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Original Article

# Prescribing and Transcribing Problems in Electronic Pediatric Compounded Prescriptions: A Descriptive Study in Outpatient and Inpatient Services at Hospital X

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**Abstract**

**Background**: Accurate prescription information supports safe review and preparation of pediatric compounded medicines, particularly during transfer between prescribing and pharmacy systems.

**Objective**: This study aimed to describe the profile of electronic pediatric compounded prescriptions and descriptively compare the proportions and distributions of identified prescribing and transcribing problems between outpatient and inpatient services at Hospital X.

**Methods**: A descriptive, retrospective observational study was conducted using pediatric compounded prescriptions recorded in e-Calyptus from January to December 2025. Using purposive sampling, 488 prescriptions were included (216 outpatient, 272 inpatient). Prescribing problems were assessed using predefined administrative, pharmaceutical, and specified clinical prescription-review criteria. Transcribing problems were identified by comparing e-Calyptus records with corresponding Buana entries; only problems newly introduced during information transfer were counted.

**Results**: Most prescriptions involved children aged five years or younger, contained a single medication item, and were prepared as divided powders. At least one prescribing problem was identified in 99.54% of outpatient and 69.12% of inpatient prescriptions. Newly introduced transcribing problems occurred in 37.50% and 25.00%, respectively. Multiple concurrent prescribing problems per prescription were more frequent in outpatient care. Prescribing problems most often involved missing dosage form and route of administration, while transcribing problems mainly involved dose information, dosing instructions, and dosage form.

**Conclusion**: Pediatric compounded prescription records show documented problems in source prescriptions and during subsequent information transfer. Differences between outpatient and inpatient services are descriptive and do not establish causal effects of care setting. These findings support improving prescription completeness, cross-system information consistency, and systematic prescription verification.

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## INTRODUCTION

Complete and accurate prescription information supports the review and preparation of medicines and contributes to patient safety. In Indonesia, Regulation of the Minister of Health Number 72 of 2016 requires pharmacists to assess administrative, pharmaceutical, and clinical requirements for prescriptions in both outpatient and inpatient services. These requirements encompass patient and prescriber information, medicine name, dosage form and strength, dose, quantity, stability, instructions for use, and clinical considerations such as dose appropriateness, therapeutic duplication, contraindications, and drug interactions. This framework provides a basis for assessing prescription information using explicitly defined criteria.[1] Pediatric compounded prescriptions require particular attention because commercially available preparations may not provide suitable doses or dosage forms for individual children. A narrative review by Yuliani et al. identified formulation information, stability, and compatibility as important challenges in extemporaneous preparation for pediatric patients in developing countries.[2] Individualized dose calculations and adjustments related to body weight and prematurity further complicate pediatric prescribing, as discussed by D'Errico et al.[3] Compounding is also relevant to Indonesian practice. In an observational study of 666

prescriptions requiring compounding at an Indonesian hospital, Yuliani et al. described frequently prescribed divided-powder formulations and assessed potential instability and incompatibility using literature-based information.[4] Together, these findings support documenting prescription profiles alongside assessing the information needed to review individual compounded preparations.

Electronic prescribing provides a structured means of recording medication instructions, but the availability of an electronic system does not ensure that its functions adequately support pediatric prescribing. Gildon et al. evaluated three electronic health record systems used in pediatric clinics and identified limitations in their implementation of recommended pediatric prescribing functions. [5] In a systematic review, Tolley et al. identified inadequate dosing support, inappropriate alerts, dropdown-menu selection, and system design as contributors to problems with computerized order entry in pediatrics.[6] A more recent systematic review by Ruutiainen et al. highlighted dose-range checking, dose calculators, and dosing-frequency checks among the clinical decision support functions evaluated in pediatric settings, while emphasizing the importance of system customization and usability.[7]

Empirical studies demonstrate why specific prescribing parameters require continued assessment within electronic workflows. In an Australian pediatric referral hospital, Westbrook et al. documented problems involving dose, route, frequency, and duplicate therapy during an evaluation of an electronic medication management system. [8] n an Irish pediatric intensive care unit, Howlett et al. found that the pattern of prescribing problems changed following technology implementation: problems involving lack of clarity, incomplete orders, and incorrect units were reduced, whereas dosing, altered-order, and duplicate-order problems increased.[9] In outpatient primary care in Guangzhou, Tan et al. identified problems involving dose selection, prescribing indications, dosing frequency, and formulation in electronic pediatric prescriptions.[10] Separately, Brennan-Bourdon et al. documented problems involving abbreviations and prescribed administration rates in pediatric critical care services in Mexico.[11] These findings illustrate that electronic systems may redistribute rather than remove prescribing problems, and that individual parameters therefore warrant examination within their respective service settings.

For compounded preparations, the representation and exchange of information between prescribing and pharmacy systems introduce additional requirements. Parrish et al. described an expert-panel initiative to standardize the identification and electronic exchange of compounded nonsterile preparations across health information systems.[12] A subsequent United States Pharmacopeia expert-panel perspective emphasized the need for interoperable information on formulation ingredients, concentrations, and compounding instructions.[13] These publications provide a conceptual basis for examining whether information describing a compounded preparation is sufficiently represented in the records used by prescribers and pharmacy personnel.

