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Original Research Article

Drug utilization study in medicine intensive care unit in tertiary care hospital

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ABSTRACT

Background: The medical intensive care unit (MICU) is a setting where patients who are critically ill are admitted and thus usually receive a large number of drugs of different pharmacological classes due to life threatening illnesses which may be fatal. The various drugs used in MICU and their clinical outcome was investigated in this study.

Methods: Patients admitted between January 2017 to June 2018 in Medicine ICU of GMC Aurangabad were included in this study.

Results: Total of 351 prescriptions was analyzed from the medicine intensive care unit. Out of 351 patients 243 (69.23%) were male, while 108 (30.77%) were female. The mean age of the patients admitted in MICU was 42.78±18.14 years. The most common type of patients admitted in MICU have the diagnosis of organophosphorous poisoning (25.36%), followed by cerebrovascular accident (15.95%), pneumonitis (10.26%), snake bite (7.12%), chronic kidney disease (5.98%), diabetic ketoacidosis (5.70%) and seizure disorder (3.42%). The most common drugs used were ranitidine (99.71%) and ondansetron (99.43%). Among antibiotics cephalosporins were most commonly used, ceftriaxone (39.03%), cefotaxim (40.46%), cefoperazone and sulbactam (24.22%). Other antibiotics most commonly used were metronidazole (61.25%), amoxicillin and potassium clavulanate (26.78%), piperacillin and tazobactam (11.68%), meropenem (11.40%).

Conclusions: In conclusion, we found that in MICU utilization rate of gastroprotective (ranitidine), antiemetic (ondansetron) and antibiotics (cephalosporins) was high. The present study provides valuable insight about the overall pattern of drugs used in medicine intensive care unit.

Keywords: Drug utilization, Medicine intensive care unit, Antibiotics

INTRODUCTION

In a world health organization report on drug utilization studies the opening speaker of this symposium, Professor Owen Wade wrote, "The aim of drug utilization studies is to be able to carry out a complete therapeutic audit; to see clearly what is prescribed with what intention and with what benefit or what ill effects and at what cost to the community".¹

Studies on drug utilization process correlate whether the drug use is beneficial or adverse. Periodic evaluation of drug use is vital so as to potentiate the therapeutic efficacy, decrease the side effects and provide proper feedback to prescribers for optimal use of drugs.² These drug utilization studies ultimately focus on rational use of drugs which requires that the patients receive medications appropriate to their clinical needs.³

The medical intensive care unit (MICU) is a setting where patients who are critically ill are admitted and thus

usually receive a large number of drugs of different pharmacological classes due to life threatening illnesses which may be fatal.⁴ The pharmacological management of these patients is usually complex and typically involves the administration of several classes of drugs.⁵ Prolonged length of stay, diagnosis during time of admission, and death are associated with increased medication administration. This lead to polypharmacy and drug-drug interactions.⁶ Clinicians often face challenges in prescribing the right medication and initiating the right therapy, especially when it comes to emergency care department where the chances of irrational prescriptions and errors usually happen. Hence, it would be better to stick on to prescribing drugs by their generic names as it has been emphasized by the WHO in their essential drug list.⁷

Therefore, by studying the prescription pattern of the ICU patients it will give an idea about the use of drug pattern in this institution and will be helpful for creating favorable conditions for wide scale improvements in therapeutic practices in our setup. Therefore, the main objective of this study was to assess the utilization of drugs, which were given in critically ill patients admitted in the medicine ICU in a government tertiary care hospital.

METHODS

A prospective study was conducted from January 2017 to June 2018 in the MICU of Government Medical College and hospital Aurangabad.

Inclusion criteria

Patients of either sex of more than 12 years, patients admitted in MICU, patients or their relatives who are willing to give informed consent were included in this study.

Exclusion criteria

Patient or their relatives not willing to give informed consent, patients who stayed for less than 24 hours, incomplete data entry case records were excluded from the study were excluded in this study.

