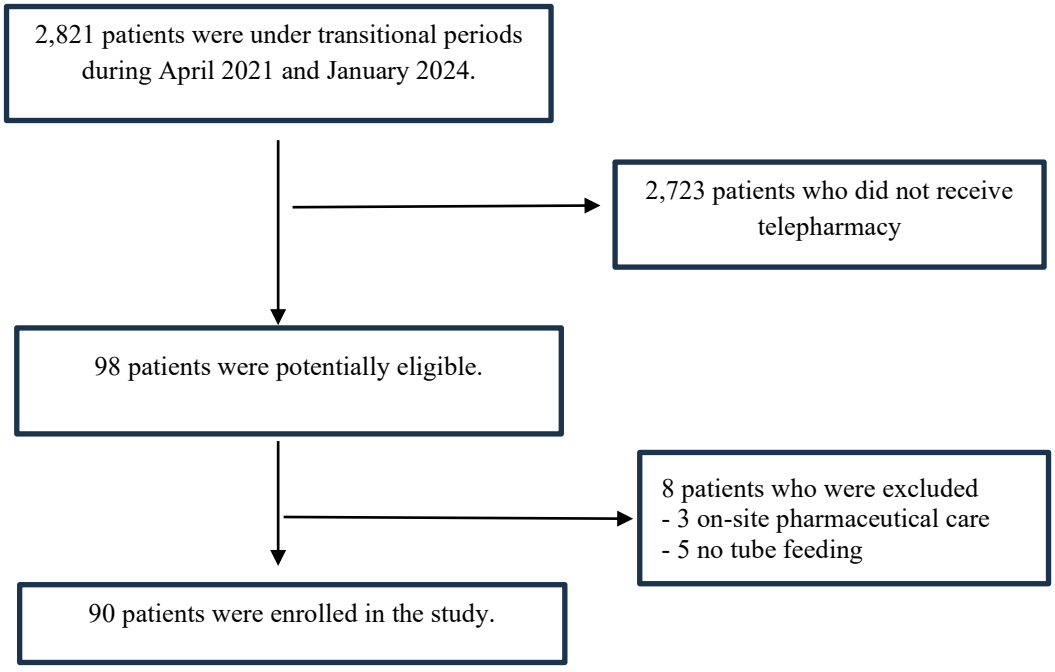

Figure 1. Flow diagram of patient enrollment in this study

Table 1. Demographic and clinical characteristics of participants receiving HEN and telepharmacy

Characteristics	Total (N = 90)	Percentage
Age (y): mean ± SD	81.5±14.5	
Gender (Male): no. (%)	33	37
Route of enteral administration: no. (%)		
Nasogastric feeding	78	87
Percutaneous endoscopic gastrostomy	12	13
Medical history: no. (%)		
Hypertension	70	78
Dyslipidemia	54	60
Diabetes mellitus	46	51
Stroke	41	46
Chronic kidney disease	36	40
Dementia	35	39
Anemia	31	34
Parkinson disease	23	26
Coronary artery disease	22	24
Gout/ Hyperuricemia	12	13
Asthma	8	9

Table 2. Classifications of potential medications with identified DRPs via telepharmacy

Drug categories (alphabetical order)	Numbers (N = 207)	Percentage
Antibiotics	13	6.28
Antithrombotics	13	6.28
Antidiabetics	7	3.38
Antipsychiatrics	8	3.86
Cardiovascular drugs	19	9.18
Gastrointestinal drugs	54	26.09
Genitourinary drugs	13	6.28
Lipid lowering agents	5	2.42
Micronutrients	15	7.25
Musculoskeletal drugs	5	2.42
Neurological drugs	13	6.28
Opioids	3	1.45
Oral anticancer drugs	12	5.80
Respiratory drugs	13	6.28
Other drugs	14	6.76