The quality of prescription information also warrants attention during pharmacy transcription. In a retrospective study at a US mail-order pharmacy, Zheng et al. compared electronic prescription directions with the corresponding transcribed directions. Pharmacy personnel corrected many existing deficiencies, although some remained and additional problems were introduced during transcription.[14] A scoping review by Farghali and Borycki similarly identified missing information, incomplete directions, and problems involving dose, quantity, and dosage form as reasons for pharmacist intervention when processing electronic prescriptions in community pharmacies.[15] These findings support examining the information available in pharmacy records as a distinct component of the prescription workflow.

Published findings require interpretation in relation to study populations, service settings, definitions, and assessment methods. Hannibal et al. identified variation in the types of prescribing problems and methodological limitations across studies of pediatric care, including differences in operational definitions, and reported that the most frequently documented problem type differed between inpatient and outpatient settings.[16] Accordingly, comparisons between outpatient and inpatient services within one institution should use explicitly defined assessment criteria and clearly specified denominators. A descriptive comparison can identify differences in documented problem percentages without attributing those differences to the service setting itself.

At Hospital X, pediatric compounded prescriptions are recorded in e-Calyptus, with corresponding prescription information documented in the Buana pharmacy system. This workflow provides an opportunity to assess both source prescriptions and the associated pharmacy records. In this study, prescribing problems refer to checklist-identified deficiencies in prescription information and specified pharmaceutical and clinical prescription-review parameters assessed against predefined criteria and references. Transcribing problems refer to problems newly introduced during the transfer of prescription information from e-Calyptus to Buana, whereby information appropriately documented in the source prescription became missing, incomplete, unclear, or inconsistent in the pharmacy record. Problems already

present in e-Calyptus and subsequently carried forward unchanged into Buana were not counted again as transcribing problems.

The studies discussed above provide evidence on pediatric prescribing, compounded preparation information, and pharmacy transcription in different contexts. However, they do not directly establish the prescription profiles or distribution of prescribing and transcribing problems within the e-Calyptus and Buana workflow at Hospital X. The specific evidence gap addressed here is therefore contextual: the need for a combined description of pediatric compounded prescription profiles and stage-specific problems across the hospital's outpatient and inpatient services. The study's contextual novelty lies in bringing these elements together within one institution and applying the same stage-specific assessment criteria across both service settings. Accordingly, this study aimed to describe the profile of electronic pediatric compounded prescriptions recorded in e-Calyptus and compare descriptively the percentages and distributions of identified prescribing and transcribing problems between outpatient and inpatient services at Hospital X. The findings are intended to provide a local evidence base for prioritizing improvements in prescription documentation, information transfer, and pharmacy verification.

## METHODS

**Study Design and Setting**

This study was a descriptive observational study employing retrospective data collection. The study was conducted at the Pharmacy Installation of Hospital X, Serang, Banten, from January to March 2026. This period encompassed data collection, processing, and analysis. The study data comprised electronic prescriptions for pediatric compounded medications, prescribed via the e-Calyptus system between January and December 2025. The study was undertaken to describe the profile of pediatric compounded prescriptions and to descriptively compare the proportions and distributions of identified prescribing and transcribing problems at the prescribing and transcribing stages between the outpatient and inpatient units.

**Population and Sample**

The study population comprised all pediatric compounded medication prescriptions issued via the e-Calyptus system at the outpatient and inpatient units of Hospital X between January and December 2025, totaling 1,320 prescriptions. This population comprised 469 outpatient prescriptions and 851 inpatient prescriptions. The sample size was determined separately for each care unit using the Slovin formula with an error parameter (e) of 0.05, yielding rounded sample sizes of 216 outpatient prescriptions and 272 inpatient prescriptions. The sample size for each unit was then allocated proportionally across all 12 months according to each month’s share of the annual prescription population within that unit. Monthly sample allocations were calculated by multiplying this proportion by the unit-specific sample size, with final monthly allocations totaling 216 outpatient prescriptions and 272 inpatient prescriptions. The Slovin formula was used to determine the planned sample size, whereas prescriptions were selected purposively based on predefined inclusion and exclusion criteria. The parameter e = 0.05 was used in the calculation and does not establish that an actual sampling margin of error of 5% was achieved for the purposively selected sample.

A total of 488 prescriptions were included in the study, comprising 216 prescriptions from the outpatient Pediatric Clinic and 272 prescriptions from the inpatient units, encompassing the pediatric inpatient ward, the Perinatology/Neonatal Ward, the NICU, and the ICU. The included prescriptions covered all 12 months of 2025 in both outpatient and inpatient units. The prescription was the unit of sampling and analysis. After medical record number formats were standardized, the outpatient sample comprised 191 unique medical record numbers, whereas the inpatient sample comprised 254 unique medical record numbers. Multiple prescriptions sharing the same medical record number were retained in the prescription-level analysis. Therefore, prescription counts should not be interpreted as counts of unique patients.