Approval from ethics committee was taken. Data collected was of age, duration in intensive care unit (ICU), final diagnosis, drugs prescribed and clinical outcome of patients from case papers. The data obtained was then analyzed in Microsoft Excel. Qualitative data are expressed in frequency and percentage while quantitative data are expressed with mean±standard deviation (SD).

RESULTS

The prospective observational study was carried out at tertiary care teaching hospital in MICU.

Total prescription of 351 patients was analyzed from Medicine Intensive care unit. Detailed information about baseline demographic characteristics and treatment received by the patient was studied. Observations of the study are presented in the form of different tables and figures.

Table 1: Demographic details (n=351).

Demographic	Frequency (%)
Male	243 (69)
Female	108 (31)
Age in years (mean±SD)	42.78±18.14
Length of ICU stay	5.84 days
Outcome	
Transferred to ward	154 (44)
DAMA	15 (4)
Expired	185 (52)

Table 2: Types of diagnosis MICU.

S. no.	Diagnosis	No. of patients	%
1	Organophosphorous poisoning	89	25.36
2	Cerebrovascular accident	56	15.95
3	Pneumonitis	36	10.26
4	Unknown poisoning	33	9.40
5	Snake bite	25	7.12
6	Chronic kidney disease	21	5.98
7	Diabetic ketoacidosis	20	5.70
8	Acute exacerbation of COPD	16	4.56
9	Seizure disorder	12	3.42
10	Alcoholic intoxication	11	3.13
11	Meningitis	10	2.85
12	Septicemia	7	1.99
13	Encephalitis	5	1.42
14	Acid poisoning	3	0.85
15	Acute gastroenteritis	3	0.85
16	Acute hepatitis	3	0.85
17	Rodenticide poisoning	1	0.28
	Total	351	100

Out of 351 patients 243 (69.23%) were male, while 108 (30.77%) were female. The mean age of the patients admitted in MICU was 42.78±18.14 years. The average duration of stay in MICU was 5.84 days. Out of 351 patients admitted in MICU, 154 (43.87%) patients were treated and transferred to other wards or discharged, 185 (51.85%) patients were expired while 15 (4.27%) patients were discharged against medical advice (Table 1). The most common type of patients admitted in MICU have the diagnosis of organophosphorous poisoning (25.36%), followed by cerebrovascular accident (15.95%), pneumonitis (10.26%), snake bite (7.12%), chronic kidney disease (5.98%), diabetic ketoacidosis (5.70%) and seizure disorder (3.42%) (Table 2 and Figure 1).

