ASSESSMENT OF MEDICATION ERRORS IN CHEMOTHERAPY RECEIVING PATIENTS IN TERTIARY CARE HOSPITAL

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ABSTRACT

Objective: Identifying, Analyzing and developing prevention strategies for medication errors in cancer patients receiving chemotherapy. Methods: A prospective, open labeled, Observational study was conducted in the Department of Medical Oncology, in a tertiary care hospital in Tamil Nadu, India. Patients who came to receive chemotherapy during the period of 6 months from Jan 2016 to June 2016 were included in the study. Medication history interview, reconstitution procedures, administration procedures and chemotherapy chart review were done. Drugs administered for other co morbid conditions were not been considered for assessing medication errors. Medication errors were assessed based on the NCCMERP index and statistical analysis was done by using SPSS tool. Prevention strategies were developed to rectify the medication errors and factors which influence the medication error. Result: Medication Error among the patients receiving chemotherapy was identified to be 51.08%, of which, prescribing error was 19.79%, administration error was 27.08%, wrong dose was 41.66%, wrong drug error was 3.12% and wrong strength was 8.33%. Based on the NCCMERP index, the majority of errors (70%) fell in the category Error, No Harm, followed by which 34% belongs to no error and 2% with Error, Harm and there was no death occurred due to medication error. Further, the errors were grouped into 8 categories (Category A to Category I). The majority of errors (35%) fall into category A. Among various chemotherapeutic agent, 5-Fluorouracil was found to have more medication
error (34.32%). Chemotherapeutic drugs found to have more medication error (79%) compared to adjuvant drugs (21%) used for the patient preparation for chemotherapy. We analysed the factors influencing the medication errors as, patient factors, disease factors, working environmental factors, drug factors, lack of interdepartmental activity, reconstituiton factors. Descriptive analysis was performed to estimate number of medication errors and expressed as total number of errors and percentage. Prevention strategy was developed for the identified factors which influence the medication errors. **Conclusion:** Developing unique drug guidelines that address the institutions dose information, making drug info available electronically and train all members of the team to use electronic drug information can reduce medication error. In chemotherapy, the total no. of drugs given to the patient cannot be reduced so, there will be error occurrence at some point, which is unavoidable.

**KEYWORDS:** Chemotherapy, NCCMERP Scale, Medication Errors, Cancer.

**INTRODUCTION**

Medication error is a failure in the treatment process that leads to harm the patient.[1] Medication error may cause due to prescription, administration, omission, wrong choice of drug or dose, inaccuracy of writing, poor legibility of handwriting. Prescription errors could be minor and harmless or may be major errors that could result in life-threatening problems.[2] The prescription error rates reported in Indian studies range from 17.6% to 44.18%.[3,4]

The rate of medication errors for chemotherapy administration in the inpatient setup is not well documented.[5] The error rate with oral chemotherapy agents is less well studied, but serious medication errors can occur with these therapies across all phases of the medication-use system.[6,7] Taylor and colleagues documented a 9.9% error rate with oral chemotherapy given to pediatric patients in hospital setup.[8] Chemotherapy-related medication-error prevention remains a priority.[9] Error-prevention strategies should be applicable to the diverse settings in which chemotherapy agents are used. We were interested in this issue and make a study on analyzing and minimizing medication errors in chemotherapy, and carried out this project.
MATERIALS AND METHODS
This was a prospective, open labeled, observational study. The study was conducted in a tertiary care teaching hospital in Tamil Nadu, during January to June 2016. It was approved by the Institutional Human Ethics Committee, PSG IMS&R (Ref: 16/055 on February 24, 2016). Medication history interview, reconstitution procedures, administration procedures and chemotherapy chart review were done. Chemotherapy related errors and adjuvant drugs like steroids, antiemetics, analgesics were monitored. Drugs administered for other co morbid conditions were not been considered for assessing medication errors.

Based on the NCCMERP index, the errors were classified into no error, error no harm, error harm and death. Further it was grouped into 8 categories from category A to category I. Using an In-House classification system (The classification system which we use in our hospital setting to classify different types of medication errors), we classified errors into prescription error, administration error, wrong dose, wrong drug, wrong strength and the prescriptions were analysed for different errors.