Inclusion criteria comprised prescriptions for pediatric patients aged 0–12 years, containing oral compounded medication, with patient name and medical record number recorded in the system, issued by a pediatric specialist, prescribed electronically via the e-Calyptus system, and issued between January and December 2025. Exclusion criteria comprised non-oral compounded prescriptions, such as ointments and mouthwashes; prescriptions inaccessible within the system; and prescriptions not prepared by staff or not collected by the patient.

**Research Instrument**

The research instrument consisted of a data collection checklist developed with reference to Regulation of the Minister of Health of the Republic of Indonesia Number 72 of 2016 concerning Pharmaceutical Service Standards in

Hospitals and relevant pediatric medication references. The instrument was used to record the prescription profile and to identify prescribing and transcribing problems. Each parameter was assessed dichotomously, with a score of 1 assigned when a predefined problem was identified and a score of 0 when no problem was identified.

Prescription profile data encompassed the care unit, patient age group and sex, recorded diagnosis category, number of medication items within the compounded preparation, and dosage form. Patient body weight and other available prescription information were additionally reviewed when required for assessment of specific prescribing parameters. Prescribing problem parameters comprised prescriber name, practice license number, prescriber authentication, patient name, medical record number, date of birth or age, sex, patient body weight, drug name, concentration or preparation strength, dose administered, dosing instructions, dose unit, dosage form, route of administration, dose appropriateness, dosing-frequency appropriateness, drug incompatibility, and potential drug interactions. Transcribing problem parameters comprised the consistency of patient name, age, medical record number, drug name, dose administered, dosing instructions, route of administration, and dosage form.

Dose appropriateness was assessed by comparing the prescribed dose, based on the available patient age, body weight, recorded diagnosis, and prescribed dosing regimen, against the applicable pediatric dosing recommendations provided in the *British National Formulary for Children 2023–2024*, the *Pediatric & Neonatal Dosage Handbook* 2021, the Indonesian National Clinical Practice Guideline for Tuberculosis, relevant World Health Organization guidance, MIMS Indonesia, Martindale: The Complete Drug Reference, and medicine-specific prescribing information where applicable. The dosing basis followed the applicable medicine-specific recommendation, including mg/kg per dose, mg/kg per day, or an age-based absolute dose, as appropriate. Doses were categorized as below the recommended range when below the applicable lower limit and as above the recommended range when exceeding the applicable upper limit or recommended maximum dose. Where body weight was required for a weight-based assessment but was unavailable in the prescription record, dose appropriateness could not be confirmed; missing body weight was recorded separately as a prescribing problem. The dose assessment was limited to determining whether the recorded dose was within or outside the applicable recommended range and was not intended as a comprehensive assessment of therapeutic appropriateness.

Potential drug interactions were screened using Stockley's Drug Interactions, Micromedex Drug Interactions, and the Drugs.com Drug Interaction Checker. For the present analysis, potential drug interactions were recorded dichotomously as present or absent; interaction severity and the clinical significance of individual interaction pairs were not analyzed as separate study outcomes. Transcribing problems were assessed by comparing the original prescription information recorded in the e-Calyptus system with the corresponding information entered into the Buana pharmacy information system. A transcribing problem was recorded only when information that was available and appropriately documented in e-Calyptus became missing, incomplete, unclear, or inconsistent in Buana. Problems already present in the e-Calyptus prescription and subsequently carried forward unchanged into Buana were regarded as propagated prescribing problems and were not counted again as newly introduced transcribing problems.

**Research Procedure**

Data collection began with the identification of pediatric compounded prescriptions recorded in the e-Calyptus system between January and December 2025. Prescriptions were screened according to the predefined inclusion and exclusion criteria, and eligible prescriptions were selected using the sampling procedure described above. Information from each included prescription was then recorded on the structured data-collection checklist, including the prescription-profile variables and the predefined prescribing and transcribing parameters.

Assessment of prescribing problems was conducted using the original prescription information recorded in the e-Calyptus system. Administrative, pharmaceutical, and specified clinical prescription parameters were assessed according to the predefined criteria described in the research instrument. Dose appropriateness was assessed using the applicable pediatric dosing reference, while potential drug interactions were screened using the specified drug-interaction references. Each prescribing parameter was recorded separately, and a prescription could contain more than one type of prescribing problem.

Assessment of transcribing problems was conducted by comparing the information recorded in the physician's prescription within the e-Calyptus system with the corresponding information entered into the Buana pharmacy information system. A transcribing problem was recorded only when information that was available and appropriately documented in e-Calyptus became missing, incomplete, unclear, or inconsistent in Buana. Problems already present in the e-Calyptus prescription and subsequently carried forward unchanged into Buana were regarded as propagated prescribing problems and were not counted again as newly introduced transcribing problems. Information that had

been incomplete in e-Calyptus but was completed or corrected in Buana was likewise not recorded as a transcribing problem.