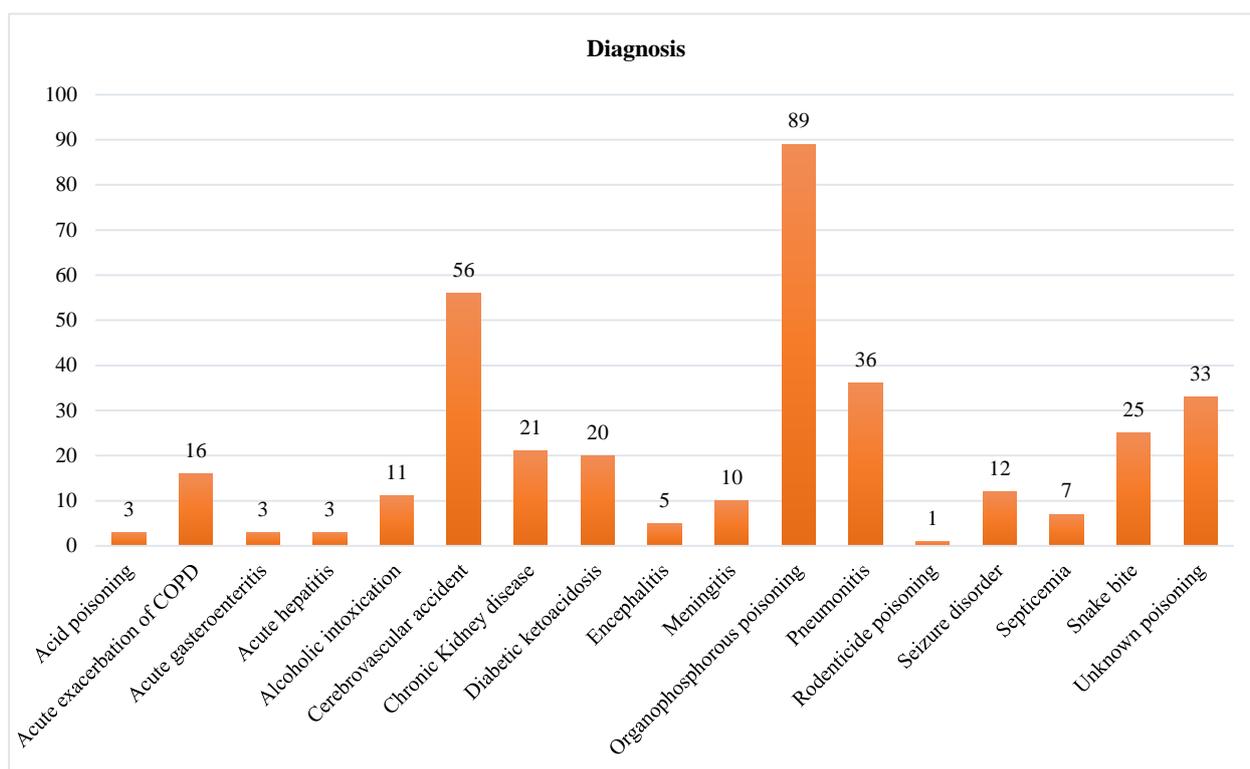


Figure 1: Types of diagnosis MICU.

Table 3: Various drugs used in MICU.

S. no.	Drugs	No. of prescriptions	Percentage (%)	ATC code
1	Ranitidine	350	99.71	A02BA02
2	Ondansetron	349	99.43	A04AA01
3	Metronidazole	215	61.25	J01XD01
4	Midazolam	151	43.02	N05CD08
5	Atropine sulphate	144	41.03	A03BA01
6	Cefotaxim	142	40.46	J01DD01
7	Ceftriaxone	137	39.03	J01DA13
8	Pralidoxime	125	35.61	V03AB04
9	Amoxicillin and Potassium clavulanate	94	26.78	A02BD04
10	Metoprolol	88	25.07	C07AB02
11	Ramipril	88	25.07	C09AA05
12	Cefoperazone and sulbactam	85	24.22	J01DD62
13	Paracetamol	61	17.38	N02DE01
14	Dexamethasone	56	15.95	S02BA06
15	Mannitol	56	15.95	B05BC01
16	Piperacillin and tazobactam	41	11.68	J01CR05
17	Acyclovir	41	11.68	J05AB01
18	Hydrocortisone	40	11.40	H02AB09
19	Meropenem	40	11.40	J01DH02
20	Lactulose	38	10.83	A06AD11
21	Multivitamins	37	10.54	A11AA03
22	Anti-snake venom	25	7.12	J06AA03
23	Sodium bicarbonate	24	6.84	B05CB04
24	Aspirin	23	6.55	B01AC06
25	Dalteparin	23	6.55	B01AB04
26	Tetanus toxoid	23	6.55	J07AM01

Continued.