Table 3. Details of telepharmacy-identifying DRPs in HEN

Categories of DRPs and description	Number of identified DRPs (%) [N=189]	Resolved rate (%)
1. Untreated indications: The patient had a medical condition requiring drug therapy (indication presented), but was not currently receiving any medication for it.	16 (8.47)	14 / 16 (87.50)
2. Improper drug selection:		
a) The patient had a condition requiring precaution with the prescribed drug.	4 (2.12)	0 / 4 (0.00)
b) A drug was prescribed to the patient despite absolute contraindication.	5 (2.64)	3 / 5 (60.00)
c) Inappropriate or suboptimal dosage form of medications	18 (9.52)	13 / 18 (72.22)
3. Subtherapeutic dose: Patient had a medical problem for which the prescribed dose was too low.	2 (1.06)	2 / 2 (100.00)
4. Failure to receive drugs		
a) Inappropriate timing of administration and/or dosing intervals by patient or caregiver.	2 (1.06)	2 / 2 (100.00)
b) The patient received a lower dose than prescribed.	3 (1.59)	1 / 3 (33.33)
c) The patient chose to take a drug as needed instead of on a regular schedule.	2 (1.06)	2 / 2 (100.00)
d) The patient decided to stop taking medications without consulting their doctor.	16 (8.47)	11 / 16 (68.75)
e) The patient received a higher dose than prescribed.	4 (2.12)	3 / 4 (75.00)
f) The patient/caregiver forgot that drug had already been given, resulting in inadvertent medication duplication.	1 (0.53)	1 / 1 (100.00)
g) The wrong drug was selected, taken or administered.	1 (0.53)	1 / 1 (100.00)
h) The patient used the drug incorrectly due to difficulty, lack of knowledge, or insufficient information provided.	40 (21.16)	38 / 40 (95.00)
i) Inappropriate use/storage with unknown cause	3 (1.59)	3 / 3 (100.00)
5. Overdose: Drug dose was too high.	5 (2.65)	2 / 5 (40.00)
6. Adverse drug reactions		
a) A drug caused an undesirable reaction that was not dose related.	1 (0.53)	1 / 1 (100.00)
b) A drug caused an undesirable reaction at a normal therapeutic dose.	13 (6.88)	6 / 13 (46.15)

c) Allergic drug reaction	1 (0.53)	0 / 1 (0.00)
7. Drug interactions		
a) A drug interaction may cause/ causes an undesirable reaction by increasing the effect of one or both drugs.	6 (3.17)	1 / 6 (16.67)
b) A drug interaction may cause/ causes an undesirable reaction by decreasing the effect of one or both drugs.	10 (5.28)	8 / 10 (80.00)
8. Drug use without indication		
a) No (documented) apparent indication	2 (1.06)	1 / 2 (50.00)
b) No indication due to duplication of the active pharmaceutical ingredients	6 (3.17)	6 / 6 (100.00)
9. Others: A problem that cannot be classified into one of the eight categories		
a) No monitor data for drug effect/adverse effect (especially high alert drugs)	2 (1.06)	2 / 2 (100.00)
b) Drug order was incorrect/ incomplete/ poorly legible/illegible or discrepant (also known as transferring error).	13 (6.88)	10 / 13 (76.92)
c) Caregivers did not follow appropriate principles for handling hazardous medications.	2 (1.06)	2 / 2 (100.00)
d) Insufficient medication until the next visit (not due to healthcare provider)	3 (1.59)	1 / 3 (33.33)
e) No medicine was available in the hospital.	8 (4.23)	0 / 8 (0.00)

by proton pump inhibitors (37/207; 17.87%), and laxatives (10/207; 4.83%). Beta-blockers are the class of cardiovascular drugs most frequent DRPs (6/207; 2.90%). Among identified DRPs, "failure to receive drugs" was the most frequent (72/189; 38.10%), of which half were categorized as "the patient uses the drug incorrectly due to difficulty, lack of knowledge, or insufficient information provided," followed by "the patient chose to discontinue a drug without recommendations from healthcare provider". Examples of medications associated with these problems included crushed enteric-coated pellets of omeprazole or lansoprazole, high-viscosity lactulose, hard-to-crush calcium or micronutrient tablets, and improper preparation of imatinib (a hazardous drug). Such problems are primarily related to the knowledge and understanding of medication use and preparation techniques for administration via enteral feeding tubes.

The second most frequently identified DRP was improper drug selection (27/189; 14.28%), in which the main issue was the use of inappropriate or suboptimal dosage forms by the prescription errors. Prescribed medications found to be unsuitable for enteral tube feeding in this study included MR dosage forms (gliclazide MR, donepezil extended-release (ER), galantamine prolonged-release (PR), mirabegron PR, tamsulosin PR, theophylline sustained-release (SR)) or enteric-coated tablets (rabeprazole, pantoprazole, duloxetine). On the other hand, in our setting, melatonin and trimetazidine were unavailable in liquid or immediate-release dosage forms. The needs for medications had been confirmed through medical consultation, and it is inevitable to use melatonin PR or trimetazidine MR for administration via enteral feeding tube. Previous studies have indicated that melatonin can be safely crushed for tube feeding, provided that appropriate medication administration procedures were followed[15,16]. However, no report about the effects of splitting or crushing trimetazidine MR tablets was available; a consultation was made with the physician to confirm the medication use and ensure close monitoring. In this context, these DRPs were inevitable, and we classified these cases under "A problem that cannot be classified into one of the eight categories".