Following the assessment**,** findings were recorded at both the parameter and prescription levels. At the parameter level, the number of identified prescribing and newly introduced transcribing problems was recorded separately for each assessed parameter in the outpatient and inpatient units. At the prescription level, the number of different prescribing or transcribing problems identified within each prescription was recorded, together with whether the prescription contained at least one identified problem. These data were subsequently used to describe the distribution of prescribing and transcribing problems and to descriptively compare the findings between outpatient and inpatient care.

**Ethical Clearance**

This study obtained ethical clearance from the Research Ethics Committee, Research Institute of YARSI University, under Approval Number 033/KEP-UY/EA.10/II/2026, dated 25 February 2026, given that the study involved pediatric patient medical record data. Patient confidentiality was maintained throughout the research process, and the data were used solely for the purposes of this study, in accordance with the biomedical research ethics principles of respect for persons, beneficence, and justice.

**Data Analysis**

Data were analyzed descriptively using Microsoft Excel. Prescription characteristics were summarized using frequencies and percentages. Prescribing and transcribing problems were analyzed separately for the outpatient and inpatient care units. For each prescribing parameter, the number of prescriptions in which the problem was identified was divided by the total number of prescriptions in the corresponding care unit (outpatient, $N = 216$; inpatient, $N = 272$) and expressed as a percentage. The same denominator was used for each newly introduced transcribing-problem parameter. Because a prescription could contain more than one problem, parameter-level percentages were not summed to estimate the proportion of prescriptions with at least one problem. At the prescription level, the number of different prescribing and newly introduced transcribing problems identified in each prescription was calculated. The number and percentage of prescriptions containing at least one problem, as well as the distribution according to the number of problems per prescription, were then determined separately for outpatient and inpatient care. The total number of parameter-level problem occurrences was also divided by the total number of prescriptions within each care unit to describe the average number of identified problems per prescription. Comparisons between outpatient and inpatient prescriptions were descriptive. No inferential statistical tests were performed; therefore, differences in percentages between the two care units were not interpreted as statistically significant differences.

## RESULT AND DISCUSSION

**Profile of Pediatric Compounded Prescriptions**

This study used secondary data comprising electronic prescriptions for pediatric patients issued via the e-Calyptus system at the outpatient and inpatient units of Hospital X between January and December 2025. From a population of 1,320 pediatric compounded prescriptions, a combined sample of 488 prescriptions meeting the study criteria was obtained, comprising 216 outpatient prescriptions and 272 inpatient prescriptions. The prescription profile analyzed encompassed care unit, age group, sex, number of medication items within the compounded preparation, and dosage form, as presented in **Table 1.**

By care unit, pediatric compounded prescriptions originated predominantly from the pediatric inpatient unit, accounting for 222 prescriptions (45.49%), followed by the outpatient Pediatric Clinic with 216 prescriptions (44.26%), the Perinatology/Neonatal unit with 48 prescriptions (9.84%), and the NICU and ICU with 2 prescriptions (0.41%). Overall, prescriptions from the inpatient units, comprising the pediatric inpatient ward, Perinatology/Neonatal ward, NICU, and ICU, totaled 272 prescriptions (55.74%), whereas prescriptions from the outpatient unit totaled 216 prescriptions (44.26%). The high number of pediatric compounded prescriptions from the inpatient unit may also be explained by the duration of hospitalization, during which patients received drug therapy daily throughout the period of care. This finding is consistent with that of Takele et al. (2024), who reported that length of hospital stay is an independent predictor of drug therapy problems in hospitalized pediatric patients, indicating a higher intensity of drug exposure during the period of care.[17] As individual patients could contribute more than one prescription, the higher number of inpatient prescriptions cannot be used to infer a greater need for compounded medicines per patient in inpatient care than in outpatient care.

**Table 1.** Profile of pediatric compounded prescriptions within the e-Calyptus system

| Characteristics | Category | n | % |
|---|---|---|---|
| **Care Unit** | | | |
| Outpatient | Pediatric Outpatient Clinic | 216 | 44.26 |
| Inpatient | Pediatric Inpatient Ward | 222 | 45.49 |
| | Perinatology/Neonatal Ward | 48 | 9.84 |
| | Nicu+Icu | 2 | 0.41 |
| **Age group** | | | |
| | 0–1 year old | 223 | 45.70 |
| | 2–5 years old | 178 | 36.48 |
| | 6–12 years old | 87 | 17.83 |
| **Sex** | | | |
| | Male | 281 | 57.58 |
| | Female | 207 | 42.42 |
| **Items in compounded preparation** | | | |
| | 1 item | 332 | 68.03 |
| | 2 items | 139 | 28.48 |
| | ≥3 items | 17 | 3.48 |
| **Dosage form** | | | |
| | Divided powders | 464 | 95.08 |
| | Capsule | 24 | 4.92 |