We analysed the factors influencing the medication errors as, patient factors, disease factors, working environmental factors, drug factors, lack of interdepartmental activity, reconstitution factors and strategies to rectify the same have been developed. Statistical analysis was done using SPSS Version 16.0.

RESULTS
Among 92 patients came for receiving the chemotherapy, 47 patients had Medication Errors, which shows that around 51.08% had medication errors. Among 96 errors observed, 68 errors (70.83%) were identified during the chart review followed by 26 errors (27.08%) occurred in ward and 2 errors (2.08%) in personal interview. Based on the NCCMERP index, the majority of errors (70%) fell in the category Error, No Harm, followed by which (34%) belongs to no error and (2%) with Error, Harm and there was no death occurred due to medication error. Further, the errors were grouped into 8 categories (category A to category I) the majority of the errors 30 (35%) fall in category A, followed by 28 (33%) category D which is then followed by category C of 26 (30%). Category E and F were 1% and there were no errors found in the category B, G, H.
Table 1.

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>NUMBER OF ERRORS</th>
<th>PERCENTAGE (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category A (No error)</td>
<td>30</td>
<td>34.88</td>
</tr>
<tr>
<td>Category B (Error, No harm)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Category C (Error, No harm)</td>
<td>26</td>
<td>30.23</td>
</tr>
<tr>
<td>Category D (Error, No harm)</td>
<td>28</td>
<td>32.55</td>
</tr>
<tr>
<td>Category E (Error, Harm)</td>
<td>1</td>
<td>1.16</td>
</tr>
<tr>
<td>Category F (Error, Harm)</td>
<td>1</td>
<td>1.16</td>
</tr>
<tr>
<td>Category G (Error, Harm)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Category H (Error, Harm)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Category I (Error, death)</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Based on the In-House classification system, errors were classified into 5 types. The majority of errors 40 (41.66%) fall in wrong dose, followed by administration error 26 (27.08%) which is then followed by prescribing error 19 (19.79%) and least errors were found in wrong drug (3.12%) and wrong strength (8.33%).

Among 92 patients, 18 (19.56%) patients were admitted with stomach cancer with the majority, followed by 15 patients with colon cancer (16.30%), followed by breast cancer 13 (14.13%), followed by which Hodgkin's disease 7 (7.60%), Non hodgkin's disease 5 (5.43%), lung cancer 7 (7.60%), ovarian cancer 6 (6.52%). Among 47 subjects with errors observed, 8 errors were in stomach cancer and colon cancer patients each. Followed by which 6 errors were seen in breast cancer and HD & NHD patients and 4 errors were observed in lung cancer and rectal cancer patients, 2 errors in ovarian cancer patients.

Among various chemotherapeutic agents prescribed to 92 patients, 47 patients were monitored to have medication errors in which the patients given 5-fluorouracil occurred majority of errors of about 23 (34.32%) errors, followed by doxorubicin 8 (11.94%). The least error occurred drug was Irinotecan & Epirubicin of about 1 (1.49%) each.
Out of 80 drugs that have caused errors, 63 drugs (79%) were chemotherapeutic drugs and 17 (21%) were adjuvant drugs. The difference between chemotherapeutic medication error and adjuvant medication error was found by using Independent sample T test, it was found that statistically significant difference between chemotherapeutic medication errors and Adjuvant medication errors was observed (*P< 0.005). It was found that the chemotherapeutic drugs were having more number of MEs than adjuvant drugs. Correlation between number of drugs and number of medication errors was done, which showed statistical significance (**P < 0.01). Hence if the number of drugs increases, number of medication errors per patient also increases. Curve estimation was done which showed that number of agents and number of errors are significant at 0.01 level. The probability of increasing error for each addition of drug is 0.179(b1) at present.

![Image](https://www.wjpps.com)

**Fig.2.**

Based on the above results, we analysed the factors that influence the medication error such as environmental factors (27.08%), drug factors(48.95%), reconstitution(11.45%), disease factors, patient factors and lack of interdepartmental activity. In this, environmental factors related MEs include 27.08% of administration errors and drug factors related MEs include 6.12% of sound alike drugs within the therapeutic class, 19.56% of failure to round drug doses and 80.43% of total course completion and reconstitution related ME’S include 9.09% of excessive interruptions during preparation, 90.90% of lack of warning stickers and labels. The factors which influence the medication errors can be reduced by implementing CPOE system and develop unique drug guidelines that address the institutions dose information, infusion, hydration, antiemetic and supportive care parameters. All doses should be calculated independently by the physician, the pharmacist and the nurse. Medical professionals may also
conduct educational program such as grand rounds type of presentation on medication error prevention for the full medical staff every week, or more often as necessary.