Drug interactions were also found in 8.47% (16/189), which causes an undesirable reaction by increasing or reducing the effect of the involved medications (Table 4). For example, ciprofloxacin was prescribed to take at the same time with calcium carbonate and ferrous fumarate supplementation. In this case, pharmacists advise such patients about dosage timing to ensure separation between ciprofloxacin and iron supplements (Table 4).

The other identified DRPs were untreated indications (16/189; 8.47%). All cases were related to missing therapy due to undetectable prescriptions in the system, which resulted in patients not receiving the appropriate medication for their conditions. This finding emphasizes the importance of comprehensive medication reconciliation and monitoring during transitions of care, particularly in the home setting. Other DRPs included subtherapeutic dosage (2/189; 1.06%), overdosage (5/189; 2.65%), adverse drug reactions (15/189; 7.94%) and drug use without indication (8/189; 4.23%). In addition, problems classified as "Others" (28/189; 14.81%) mainly involved incomplete or incorrect drug orders, insufficient medication supply, and inappropriate handling of hazardous drugs by caregivers. These cases highlight practical limitations in HEN and the need for close monitoring.

Pharmaceutical counseling and management via telepharmacy were essential in resolving DRPs in this study. The overall resolved rate by pharmacist intervention was 70.89% (134/189 DRPs). Most problems were managed by providing medication counseling to caregivers, clarifying drug administration techniques, correcting inappropriate dosage forms, and adjusting drug regimens in collaboration with physicians. High success rates were observed in categories of subtherapeutic dose (100%), improper use of medications (95%), and untreated indications (87.5%). However, some problems remained unresolved due to specific limitations. In certain cases, the issues were considered low clinical risk or associated with mild or uncertain symptoms. In other cases, resolution required adequate period of time to confirm the cause and clinical impact, the absence of safer therapeutic alternatives

Table 4. Identified drug interactions and management by pharmacists

Action	Drug pairs	Management
Possibility of increasing drug levels	Hypokalemia induced by hydrocortisone – furosemide	Monitoring electrolytes
	Hypercalcemia by calcium carbonate – calcium polystyrene sulfonate – Ketosteril®	Monitoring, later physician off calcium carbonate at the follow-up OPD
	Colchicine – carvedilol in advanced CKD and cirrhosis	Monitoring signs/symptoms of colchicine toxicity
	Colchicine – rosuvastatin in advanced CKD and cirrhosis	Monitoring any myotoxicity
	Edoxaban - amiodarone - verapamil (P-glycoprotein inhibitors) in CKD	Verifying dosage and monitoring for bleeding signs
	Hypersomnia induced by coadministration of quetiapine – mianserin – brexpiprazole	Advice for earlier psychiatric consultation
Possibility of reducing drug levels	Ciprofloxacin, levofloxacin, sitafloxacin – ferrous fumarate, calcium carbonate, or multi minerals	Advice to separate dosage timing
	Rivaroxaban – phenytoin (CYP3A4 inducer)	Physician consultation to modify the DOAC regimen
	Edoxaban – rifampin (CYP3A4 inducer)	Monitoring for atrial fibrillation-related complications
	Erlotinib – lansoprazole	Monitoring, separate dosage timing
	Imatinib – cholestyramine	Advice to separate dosage timing
	Pazopanib – lansoprazole, omeprazole	Physician consultation, then off proton pump inhibitors

Abbreviations: CKD, chronic kidney disease; CYP3A4, cytochrome P450 3A4; DOAC, direct oral anticoagulant; OPD, out-patient department

at the time, or further consultation with specialists. These findings highlight the value of telepharmacy services in optimizing pharmacotherapy and ensuring medication safety in HEN patients.