By age group, compounded prescriptions were issued predominantly to patients aged 0–1 year, accounting for 223 prescriptions (45.70%), followed by the 2–5-year age group with 178 prescriptions (36.48%) and the 6–12-year age group with 87 prescriptions (17.83%). The predominance of the infant and toddler groups is related to the limited availability of commercial preparations in appropriate forms and doses. In children aged six years and above, drug doses can generally be adjusted more readily without a compounding process, for example by dividing tablets according to the therapeutic requirement. Commercially available pediatric formulations remain limited, particularly for the neonatal and infant groups, such that compounding is frequently required to provide an appropriate dose and dosage form.[18] A study conducted in primary healthcare services in Indonesia likewise demonstrated that pediatric patients aged 0–5 years constituted the group most frequently receiving compounded preparations, with divided powders as the predominant dosage form.[2]

Prescriptions issued to male patients predominated in the sample, accounting for 281 prescriptions (57.58%), whereas prescriptions issued to female patients totaled 207 (42.42%). The difference in prescription counts was greater in inpatient care (163 for male patients versus 109 for female patients) than in outpatient care (118 versus 98). Among records labelled solely as acute respiratory tract infection (ARI) or pneumonia, absolute counts were also higher for male patients. However, the proportions within each sex were relatively close: 25.98% versus 25.12% for ARI and 11.39% versus 10.63% for pneumonia, respectively. A study of pediatric patients with lower respiratory tract infection likewise found a higher proportion of male patients compared with female patients.[19] A similar finding was reported in an 11-year analysis conducted at a tertiary hospital, which demonstrated a higher incidence of respiratory viral infection among males, particularly within the infant and young child groups.[20] These studies provide contextual comparisons of male predominance, although their populations and outcomes differ from those of the present study. The findings in this study describe the composition of the prescription sample and do not establish that respiratory diagnoses explain the higher number of prescriptions issued to male patients or that male patients have a greater need for compounded medicines.

By number of medication items, the majority of prescriptions contained a single item (68.03%; n=332), followed by two items (28.48%; n=139) and three or more items (3.48%; n=17). The predominance of single-item compounded preparations may reflect their use in adjusting individual doses according to body weight or body surface area when a commercially appropriate preparation strength is unavailable.[21] However, a low number of items does not in itself demonstrate prescription rationality, as the appropriateness of indication, dose, frequency, and drug compatibility still requires assessment. Divided powders (*pulveres*) constituted the most frequently used dosage form (95.08%; n=464), whereas capsules accounted for only 4.92% (n=24). The predominance of divided powders is consistent with pediatric compounding practice in Indonesia and may be related to the difficulty experienced by infants and toddlers in swallowing tablets or capsules, as well as the limited availability of appropriate commercial preparations.[2,21] The

processes of crushing, mixing, and dividing powders must nonetheless be conducted in a standardized manner to ensure homogeneity and dose accuracy.[1]

**Prescribing Problems**

Prescribing problems were assessed in 488 pediatric compounded prescriptions using the checklist described in the Methods, which covered nineteen prescribing parameters across administrative, pharmaceutical, and clinical requirements. For each parameter, percentages were calculated as the number of prescriptions with an identified problem divided by the total number of prescriptions in the corresponding care unit: 216 outpatient prescriptions or 272 inpatient prescriptions. Each prescription was counted once per parameter but could contribute to multiple parameters; the parameter-level percentages therefore cannot be added to obtain the proportion of prescriptions with at least one identified prescribing problem, which is presented in **Table 4**. No problems were recorded in either care unit for seven parameters: prescriber name, practice license number, prescriber authentication, patient name, medical record number, date of birth or age, and sex. These parameters are therefore not tabulated; **Table 2** presents the twelve parameters for which at least one problem was identified. As shown in **Table 2**, the most frequent outpatient findings were missing dosage form (84.26%; n=182) and route of administration (81.94%; n=177), followed by potential drug interactions (54.63%; n=118), missing patient body weight (53.24%; n=115), and incorrect or missing dose unit notation (50.00%; n=108). Among inpatient prescriptions, the most frequent findings were missing route of administration (47.06%; n=128) and dosage form (42.28%; n=115), followed by dose inappropriateness (14.71%; n=40), potential drug interactions (14.34%; n=39), and incorrect or missing dose unit notation (11.40%; n=31).

**Table 2.** Distribution of prescribing problems in outpatient and inpatient compounded prescriptions

| Parameter | Outpatient | | Inpatient | |
|---|---|---|---|---|
| | n | % | n | % |
| Missing dosage form | 182 | 84.26 | 115 | 42.28 |
| Missing route of administration | 177 | 81.94 | 128 | 47.06 |
| Potential Drug interaction | 118 | 54.63 | 39 | 14.34 |
| Missing patient body weight | 115 | 53.24 | 7 | 2.57 |
| Incorrect or missing dose unit notation | 108 | 50.00 | 31 | 11.40 |
| Missing concentration/preparation strength | 92 | 42.59 | 23 | 8.46 |
| Dose inappropriateness | 39 | 18.06 | 40 | 14.71 |
| Drug incompatibility | 7 | 3.24 | 10 | 3.68 |
| Missing/incorrect dosing instructions | 6 | 2.78 | 0 | 0.00 |
| Missing/incomplete dose administered | 2 | 0.93 | 1 | 0.37 |
| Dosing frequency inappropriateness | 2 | 0.93 | 0 | 0.00 |
| Incorrect/unclear drug name | 1 | 0.46 | 0 | 0.00 |