**DISCUSSION**

The overall medication error rate in this study was found to be 51.08%. Whereas in the study done by Qian Ding, Ph.D et al[20] under the title “Incidence of intravenous medication errors in a Chinese hospital” showed less no. of error rate of about 12.8%, as it included only IV medications, but in our study we included both IV and oral medications.

In this study we assessed the various Medication Errors in cancer population and minimizing strategies were developed. According to the inclusion and exclusion criteria 92 patients admitted in the oncology ward were involved in the study. All these patients were categorized according to their demographic data. Among the 92 patients, 1 patient was in the age group of <10, 4 patients were in the age group of 11-19, 5 patients were in the age group of 20-29, 15 patients were in the age group of 30-39, 20 patients were in the age group of 40-49, 25 patients were in the age group of 50-59, 14 patients were in the age group of 60-69, 8 patients were in the age group of 70-79. So, the age group between 50-59 were more patients admitted. In other study done by Maximilian J Hartel et al[17] showed that the median patient age was 55 years (range17-93). Out of 92 patients, 1 patient had error in the age group of <10, 1 patient had error in the age group of 11-19, 1 patient had error in the age group of 20-29, 6 patients had error in the age group of 30-39, 10 patients had error in the age group of 40-49, 18 patients had error in the age group of 50-59, 7 patients had error in the age group of 60-69, 3 patients had error in the age group of 70-79. The chi square statistical analysis was done to find the association between Age and Medication error (P>0.05). Therefore, there is no significant association between Age and Medication errors. Hence, the medication errors were equally distributed in all age groups and doesn’t show any association.

54 were male patients and 38 were female patients were included in the study. we observed more of male population affected by cancer in our study. In the study done by Maximilian J Hartel et al[17] 165 patients retrospectively monitored for ME and showed 42% of the female patients and 58% were male patients, which shows men are more prone to cancer nowadays due to various factors.

There are different types of cancer according to their anatomical site in the body. Patients were also categorized according to their type of cancer. Out of 92 patients, 7.60% had
Hodgkin’s lymphoma, 5.43% had Non Hodgkin’s lymphoma, Lung cancer of about 7.60%, Breast cancer of about 14.13%, Rectal cancer of about 7.60%, Caecum cancer is 3.26%, Ovarian cancer of about 6.52%, Stomach cancer 19.56%, Colon cancer of 16.30%, Cervix cancer of about 3.26%, Pancreas cancer was 2.17%. Other cancer types were NSGCT, Carcinisarcoma, Testicular GCT, Relapsed seminoma, Relapsed thymoma, Adenocarcinoma. High prevalence of Stomach cancer and Colon cancer were observed.

Types of errors were noted and was classified, among 96 errors observed, the major error was wrong dose of 41.66%. Administration errors were 27.08%, but in the study done by Kathleen E. Walsh et al\textsuperscript{[18]} showed that administration errors were 56% which is more when compared to our results. Prescribing errors were 19.79% in our study, whereas in their study it was 36% which is more when compared to our study result. Most of the errors were identified in chart review 70.83%, followed by in ward of about 27.08% errors were identified and 2.08% errors identified was from the personal interview with the patients.

The identified errors were classified based on their harm, out of 96 errors observed, 64% had error, No harm; 34% had No error; 2% had error harm. Whereas in the study done by Saul N. Weingart MD Ph.D et al\textsuperscript{[12]} under the title “Medication Errors involving oral chemotherapy” which showed minimal harm to the patients of about 80.7%.

The identified errors were categorized based on the NCCMERP categorization scale, in which major error (35%) belong to category A, 30% belong to category C, 32.55% belong to category D, category E & F had 1%, were as category B, G, H & I was 0%. Whereas in the study done by A. Fyhr et al\textsuperscript{[13]} who is a Hospital pharmacist in the division of Ergonomics and Aerosol Technology, Lund university, which showed major error was 15 belong to the Category E–H, Error, Harm.

