# Evaluation of the Impact of Implementing Electronic Prescription in an Oncology Referral Hospital in Recife, Brazil

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## Abstract

**Introduction** The occurrence of errors in the prescription of antineoplastic oncological drugs constitutes a serious public health problem, directly affecting patient safety. In Brazil, the Protocol for the Safety in Prescription, Use, and Administration of Medications, established in 2013, aims to improve care related to medication use in healthcare facilities. This study aims to evaluate the prescription profiles of patients undergoing antineoplastic chemotherapy treatment admitted to the Pernambuco Cancer Hospital before and after the implementation of electronic prescription.

**Materials and Methods** The present cross-sectional study was conducted by analyzing manual and electronic prescriptions collected from the clinical oncology ward of the Pernambuco Cancer Hospital during the periods from March to May 2016 and from June to August 2016, respectively. The data collected were extracted into a specific instrument, previously adapted for the study, containing information related to patients, prescribers, and medications. Descriptive statistics were used for data analysis.

**Results** Among the 694 prescriptions analyzed, prescription errors were found in at least one item, with the omission of the patients' sex and bed number being the most common findings.

**Conclusion** All of the prescriptions analyzed, both pre- and postcomputer standardization, contained errors in their completion. With the standardized prescriptions, a significant impact was observed in reducing these rates, especially regarding omission of items and information.

**Keywords**
- prescriptions
- medication errors
- antineoplastic agents

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## Introduction

Medication errors are defined as any preventable adverse event that may actually or potentially lead to inappropriate use of medications.[1]

The occurrence of errors in medication orders involving antineoplastic chemotherapy constitutes a serious public health problem. The cumulative and potentially harmful effect, caused by the narrow therapeutic index, where incorrect dosages or administrations may result in increased toxicity and/or decreased tumor response, directly affects patient safety. This has a significant impact on the Brazilian publicly funded health system (*Sistema Único de Saúde*, SUS, in Portuguese), leading to an increase in morbidity and mortality among people with cancer.[2,3]

Preventable damage during care is frequently recorded, especially in developed countries, such as the United States of America (USA), where approximately 2% of all patients admitted to hospitals are affected by a medication error, with at least 400,000 preventable drug-related adverse events recorded annually.[4,5] In Brazil, statistics on deaths related to medication errors are not yet available.[6]

The Safety Protocol in the Prescription, Use and Administration of Medications *(Protocolo de Segurança na Prescrição, Uso e Administração de Medicamentos*) is an integral part of the National Patient Safety Program (*Programa Nacional de Segurança do Paciente*), established in Brazil in 2013 with the aim of contributing to the qualification of health care through safe practice in use of medicines in healthcare establishments.[7]

Prescription analysis is a standard operating procedure for dispensing medication and must be carried out by the pharmaceutical professional, responsible for checking all identification elements of the institution, the patient, the prescriber and the prescribed medications, considering the following aspects: dose, pharmaceutical form, concentration, route of administration, dosage, diluent, infusion speed and infusion time in order to prevent possible prescription errors from becoming dispensing errors.[8–10]

Despite the demonstrated relevance of medication use failures as a significant contributing factor to reduced patient safety,[11] there are only a few studies pertinent to this topic on antineoplastic chemotherapy prescriptions in Brazil, particularly in the State of Pernambuco.

The objective of this study was to evaluate the profile of medical prescriptions of patients undergoing treatment with antineoplastic chemotherapy admitted to the clinical oncology ward of Hospital de Câncer de Pernambuco (Pernambuco's Cancer Hospital), before and after the implementation of the standardization of computerized prescriptions.

## Materials and Methods

This is a cross-sectional study based on the evaluation of oncological medication prescriptions at a reference center in the city of Recife, Brazil.

The prescription collection phase was conducted between March and May 2016 for the first stage, and for the second it was between June and August 2016, in the clinical oncology ward of the Pernambuco Cancer Hospital, responsible for 55% of the antineoplastic chemotherapy patient care in the state. Subsequently, after 8 years, in the first half of 2024, a detailed analysis based on descriptive statistics of the collected data was executed.

At the first stage, prior to electronic prescribing, the method of documenting antineoplastic chemotherapy prescriptions was heterogeneous, consisting of both handwritten and computer-typed elements. In the second stage, following the standardization process enabled by the adoption of the electronic system, prescriptions were transitioned to a fully digital format, with doctors prescribing drugs using a specific software where chemotherapy protocols, formulations, and medication dosages were available. The system calculated and suggested doses based on the input of patient identification data, such as height, weight, age, and others. The oncology medication distribution system operates on a 'unit dose' mode, and all prescribers had a digital signature.

Data extraction was conducted by the main researcher through the application of a specific analysis instrument, built and adapted for this study, with information regarding patient, prescriber, and medication.