Missing dosage form and route of administration were common documentation problems in both care units. However, the present study did not establish whether these omissions were attributable to system configuration, manual data-entry practices, or other aspects of the prescribing workflow. A quality improvement study in a pediatric intensive care unit reported that the proportion of formally complete prescriptions increased from 5% before implementation of computerized physician order entry (CPOE) to 47% after implementation. In that system, dosing interval and route of administration were present in all electronic prescriptions because both were configured as compulsory fields.[22] This finding provides context for considering improvements to electronic prescription documentation, but does not establish the cause of the omissions observed in the e-Calyptus prescriptions reviewed here.

The proportion of prescriptions with an identified problem was higher in outpatient than in inpatient care for eleven of the twelve parameters presented in **Table 2**. Drug incompatibility was the only parameter with a higher inpatient proportion (3.68% in inpatient care versus 3.24% in outpatient care). These comparisons are descriptive; no inferential statistical testing was performed, and the observed differences should therefore not be interpreted as statistically significant differences between the two care units. Examples of higher outpatient proportions included missing patient body weight (53.24% versus 2.57%), potential drug interactions (54.63% versus 14.34%), incorrect or missing dose unit notation (50.00% versus 11.40%), and missing concentration or preparation strength (42.59% versus 8.46%). These differences do not establish their underlying causes, as differences in documentation practices and prescribing workflows were not evaluated. For dose assessment, missing body weight limited evaluation where the reference recommendation required a weight-based calculation; therefore, the absence of identified dose inappropriateness should not be interpreted as confirmation that the dose was appropriate. Problems involving dosing

instructions, missing or incomplete dose administered, dosing frequency, and drug names also warrant review despite their lower recorded frequencies. The findings identify documentation fields that warrant particular attention during prescription review. Mandatory fields, validation checks, and pharmacist verification, with clarification from prescribers when necessary, could be considered as potential improvements, with their suitability and effects assessed in the local prescribing workflow.

**Transcribing Problems**

Transcribing problems were identified by comparing the information recorded in the physician's prescription within the e-Calyptus system with the corresponding information entered into the Buana pharmacy information system. For this analysis, a transcribing problem was counted only when information that was available or appropriately documented in e-Calyptus became missing, incomplete, unclear, or inconsistent in Buana. Problems already present at the prescribing stage and subsequently carried forward into Buana were not counted again as newly introduced transcribing problems. This distinction is consistent with the approach used by Ab Rahman et al., who defined transcribing errors as errors arising during the interpretation, verification, and transfer of medication-order information and specifically excluded errors originating during the prescribing process.[23] Each prescription could contain more than one transcribing problem; therefore, percentages for individual parameters should not be summed to represent the proportion of prescriptions with at least one transcribing problem.

**Table 3.** Distribution of transcribing problems on outpatient and inpatient compounded prescriptions

| Parameter | Outpatient | | Inpatient | |
|---|---|---|---|---|
| | n | % | n | % |
| Incomplete/missing dose administered | 79 | 36.57 | 30 | 11.03 |
| Incomplete/unclear dosing instructions | 13 | 6.02 | 40 | 14.71 |
| Incomplete/missing dosage form | 3 | 1.39 | 15 | 5.51 |
| Incomplete/missing route of administration | 0 | 0.00 | 3 | 1.10 |
| Incomplete/missing drug name | 0 | 0.00 | 0 | 0.00 |

As shown in **Table 3**, the most frequently identified transcribing problem among outpatient prescriptions was incomplete or missing dose information, occurring in 79 of 216 prescriptions (36.57%). This was followed by incomplete or unclear dosing instructions in 13 prescriptions (6.02%) and incomplete or missing dosage form in three prescriptions (1.39%). No newly introduced problems involving route of administration or drug name were identified in the outpatient unit. These findings indicate that, among the parameters assessed, dose information represented the principal point at which information became incomplete during transfer to the pharmacy information system.

Among inpatient prescriptions, incomplete or unclear dosing instructions were the most frequent transcribing problem, occurring in 40 of 272 prescriptions (14.71%). Incomplete or missing dose information was identified in 30 prescriptions (11.03%), followed by incomplete or missing dosage form in 15 prescriptions (5.51%) and route of administration in three prescriptions (1.10%). No newly introduced problems involving drug name were identified. Thus, the pattern differed descriptively between the two care units: outpatient transcribing problems were predominantly related to dose information, whereas inpatient problems were more frequently related to dosing instructions.

The prominence of dose-related information in the present study is broadly consistent with the findings of Ab Rahman et al. In their national analysis of 12,049 reported transcribing errors in Malaysian public healthcare facilities, incorrect dose accounted for 48.6% of errors and incorrect frequency for 19.9%, while incorrect dosage form accounted for 4.8%.[23] Although the categories and healthcare settings were not identical to those in the present study, both studies indicate that dose and dosing information constitute important areas of vulnerability during the transcription or transfer of medication-order information. Accordingly, these findings should be interpreted as a contextual comparison rather than a direct comparison of prevalence.