DISCUSSION

The implementation of telepharmacy for detecting DRPs in patients receiving HEN has demonstrated significant efficacy. The prevalence of DRPs in this population is notably high, often ranging from 50% to over 80% of patients, highlighting the complexity of managing medication alongside specialized nutrition and the critical need for pharmaceutical intervention[17-19]. In our study, the most frequently identified DRPs were categorized as inappropriate drug administration and suboptimal dosage regimens. Problems including crushing enteric-coated or MR formulations, or handling hazardous medications such as imatinib, were practical concerns that required careful consideration by both caregivers and healthcare professionals. These results underscore the importance of clear, practical guidelines to support safe and effective administration of medications in the HEN setting.

Beyond quantifying DRPs, our findings provide important implications for clinical practice in HEN. First, the high rate of problems related to improper dosage forms suggests that prescribers and pharmacists should adopt proactive medication reviews at both admission (during medication reconciliation) and discharge, with specific attention to formulation suitability for tube feeding. Developing a standardized checklist or protocol for drug administration via feeding tubes could reduce errors and provide caregivers with clear instructions. Second, the frequent identification of problems in drug preparation and administration underscores the need for structured caregiver education programs, focusing not only on how to prepare and administer medications but also on appropriate storage, timing, and recognition of potential adverse effects. It is also crucial to communicate clearly and at the proper language level for the audience. Telepharmacy offers a practical platform to reinforce this training, as it allows repeated counseling and timely clarification of concerns without requiring hospital visits.

Another key finding is that nearly 30% of identified DRPs remained unresolved, often due to systemic barriers such as unavailable dosage forms, limited therapeutic alternatives, or the need for specialist consultation. These challenges suggest that collaborations across disciplines (e.g., physicians, nurses, and pharmacists) are essential to address unresolved issues. For example, establishing a communication loop between hospital and community pharmacies could improve access to alternative formulations or compounded preparations when standard products are unsuitable. Integrating pharmacists into outpatient care teams by telepharmacy plays a pivotal role in identifying and managing DRPs through proactive medication review and individualized counseling. Similarly, integrating telepharmacy documentation into the EMR may support continuity of care by ensuring that all team members are informed of identified issues and pharmacist recommendations.

While the specific number and type of DRPs vary depending on study design, patient population, and assessment criteria, several key findings are consistently reported in the literature, including patients' education, correct medication prescription and continuous monitoring. Telepharmacy is an effective strategy for reducing DRPs in home care. Studies consistently show that proactive telepharmacy interventions can lead to a substantial reduction in DRPs. Pharmacists providing teleconsultations and individualized care plans have successfully identified and resolved most of these problems, with resolution rates often exceeding 70%. This demonstrates the clear value of a pharmacist's expertise in this specialized

area[20,21].

Nonetheless, some DRPs remained unresolved, largely due to factors beyond immediate pharmacist management. These included issues considered to be of low clinical risk. For example, the crushing and administration of melatonin PR tablets that are technically "should not be crushed", but evidence suggested safe protocols for administration via feeding tube[15,16]. Some cases required longer follow-up to clarify causality and clinical impact. For example, a patient with adrenal insufficiency and hypokalemia who was monitored with potassium supplementation, while physician consultation was planned for hydrocortisone dose adjustment or addition of spironolactone if serum potassium < 3 mEq/L.

Additional unresolved problems from the absence of safer or more appropriate therapeutic alternatives, such as trimetazidine MR (no immediate-release formulation available in Thailand), and the need for consultation with other specialists. There was a patient with paroxysmal atrial fibrillation who ran out of apixaban originally prescribed at another hospital; the pharmacist advised the caregiver to contact their physician to verify the continued indication, recommended monitoring and cardiologist consultation, the problem remained unresolved due to limited authority to modify therapy or follow-up schedule cardiologist. Such limitations emphasize that, although pharmacist intervention can address the majority of DRPs, certain challenges in HEN management are systemic and require broader solutions.

The supportive components of sustaining telepharmacy services require executive support with careful consideration of workload and long-term feasibility (Figure 2). Remote consultations, medication reviews, and structured follow-up inevitably add responsibilities to pharmacists, who are often already managing high workloads of inpatient and outpatient care. Without adequate workforce support, financial resources, and organizational infrastructure, the expansion of telepharmacy may not be sustainable in routine practice[19,22]. Ensuring service continuity will therefore require established policies, including clear allocation and development of personnel, financial support, and health information systems such as integrating documentation into EMRs to reduce duplication of work. Legal approval and standardized medical technology for remote counseling should be developed to ensure the protection of patients' privacy and confidentiality. Those components can serve as a foundation for the future establishment of telepharmacy in home care settings.