Medical prescriptions were collected at two different times, before and after the implementation of prescription standardization, with prestandardization prescriptions collected during the first stage period and computerized during the second one. The sample of this study includes 694 prescriptions for intravenous injectable antineoplastic chemotherapy drugs that were compiled consistently and consecutively through daily analysis (Monday to Friday) of copies of the original prescriptions. All prescriptions assessed during this period were used in this study and there were no exclusions.

Aiming to detect the main issues with the criteria related to the legal requirements necessary for correct dispensing and administration of medications, the following variables were analyzed: use of the trade name, dose, diluent, infusion rate, use of abbreviations and acronyms in the medication name, identification of the prescriber and the patient, medical record number, bed number, sex, age, body surface area, chemotherapy protocol, and diagnosis.

The data were stored in a proprietary database created exclusively for this research. In order to check for possible typing errors, we also used a double-entry method for validation in the EPI-INFO (Centers for Disease Control and Prevention, Atlanta, GA, USA) software, version 7.2.6, and were subsequently compared. In order to verify the statistical significance of the differences found in the frequency distribution of the variables, the Pearson's chi-squared test was used and, when necessary, the Fisher's exact test with a significance level below 5% ($p < 0.05$). The analysis was performed using the STATA (StataCorp LLC., College Station, TX, US) software version 17.0.

This study received approval from the Research Ethics Committee of the Pernambuco Cancer Society (SPCC)/Pernambuco Cancer Hospital (CAAE N. 50724415.7.0000.5205),

as provided for in resolution no. 466/12 of the Brazilian National Health Council (*Conselho Nacional de Saúde*).

## Results

An examination of all prescriptions included in this study revealed prescription errors in at least one of the evaluated items. ►**Table 1** displays the characteristics of oncological medication prescriptions delineated by patient identification data before and after the implementation of digital standardization. This comparative analysis highlighted a consistent lack of essential information: the patient's full name was missing in 10.4 versus 5.1% ($p = 0.009$), age in 84.8 versus 62.3% ($p < 0.05$), body surface area in 51.5 versus 43.6% ($p = 0.037$), chemotherapy protocol in 56.3 versus 21.4% ($p < 0.05$), and diagnosis in 69.7 versus 43.9% ($p < 0.05$).

►**Table 2**, meanwhile, presents data from the analysis of prescriptions before and after the digital standardization delineated by the identification of the prescriber and medication. The correction of the absence of the prescriber's signature was observed in all prescriptions after the standardization, with this result not being statistically significant. Additionally, correction of the absence of dose in the poststandardization period can also be observed with a statistically significant result ($p = 0.002$). Furthermore, it was found that prescriptions for oncology medications were characterized by the presence of abbreviations and acronyms in 44.8 versus 10.7% ($p < 0.05$), presence of the trade name in 64.4 versus 23.2% ($p < 0.05$), absence of diluent in 26.6 versus 4.5% ($p < 0.05$) and absence of infusion speed in 44.5 versus 10.9% ($p < 0.05$).

## Discussion

It is important to note that this study was conducted during the initial transition phase from manual to electronic

**Table 1** Profile of prescriptions for oncology medications at Hospital do Câncer de Pernambuco, according to patient identification, before and after the implementation of digital prescription standardization

| Characteristics | Prescription status relative to standardization N (%) | | *p*-value |
|---|---|---|---|
| | Before (n = 357) | After (n = 337) | |
| **Patient identification** | | | |
| **Full name** | | | |
| Yes | 320 (89.6) | 320 (94.7) | 0.009* |
| No | 37 (10.4) | 17 (5.1) | |
| **Medical record number** | | | |
| Yes | 337 (94.4) | 324 (96.1) | 0.280 |
| No | 20 (5.6) | 13 (3.9) | |
| **Bed number** | | | |
| Yes | 6 (1.8) | 3 (0.9) | 0.358 |
| No | 351 (98.2) | 334 (99.1) | |
| **Sex** | | | |
| Yes | 2 (0.56) | 0 (0) | 0.169 |
| No | 355 (99.4) | 337 (100) | |
| **Age** | | | |
| Yes | 54 (15.2) | 127 (37.6) | 0.05* |
| No | 303 (84.8) | 210 (62.3) | |
| **Body surface area** | | | |
| Yes | 173 (48.5) | 190 (56.4) | 0.037* |
| No | 184 (51.5) | 147 (43.6) | |
| **Chemotherapy protocol** | | | |
| Yes | 156 (43.7) | 265 (78.6) | 0.05* |
| No | 201 (56.3) | 72 (21.4) | |
| **Diagnosis** | | | |
| Yes | 108 (30.3) | 189 (56.1) | 0.05* |
| No | 249 (69.7) | 148 (43.9) | |

**Notes:** The groups were evaluated using the Chi-squared test and Fisher's exact tests, *p*-value < 0.05.

 