S. no.	Drugs	No. of prescriptions	Percentage (%)	ATC code
27	Amikacin	22	6.27	J01GB06
28	Calcium lactate	21	5.98	A12AA05
29	Furosemide	21	5.98	C03CA01
30	Iron and folic acid	21	5.98	B03AE01
31	Telmisartan	21	5.98	C09CA07
32	Insulin	20	5.70	A10AD01
33	Neostigmine	20	5.70	N07AA01
34	Potassium sol	20	5.70	A12BA01
35	Salbutamol and ipratropium	16	4.56	R03AC02
36	Formetrol	16	4.56	R03AC13
37	Theophylline	15	4.27	R03DA04
38	Vancomycin	14	3.99	J01XA01
39	Levitraacetam	12	3.42	N03AX14
40	Phenytoin	12	3.42	N03AB02
41	Budesonide	9	2.56	R01AD05
42	Sodium valproate	7	1.99	N03AG01
43	Lorazepam	6	1.71	N05BA06
44	Serratiopeptidase	6	1.71	-
45	Tramadol	5	1.42	N02AX02
46	Rabeprazole	4	1.14	A02BC04
47	Ciprofloxacin	3	0.85	J01MA02
48	Cital syrup	3	0.85	-
49	Colistin	3	0.85	J01XB01
50	Dopamine	3	0.85	C01CA04
51	Lignocaine	3	0.85	D04AB01
52	Nitrofurantoin	3	0.85	J01XE01
53	Sucralfate	3	0.85	AO2BX02
54	Doxophylline	2	0.57	R03DA11
55	Salmeterol	1	0.28	R03AK06
56	Vitamin K	1	0.28	B02BA01

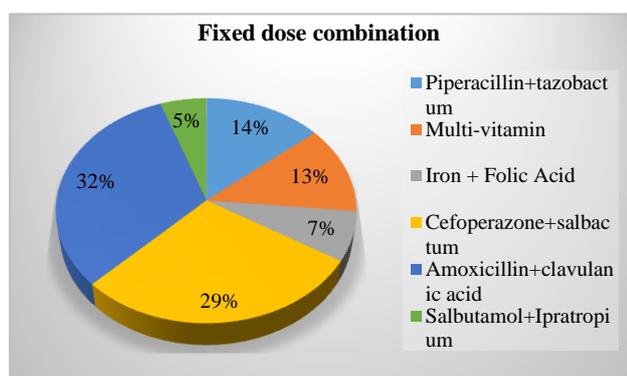


Figure 2: Most commonly prescribed fixed drug combinations.

Drug utilization pattern

A total of 351 patients from MICU received 2809 drugs, number of drugs prescribed per patient being 8.00 ± 2.13 (mean \pm SD) (Table 6). The most common drugs used were ranitidine (99.71%) and ondansetron (99.43%). Among antibiotics cephalosporins were most commonly used, ceftriaxone (39.03%), cefotaxim (40.46%), cefoperazone

and sulbactam (24.22%). Other antibiotics most commonly used were metronidazole (61.25%), amoxicillin and potassium clavulanate (26.78%), piperacillin and tazobactam (11.68%), meropenem (11.40%) (Table 3).

Table 4: Most commonly prescribed FDC.

Fixed dose combinations	No. of prescription	Percentage (%)
Amoxicillin and clavulanic acid	94	26.78
Cefoperazone and salbactam	85	24.22
Piperacillin and tazobactam	41	11.68
Multi-vitamin	37	10.54
Iron and folic acid	21	5.98
Salbutamol and ipratropium	16	4.56

The total number of drugs prescribed per prescription in MICU is most commonly between 5-8 (65.81%) drugs, between 9-12 were 27.35% and between 13-16 were

6.55% (Table 5). Using WHO drug prescription indicator, collected data were analyzed and found that average number of drugs prescribed per encounter in MICU was 8.00 ± 2.13 .

Percentage of encounters with injection in MICU was 84.94%, percentage of drugs from National list of essential medicine in MICU was 73.2%, percentage of drugs from WHO essential medicine list in MICU was 69.6% (Table 6).

Table 5: Total no. of drugs per prescription MICU.

No. of drugs	No. of prescription	Percentage (%)
5-8	231	65.81
9-12	96	27.35
13-16	23	6.55
1-4	1	0.28
Grand Total	351	100.00

Table 6: WHO core indicators.