The strengths of this study are a real-world home care setting applying the structured documentation of DRPs and pharmacist interventions. It can guarantee reliability and accuracy of data collection. We focused on a highly vulnerable population requiring medication administration via tube feeding at home, who are often left understudied. This study highlighted the need for proactive medication reviews and the existing communication gap between patients/caregivers and pharmacists. The limitations presented as sample size at a single hospital may reduce the generalizability of the findings to other settings. Selection bias may also exist, as patients referred by nurses for telepharmacy consultation, which may overrepresent complex cases and might not fully represent the overall HEN population. In addition, incomplete or inconsistent documentation in EMRs could have led to underestimation of DRPs identified during follow-up. Reported data during telepharmacy relied on patient/caregiver reporting, which may be affected by recall bias or incomplete information. Suggested areas for future studies include conducting multicenter research with larger populations and evaluating patient-

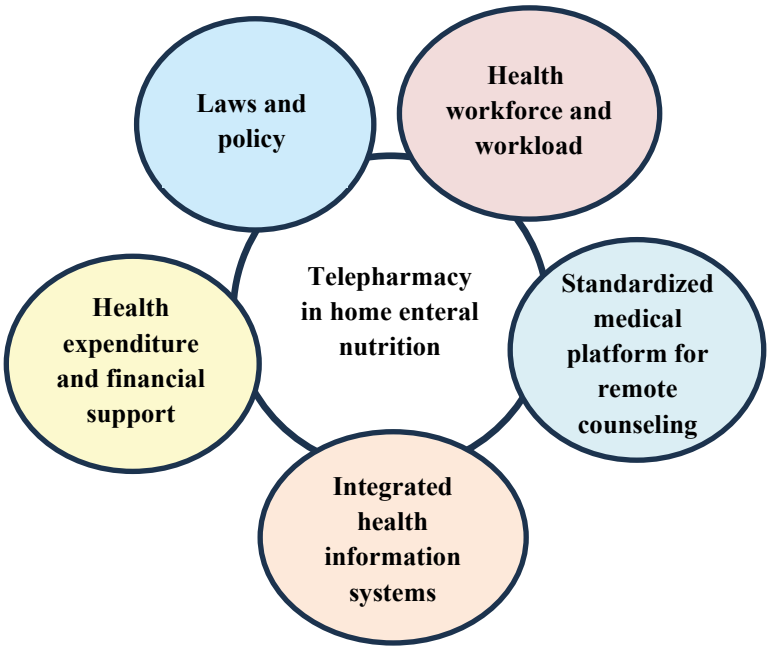

Figure 2. Factors that may affect the feasibility and sustainability of telepharmacy implementation in Home Enteral Nutrition

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centered outcomes such as quality of life, hospital readmission rates, and long-term safety. Furthermore, the development of standardized guidelines for medication administration in HEN patients would provide essential support for both caregivers and healthcare professionals in minimizing preventable DRPs.

CONCLUSION

Telepharmacy is a highly effective method for identifying and resolving DRPs in patients on HEN. Proactive pharmacist intervention through telepharmacy significantly improves medication safety and patient outcomes in this vulnerable population. These findings demonstrate the important role of pharmacists in supporting caregivers, improving medication safety, and ensuring continuity of care during the transition from hospital to home. Although some challenges remain unresolved due to system-level constraints or the absence of safer therapeutic alternatives, the results suggest that integrating telepharmacy into routine HEN management can significantly enhance patient safety. Future efforts should focus on multicenter studies, the evaluation of long-term patient-centered outcomes, and the establishment of standardized practice guidelines to further strengthen pharmaceutical care in this vulnerable population.

AUTHOR'S CONTRIBUTION

Thewa Chungwatanakit: Conceptualization, Investigation, Methodology, Data acquisition, Formal analysis, Data interpretation, Resources, Writing – original draft.

Benjapa Supina: Conceptualization, Investigation, Resources.

Tippawan Siritientong: Conceptualization, Methodology, Data Curation, Formal analysis, Data interpretation, Supervision, Validation, Writing – original draft, Writing – review and editing. All authors have approved of the version to be published in the journal.

CONFLICTS OF INTEREST

The authors declare that they have no potential conflicts of interest with respect to the research.

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