**Table 2** Profile of prescriptions for oncology medications at Hospital do Câncer de Pernambuco, according to the prescriber and medication identification, before and after the implementation of digital prescription standardization

| Characteristics | Prescription status relative to standardization N (%) | | *p*-value |
|---|---|---|---|
| | Before (n = 357) | After (n = 337) | |
| **Prescriber identification** | | | |
| **Prescriber's signature** | | | |
| Yes | 356 (99.7) | 337 (100) | 0.331 |
| No | 1 (0.3) | 0 (0) | |
| **Professional license** | | | |
| Yes | 354 (99.2) | 336 (99.7) | 0.344 |
| No | 3 (0.8) | 1 (0.3) | |
| **Drug identification** | | | |
| **Abbreviations and acronyms** | | | |
| Yes | 160 (44.8) | 36 (10.7) | 0.05* |
| No | 197 (55.2) | 302 (89.3) | |
| **Commercial name** | | | |
| Yes | 230 (64.4) | 78 (23.2) | 0.05* |
| No | 127 (35.6) | 259 (76.8) | |
| **Dose** | | | |
| Yes | 347 (97.2) | 337 (100) | 0.002* |
| No | 10 (2.8) | 0 (0) | |
| **Diluent** | | | |
| Yes | 262 (73.4) | 322 (95.5) | 0.05* |
| No | 95 (26.6) | 15 (4.5) | |
| **Infusion speed** | | | |
| Yes | 198 (55.5) | 300 (89.1) | 0.05* |
| No | 159 (44.5) | 37 (10.9) | |

**Notes:** *Fisher's chi-squared test, *p*-value $< 0.05$. The groups were evaluated using the Fisher's exact tests.

prescribing in Pernambuco Cancer Hospital. This timing may have contributed to an increase in errors in the digital format due to the users' unfamiliarity with the new system.

The results found in this analysis are in agreement with national and international studies on medication errors, prescription errors, and adverse events associated with medications.[3,10,12–16] They also reinforce that prescription errors are common and must be addressed by professionals involved in health care, with an emphasis on teaching hospitals. Medication errors may refer, among others, to prescription problems, such as incorrect selection, illegible prescription, and omission of patient, prescriber, and medication information.[17] Of the 694 prescriptions analyzed, none covered all the indicators analyzed and required according to ordinances, laws, and resolutions.

The registration of patients' names in incomplete forms or with abbreviations was noted in 10.4% of the prescriptions analyzed in the first period of the study. Alternatively, with standardized prescriptions, this percentage was reduced by 50%. Our results were better when compared to two other studies conducted in the Northeast of Brazil, which found the absence of the patient's full name in 32 and 35% of the prescriptions analyzed, respectively.[18,19] It should be noted that issues with data relating to patient identification, influence on therapeutic quality, and personal information can lead to mistakes by those responsible for preparing, dispensing, and administering medications, and must be validated in all prescriptions.

Our results revealed an important percentage of age omission in prescriptions collected during the first study period (84.8%). Conversely, with standardization, there was a significant drop, but the omission of this item is still high, demonstrating similarity to the study conducted by Jacobsen et al.,[20] where they found a percentage of 63.7% missing age in the prescriptions analyzed.

The absence of body surface area in medical prescriptions, specifically oncological prescriptions, makes it difficult for pharmacists to manipulate and dispense medication, and its presence in prescriptions is therefore of fundamental importance for calculating the dose to be administered. With the

standardization of prescriptions, it was observed that the body surface area was absent in 43.6% of the prescriptions analyzed. This result corroborates the study conducted by Bózoli et al.[21] where this item was missing in 43.8% of prescriptions. Another study conducted in Portugal showed a reduction of almost 50% in the absence of this item (25.3%) when compared to our results. This is due to the frequency of preventable damage recorded in developed countries.[4,5]

Concerning the omission of chemotherapy protocol details, the standardization of prescriptions resulted in a reduction of this oversight from 56.3 in nonstandardized samples to 21.4%, signifying a substantial enhancement. This advancement is particularly notable when compared to the study conducted by Michelena et al.,[22] which documented a 32% rate of omission for this information.

The inclusion of a diagnosis in oncology medication prescriptions is critically important due to the intricate nature of cancer and its treatments. In the prescriptions examined, the rate of diagnosis omission was also assessed. Following the implementation of standardization, the incidence of omission, which previously stood at 69.7% during the first stage, was reduced to 43.9%. Although this reduction signifies a notable enhancement, the persisting rate is still higher than the findings from a study conducted in Portugal, which reported an 8.4% prevalence of diagnosis omission in the analyzed prescriptions.[23]

Prescriber identification data, such as the presence of signature and professional registration, were researched, but no statistically significant differences were found comparing the data before and after the implementation of standardization protocols.