The distinction between newly introduced transcribing problems and propagated prescribing problems is also important when interpreting the findings. Several problems identified in e-Calyptus at the prescribing stage were no longer present in the corresponding Buana record, whereas others remained unchanged across both systems. The latter were not included in **Table 3** because they did not originate during the transcription process. This approach avoids counting the same documentation problem at both the prescribing and transcribing stages and provides a more specific estimate of problems arising during information transfer.

The present study did not evaluate the specific technical, organizational, or human factors responsible for the observed discrepancies. Therefore, differences between outpatient and inpatient care should not be attributed to

system configuration, workload, staff performance, or other workflow characteristics without further investigation. Nevertheless, previous evidence suggests that reducing manual transcription and improving electronic information transfer may strengthen medication safety. Liang et al. reported that, after implementation of a computerized provider order entry system in a pediatric hospital, errors occurring across the combined order acknowledgement, transmission, and transcribing stages decreased from 6.4 to 1.4 per 10,000 orders, with a rate ratio of 4.4 (95% CI 1.1–32.5).[24] In that system, medication-order information could be imported electronically into the pharmacy information system rather than manually transcribed. These findings support attention to the accuracy and consistency of information transferred between e-Calyptus and Buana, particularly for dose and dosing instructions. Potential improvements may include structured electronic data transfer, validation checks, and pharmacist verification; however, their effectiveness in reducing transcribing problems in the present setting would require prospective evaluation.

**Descriptive Comparison of Prescribing and Transcribing Problems Between Care Units**

As shown in **Table 4**, at least one prescribing problem was identified in 215 of 216 outpatient prescriptions (99.54%) and in 188 of 272 inpatient prescriptions (69.12%). Among outpatient prescriptions, four prescribing problems per prescription were most frequently recorded (n=62), followed by three (n=56) and five problems (n=41). In inpatient care, two prescribing problems per prescription predominated (n=98), followed by one (n=46) and three problems (n=26). Thus, within the parameters assessed in this study, outpatient prescriptions more frequently contained at least one prescribing problem and also tended to contain a greater number of identified problems per prescription. These comparisons are descriptive and should not be interpreted as evidence of a statistically significant difference between the two care units.

At the parameter level, 849 prescribing problems were recorded across 216 outpatient prescriptions, corresponding to an average of 3.93 identified problems per prescription. In inpatient care, 394 prescribing problems were recorded across 272 prescriptions, corresponding to an average of 1.45 problems per prescription. These values should be interpreted in relation to the operational definitions and checklist used in the present study rather than compared directly with prevalence estimates from other studies. A recent systematic review of pediatric prescribing errors reported substantial variation in the prevalence and types of prescribing errors across healthcare settings, reflecting differences in study populations, operational definitions, data-collection methods, and prescribing processes.[16] Accordingly, the higher burden of prescribing problems observed in outpatient care in the present study should not be interpreted as evidence that outpatient prescribing is inherently less safe than inpatient prescribing.

Differences in prescribing problems between care settings may be influenced by contextual factors, although these were not directly evaluated in the present study. Workload and working conditions have been associated with prescribing errors in other healthcare settings. A large study involving more than 1.65 million medication orders found that prescribing errors were more likely to occur during periods of high physician workload.[25] However, workload, working hours, and prescriber experience were not measured in the present study; therefore, these factors cannot be used to explain the observed differences between outpatient and inpatient care and should be regarded only as contextual considerations.

**Table 4**. Distribution of prescriptions according to the number of prescribing and transcribing problems in outpatient and inpatient care

| Stage | Problems per prescription | Outpatient | | Inpatient | |
|---|---|---|---|---|---|
| | | n | % | n | % |
| **Prescribing** | 1 | 9 | 4.17 | 46 | 16.91 |
| | 2 | 17 | 7.87 | 98 | 36.03 |
| | 3 | 56 | 25.93 | 26 | 9.56 |
| | 4 | 62 | 28.70 | 16 | 5.88 |
| | 5 | 41 | 18.98 | 2 | 0.74 |
| | 6 | 26 | 12.04 | 0 | 0.00 |
| | 7 | 3 | 1.39 | 0 | 0.00 |
| | 8 | 1 | 0.46 | 0 | 0.00 |
| | **Total prescriptions with ≥1 prescribing problem** | **215** | **99.54** | **188** | **69.12** |
| **Transcribing** | 1 | 67 | 31.02 | 51 | 18.75 |
| | 2 | 14 | 6.48 | 14 | 5.15 |
| | 3 | 0 | 0.00 | 3 | 1.10 |
| | **Total prescriptions with ≥1 transcribing problem** | **81** | **37.50** | **68** | **25.00** |

At the transcribing stage, 81 outpatient prescriptions (37.50%) and 68 inpatient prescriptions (25.00%) contained at least one newly introduced transcribing problem. Among outpatient prescriptions, 67 contained one transcribing problem and 14 contained two problems, while no prescription contained three newly introduced problems. Among inpatient prescriptions, 51 contained one problem, 14 contained two problems, and three contained three problems. Overall, 95 newly introduced transcribing problems were identified among outpatient prescriptions, corresponding to an average of 0.44 problems per prescription, whereas 88 were identified among inpatient prescriptions, corresponding to an average of 0.32 problems per prescription. These figures differ from the prescribing-stage totals because transcribing problems were restricted to discrepancies newly introduced during the transfer of information from e-Calyptus to Buana; problems already present at the prescribing stage and subsequently carried forward into the pharmacy system were not counted again.