S. no.	Core indicators	Percentage (%) MICU
1	Total number of drugs prescribed	2809
2	Average no. of drugs per prescription	8.0 (2809/351)
3	Total encounters having injectable formulation	84.94 (2386/2809)
4	Drugs mentioned in NLEM 2015	73.2
5	Drugs mentioned in WHO EML 2017	69.6

DISCUSSION

Intensive care unit is one of the busiest but neglected departments as far as drug utilization studies are concerned. Present study was intended to focus on drug use pattern in intensive care unit department. MICU is a setting where seriously ill patients who often suffer from multiple organ dysfunctions are administered. Therefore, the number of prescribed drugs and the cost of treatment and hospitalization are usually high.

Total 351 patient's case data was studied were from MICU. The data which was collected included demographic information of the patient (age and sex), diagnosis of the patient, treatment given, duration of stay in ICU and there clinical outcome.

The demographic parameters of the patients revealed the number of males admitted in the MICU was 69.23% while that of female was 30.77% which shows male admissions are almost double to that of female (Table 1 and Figure 1) This was also seen in other studies done by Anand et al, Barot et al, Gupta et al, Arathy et al,

Benjamin et al, respectively.⁸⁻¹² In contrast, a study done by Smythe et al in Detroit showed an equal proportion of male and female admitted to the ICU with a mean age of 64.6 ± 17.9 years.⁵ These findings suggest that in Indian settings more males are admitted to the ICU. The most likely reason for this finding could be that in India male population has more access to medical facility compared to females, who even in critical illnesses are reluctant to utilize health care facilities, especially in those of lower socioeconomic strata. Also certain diagnosis like poisoning and cerebrovascular accident have more incidence in males.

A wide spectrum of clinical diagnosis was observed in MICU. The most common diagnosis observed were organophosphorous poisoning (25.36%), cerebrovascular accident (15.95%), pneumonitis (10.26%), snake bite (7.12%), chronic kidney disease (5.98%), diabetic ketoacidosis (5.70%) and seizure disorders (3.42%). (Table 2 and Figure 1).

Poisoning was most common indication for admission, this is probably because of mostly low socio economic people and prevailing draught in this region, as the primary occupation of the people here is agriculture. Poisoning and snake bite persist to stay a major health problem in the current study. The most common type of poisoning was by consumption of pesticides, as they are readily available among farmers and households. After pesticides poisoning, snake bite is most common by both neurotoxic as well as vasculotoxic snakes. Organophosphorus compounds are common among the pesticides and their treatment included mainly atropine and oximes. Snake bite is a very serious but neglected public issue in various countries which affect mainly the rural population. In India, snake bites take a heavy toll of human lives, and therefore needs urgent attention.

The total number of drugs prescribed per prescription in MICU are most commonly between 5-8 (65.81%) drugs, between 9-12 were 27.35% and between 13-16 were 6.55% (Table 5). The average number of drugs per prescription, which was shown to be an important index of the standard of prescribing in this study was 8.002 (Table 6) which was higher than WHO recommended that average number of drug per prescription should be 2.0.

The average number of drugs per prescription in the study done by Gupta was 7.12, Arathy et al was 12.83, Al-Zakwani et al was 8.0 and Paudel et al was 11.94 respectively.^{10,11,13,14} It is possible that when the patient was ill and the diagnosis was not yet confirmed at the time of admission, empirical polypharmacy will be required. However, it is always preferable to keep the mean number of drugs per prescription as low as possible to reduce the cost of treatment and to minimize the adverse effects and drug interactions.

The majority (>95%) of drugs was prescribed by trade name. Physician prefers to write brand names of drugs of

repute rather than by generic names. According to some physicians, prescribing by generic name may result in the purchase of drugs of uncertain bioavailability due to lack of awareness about bioequivalence and regulatory that control generic drugs. However, prescribing by generic name helps the hospital pharmacy to have a better control of inventory. This will also help the pharmacy to purchase the drugs on contract basis, as the number of brands will be less. It can also reduce the confusion among the pharmacists while dispensing. Use of generic names of prescription eliminates the chance of duplication of drug products and reduces the cost of the patient.