Month wise Medication errors were categorized, Out of 47 patients with errors, February month had 3 errors, March had 9 errors, April with 10 errors, May month 10 errors were observed, June month with the highest of about 15 errors were observed. The chi square statistical analysis was done to find the association between Month and Medication error, because some specific months, due to nursing workload, or other reasons the error occurrence might be more. So, we have checked the association between month and medication error, (P >0.05), it is statistically NOT significant. Hence, the medication errors were equally distributed in all the month and doesn’t show any association. But, in the study done by
Florence Ranchon et al[21] under the title “Chemotherapeutic errors in hospitalised cancer patients: attributable damage and extra costs”, showed a statistical significant relationship was found between the rate of medication errors and month of the year (p = 0.001). May and January were the months most at risk of errors, while October and November were the least. The prevalence of errors in different cancer types was observed, out of 47 patients, 2 patients of Hodgkin’s lymphoma had medication errors whereas Non Hodgkin’s Lymphoma had 4 errors, 4 Lung cancer patients had errors. 6 Breast cancer patients were monitored with medication errors. 4 Rectal cancer patients had errors. 8 Stomach cancer patients and 8 Colon cancer patients had medication errors. 2 Ovarian cancer patients had medication errors. Other cancers patients like NSGCT, Caecum cancer, Carcinosarcoma, Testicular GCT, Relapsed seminoma, Relapsed thymoma, Adenocarcinoma, Cervix cancer, Pancreas cancer had 1 medication errors in each.

The medication errors were classified into chemotherapeutic agents and adjuvant drugs. Among the 80 drugs that have caused errors, 63 drugs (79%) were chemotherapeutic drugs and 17 (21%) were adjuvant drugs. The Independent samples T test statistical analysis was done to find the difference between chemotherapeutic medication error and adjuvant medication error, where P value was found to be 0.000 (*P <0.05), Therefore, a significant difference between chemotherapeutic medication errors and Adjuvant medication errors were observed. In the study done by Kathleen E. Walsh et al[18] out of 10,995 medications, 40% chemotherapeutic drugs, 0.8% of Adjuvant drugs have contributed to medication errors.

The individual chemotherapeutic agents were monitored for medication errors to find which drug caused highest number of errors. Among different chemotherapeutic agents, 5-Fluorouracil was monitored with 23 errors (34.32%), followed by doxorubicin of 8 errors (12%), Oxaliplatin 7 errors (10.4%), Cyclophosphamide 6 errors (9%), Paclitaxel 5 errors (7.46%), Cisplatin 4 errors (6%), Etoposide and Carboplatin 3 errors each (4.47%), Dacarbazine, Vincristine, Bleomycin had 2 errors each (2.98%), Irinotecan and Epirubicin had 1 error each (1.49%). Whereas in the study done by Florence Ranchon et al[21] out of 6,607 prescriptions, 21% of errors was by carboplatin which is highest followed by which, 11% by 5- Fluorouracil & oxaliplatin of about 8%.

Correlation between No. of drugs prescribed per patient and No. of Medication errors was correlated which showed P value 0.000 (**P< 0.01) hence it is highly significant and which denotes if the no. of drugs per patient is increased, medication error also increases and shows
positive correlation. Thus we developed a tool to minimize the medication errors and implemented in our oncology ward setting.

CONCLUSION
Pharmacists must be integral members of all implementation teams for automated prescribing and administration systems. Developing unique drug guidelines that address the institutions dose information, making drug info available electronically and train all members of the team to use electronic drug information can reduce medication error. In chemotherapy, the total no. of drugs given to the patient cannot be reduced so, there will be error occurrence at some point, which is unavoidable.

ABBREVIATIONS
SPSS  - Statistical Package for Social Science
ME - Medication Error
5-FU - 5- Fluorouracil
HD - Hodgkin’s Disease
NHD - Non Hodgkin’s Disease
CPOE - Computerized Physician Order Entry
IV - Intravenous
NSGCT - Non-Seminomatous Germ Cell tumour
GCT - Germ Cell Tumour

REFERENCE