Overall, prescribing problems were more frequently identified than newly introduced transcribing problems in both care units. Within the scope and operational definitions of this study, this finding indicates that a greater burden of identified documentation and clinical problems occurred at the prescribing stage. However, the observed differences do not establish why these problems occurred or whether differences in staffing, supervision, workload, or pharmacist involvement were responsible. Evidence from pediatric inpatient settings nevertheless supports the potential contribution of pharmacist involvement to medication safety. A systematic review and meta-analysis found that pharmacist interventions, including prescription review, participation in ward rounds, education, and clinical pharmacy services, were associated with a significant reduction in medication errors among hospitalized pediatric patients.[26] This evidence supports pharmacist review as a potential safety strategy but does not demonstrate that pharmacist involvement caused the lower frequency of problems observed in the inpatient group in the present study.

Electronic prescribing and clinical decision-support functions may also contribute to medication-safety improvement. A pediatric hospital study reported that potentially harmful prescribing errors decreased from 18 to 11 errors per 100 prescriptions following implementation of a computerized physician order entry system, although the effect varied according to error type.[27] These findings support consideration of structured electronic prescribing and clinical decision support, mandatory data fields,[22] and pharmacist verification[26] as potential improvement strategies. However, their effectiveness within the e-Calyptus–Buana workflow should be evaluated prospectively rather than inferred from the descriptive differences observed in the present study.

## Limitation

This descriptive, retrospective, single-center study employed purposive sampling; therefore, the findings should be interpreted primarily within the context of Hospital X and may not be generalizable to other healthcare settings. The prescription was used as the unit of analysis, and individual patients could contribute more than one eligible prescription; consequently, observations were not necessarily independent at the patient level. The study was limited to the prescribing and transcribing stages and did not assess dispensing, administration, or subsequent clinical outcomes. As no inferential statistical testing was performed, differences between outpatient and inpatient services should be interpreted descriptively and not as evidence of association or causation. All prescription assessments were performed by a single assessor using predefined checklist criteria. Consequently, inter-rater reliability could not be evaluated, and some assessor-related misclassification cannot be excluded. In addition, the checklist was developed from regulatory and pharmaceutical references but was not formally evaluated as a psychometrically validated measurement instrument. The prescribing and transcribing stages were also assessed using different numbers and types of parameters, which limits direct comparison of the overall burden of problems between stages.

The analysis relied on information documented in the e-Calyptus and Buana systems. Missing or incomplete clinical information, particularly body weight or age information required for medicine-specific dose assessment, could limit the ability to determine dose appropriateness; such cases were treated as not assessable rather than inappropriate when the required information was unavailable. Potential drug interactions were identified through reference-based screening and recorded as present or absent; their actual clinical significance and patient-level consequences were not evaluated. Although the revised transcribing definition distinguished newly introduced problems from prescribing problems propagated into the pharmacy system, retrospective records may still limit the assessment of how and why individual discrepancies arose.

Future studies should consider prospective, multicenter designs with patient-level linkage, independent duplicate assessment, formal evaluation of inter-rater reliability, and follow-up through dispensing, administration, and

clinical outcomes. Such studies could also evaluate the effects of proposed electronic-system improvements and prescription-verification strategies using appropriate comparative or before-and-after designs.

## CONCLUSION

Pediatric compounded prescribing at Hospital X was characterized by the predominance of divided-powder preparations prescribed for younger children, typically containing a single medication item, and by documented problems across both prescribing and transcription processes. A broader range of problems was identified in the source prescriptions, while additional problems were introduced during the transfer of prescription information from e-Calyptus to the Buana pharmacy system. Differences observed between outpatient and inpatient services should be interpreted descriptively and do not establish that the care setting itself caused the observed pattern. Overall, the findings highlight the importance of improving the completeness of electronic prescription information, maintaining consistency across interconnected systems, and strengthening systematic prescription verification for pediatric compounded medications.

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## AUTHOR CONTRIBUTION STATEMENT

**Jenny Pontoan**: Conceptualization, Methodology, Formal Analysis, Writing—Original Draft Preparation, Writing – Review & Editing, Supervision; **Nizar Pajriah**: Investigation, Data Curation, Writing – Review & Editing; **Siswati Siswati**: Conceptualization, Formal Analysis, Writing – Review & Editing.

## CONFLICT OF INTEREST DECLARATION

All contributing authors have examined and consented to the final published manuscript. The authors declare no conflict of interest.

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