With regard to medication identification data, it was observed that all variables studied showed a significant reduction in errors identified after the computerization of prescriptions, with statistically significant differences. The presence of abbreviations and acronyms in the name of the medicine poses a potential risk of confusing pharmaceutical professionals when analyzing prescriptions. In the present study, it was observed that 44.8% of manual prescriptions contained abbreviations and acronyms in the name of the medication, echoing the findings of analogous Brazilian research, which reported prevalence rates of 48.3 and 82%.[24,25] Subsequent to the digitalization in the study's service, this percentage dropped considerably to 10.7%, reinforcing the importance of implementing the standardization of computerized prescriptions.

In accordance with law n. 9,787,[26] all medicines in Brazil must be prescribed by their generic name in public health services. It was observed that the commercial name of the medicines was present in 64.4% of the manual prescriptions analyzed, corroborating the results obtained in the study by Bózoli et al.,[21] which found the presence of 54.7% of drug names by trade name. Another study conducted by Coutinho et al.[27] observed a prevalence of 37.2% of the commercial name in prescriptions for oncology medications, a percentage lower than that observed in the present study in the period prior to the computerization of prescriptions and very close to the percentage observed after standardization, reinforcing a significant improvement in patient safety.

The presence of the diluent prescription, especially in prescriptions containing injectable medications, is extremely important, as the lack of this information can lead to serious, irreparable harm to the patient. In the present study, after the digitalization of prescriptions, 4.5% of omission of the diluent prescription was found, a result considered low when compared to a study conducted by Aguiar et al.,[28] which found a rate of 19.14%.

Another important factor that must be present when prescribing injectable medications is their infusion speed. It is already well established in the literature that parenteral medications require monitoring of the amount injected versus infusion time, to avoid adverse reactions.[19,20] The results found in the present study in relation to infusion speed, in both periods studied, were better and divergent from the study conducted at the university hospital in Ceará, in which the infusion speed of injectable medications was omitted in 78.2% of the analyzed prescriptions.[19]

Correctly specifying all components of a medical prescription is essential for patient safety. Illegible or missing prescription components compromise the efficiency of any medication distribution system and can lead to preparation and dispensing errors that lead to improper medication administration.[29]

The clinical practices of pharmaceutical professionals should be encouraged, as they reduce prescription and medication errors in general and are based on proven scientific evidence.[4,30]

## Conclusion

Appreciating all the results obtained in this study, it was observed that a large part of the prescriptions lacks the necessary information to ensure the safe and rational use of oncology medications, demonstrating noncompliance with current legislation. The evaluation of the oncology medications' prescription profile in a reference hospital in the city of Recife made it possible to identify the presence of errors in all of them before and after the standardization of computerized prescriptions.

Ensuring that all elements of a medical prescription are accurately listed is critical for patient safety. Illegible prescriptions or those with missing components compromise the efficiency of any distribution system and can lead to preparation and dispensing errors that lead to improper medication administration.[29] The clinical practices of pharmaceutical professionals should be encouraged, as they reduce prescription and medication errors in general and are based on proven scientific evidence.[4,30]

The findings of this study indicate that the implementation of standardized prescriptions has significantly reduced the occurrence of errors due to missing items and information. This also highlights the vital role of medical and pharmaceutical professionals in developing and reviewing prescriptions before they are processed, ensuring greater

safety and quality in the treatment provided to cancer patients.

Finally, as this analysis is based on records collected in 2016, even having a coherent dialogue with the findings of other studies from various time periods and locations, the results of this study may not reflect the current state of the institution where it was conducted.

### Disclosure

The authors of the present article state that it has not been submitted for evaluation to any other journal. Additionally, they declare that the study was approved by the relevant ethics committee.

### Author's Contribution

DCGF: collection and assembly of data, conception and design, data analysis and interpretation, final approval of manuscript, writing of the manuscript, and provision of study materials or patient; ALVS: conception and design, data analysis and interpretation, final approval of manuscript, and writing of the manuscript; HCAJ: conception and design, data analysis and interpretation, final approval of manuscript, and writing of the manuscript; JKNSF: conception and design, data analysis and interpretation, final approval of manuscript, and writing of the manuscript; NMFM: conception and design, data analysis and interpretation, final approval of manuscript, and writing of the manuscript; PVBM: conception and design, data analysis and interpretation, final approval of manuscript, and writing of the manuscript; RBMN: conception and design, data analysis and interpretation, final approval of manuscript, and writing of the manuscript; TCM: data analysis and interpretation, final approval of manuscript, and writing of the manuscript; MRPP: conception and design, data analysis and interpretation, final approval of manuscript, and writing of the manuscript; MASM: conception and design, final approval of manuscript, and writing of the manuscript.

### Clinical Trials

None.

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### Conflict of Interests

The authors have no conflict of interests to declare.

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