In MICU drugs acting on gastrointestinal tract like ranitidine (H₂ antagonist) and ondansetron (5HT₃ receptor antagonist) were the most commonly used drugs, 99.71% and 99.43% respectively (Table 3). It is also seen in studies done by Kacha et al.⁷

The most frequently mentioned explanation for prescribing Ranitidine without an indication was gastrointestinal prophylaxis in order to inhibit gastric acid secretion and chances of nausea and vomiting in a majority of the cases. Physicians consider those patients without oral feeding or who were receiving nonsteroidal anti-inflammatory drugs, aspirin, corticosteroids, and chemotherapy are at a high risk of developing stress ulcers.

Use of ondansetron is off-label, as it is not recommended anywhere except chemotherapy/radiotherapy induced vomiting and post-operative nausea or vomiting. Ondansetron was shown to prolong QT interval. However, Patanwala et al suggested that based on the comparative safety and efficacy of ondansetron with droperidol, promethazine, prochlorperazine, metoclopramide, ondansetron may be used as a first line agent for relief of nausea or vomiting for most patient populations in the emergency department.¹⁵

Among antibiotics cephalosporins were most commonly used, ceftriaxone (39.03%), cefotaxim (40.46%), cefoperazone and sulbactam (24.22%). Other antibiotics most commonly used were metronidazole (61.25%), amoxicillin and potassium clavulanate (26.78%), piperacillin and tazobactam (11.68%), meropenem (11.40%).

Cephalosporin's, metronidazole and Penicillin's were the most commonly prescribed antimicrobials similar to studies done by Mamatha et al, Gupta, Drupad et al, John et al, showed the similar results.^{10, 16, 17, 18} But in the study done by Shankar et al. Penicillin's were the commonest antimicrobial drug class prescribed.¹⁹ Metronidazole was prescribed along with Cephalosporin's in majority of the prescription as the first line drug. The rationale behind prescribing metronidazole is that it covers the anaerobic infection which is quite common in hospital acquired infections.

Older intravenous antiepileptic agents, such as phenytoin were preferred in this study. This finding was in concordance to an earlier study from India like John et al and Biswal et al.^{18,20} Phenytoin was used mainly for seizure prophylaxis and maintenance therapy. Newer antiepileptic agents can replace phenytoin, due to its saturation kinetics, drug interactions, and adverse effects. Newer agents, such as levetiracetam are also frequently used in this study.

Limitations of the study

- In this study, we had not taken the prescription data after the patients were transferred from ICU to wards.
- Defined daily dose was not calculated which would have given a more knowledge on drug utilization.
- The utilization of intravenous fluids and various drug interaction among the prescribed drugs was not accounted.
- Pharmacoeconomic calculation of expenditures was not done

Future out looks

- Education to the healthcare professional.

The outlook of this study is to conduct interventional studies in order to compare the use and efficacy and cost effectiveness of two drugs within the same class in order to prepare an efficacious hospital formulary plan.

CONCLUSION

In conclusion, in this study we noticed that the most common emergencies in MICU were poisoning and cerebrovascular accident. After analyzing the prescriptions we found that in MICU utilization rate of drugs like gastroprotective (ranitidine), antiemetic (ondansetron) and antibiotics (cephalosporins) was in large quantities. The present study provides valuable insight about the overall pattern of drugs used in MICU. Physicians should be motivated to prevent inappropriate overuse of gastroprotective drugs and antimicrobials where it is not indicated so that polypharmacy can be reduced. The presence of a clinical pharmacologist in every ICU setup will ensure rational use of antimicrobials in a cost effective manner. The antimicrobial stewardship program is necessary for every hospital.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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