Drug Utilization Pattern in Adult Medical Intensive Care Unit of a Tertiary Care Hospital

Abstract

**Aims:** This study aims to evaluate the drug utilization pattern in terms of Defined Daily Dose (DDD) in adult Medical Intensive Care Unit. **Methods:** In this prospective study conducted over a period of 8 months, data pertaining to all adult (age ≥18 years) patients’ demography, diagnosis, treatment, and laboratory investigation were collected. The drugs were categorized by anatomical therapeutic classification, and their DDD was calculated. **Results:** A total of 452 patients were evaluated, of which 62.6% were males. The most common reason for hospitalization was cardiovascular disorder (21.4%), followed by respiratory disorder (21%) and central nervous disorder (20%). An average of 9.9 drugs was prescribed per patient. Nearly 52% of drugs were administered parenteral, 43% were oral and 5% were either nebulization or topical. Among the drugs prescribed, the most common drugs were pantoprazole, ondansetron, aspirin, furosemide, and atorvastatin and most common antimicrobials were ceftriaxone followed by piperacillin + tazobactam and metronidazole. **Conclusions:** Drug utilization produces an important impact on quantitative data for Intensive Care Unit patients and should be conducted regularly so as to understand the drug consumption as well as for protocol implementation to improve the quality of health care.

**Keywords:** Anatomical therapeutic Chemical classification system, Drug utilization research, Intensive care unit

Introduction

The marketing, distribution, prescription, and use of drugs in a society, with special emphasis on the resulting medical, social, and economic consequences are drug utilization research. Drug utilization research may provide insights into different aspects of drug use and prescribe such as pattern, quality, determinants, and outcome of drug use as well as economic outcomes.

Intensive Care Unit (ICU) provides critical care which is fast-paced, complex and commonly requires urgent high-risk decision-making, often with incomplete data, leading to use of a large number of drugs making the cost of hospitalization and drug treatment high.

Defined Daily Dose (DDD) is internationally accepted measuring unit for drug utilization research. The present study was done to understand the pattern of drug use and evaluating the drug utilization pattern in terms of DDD in adult medical ICU (MICU).

Methods

A prospective study was conducted in tertiary care hospital over a period of 8 months from August 2016 to March 2017 and included 452 adult patients admitted to 15-bedded MICU. Modified patient profile form was developed to collect data of individual patient according to the inclusion criteria of all ICU patients above 18 years. Data obtained were assessed for the age and gender distribution, reason for hospitalization, total number of drugs, drug class, indication, dose, and route of administration.

The DDD is the assumed average maintenance dose per day for a drug used for its main indication in adults. Only one DDD is assigned based on Anatomical Therapeutic Chemical (ATC) classification system and route of administration. Therapeutic doses for individual patients and patient groups are based on characteristics (such as age, weight, ethnic differences, type, and severity of disease) and pharmacokinetics; therefore, they will always differ from DDD. The drugs were...
categorized based on ATC and DDD were calculated. The DDD/100 bed-days was calculated using following formula:

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\text{DDD} / 100 \text{ bed days} = \frac{\text{Total dose in mg during study period} \times 100}{\text{DDD of the drug} \times \text{study duration (days)} \times \text{bed strength} \times \text{average bed occupancy rate}}
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Descriptive statistics were used.

**Results**

A total of 452 patients were admitted in adult MICU during the study period. Of which 283 (62.6%) were males and 169 (37.3%) were females. Mean age of patients was 57 and 146 (32%) of total patients were above 65 years. The most common reason for hospitalization based on organ system was cardiovascular disorder (21.4% [97]), followed by respiratory disorder (21% [95]) central nervous disorder (20% [94]) [Figure 1]. Most of the patients had more than one comorbid condition. Hypertension (181) and diabetes mellitus (128) accounting as the most frequent comorbid condition followed by ischemic heart disease (85), chronic kidney disease (39), and chronic obstructive pulmonary disease (21). Average length of stay per patient was 4.8 days.

A total of 4467 medication were prescribed during the study period in ICU. An average of 9.9 drugs was prescribed per patient. About 2329 of drugs were administered parenteral, 1913 were oral, and 225 were either nebulization or topical. The drugs were categorized according to ATC classification [Table 1]. Most of the drugs were prescribed from alimentary tract and metabolism (1226), followed by blood and blood-forming agents (842), cardiovascular system (777), and anti-infective for systemic use (634). Among the drugs prescribed, the most common drugs were pantoprazole, followed by ondansetron, aspirin, furosemide, and atorvastatin. In antimicrobials, the most common drugs were ceftriaxone followed by piperacillin + tazobactam and metronidazole. Of total prescribed drugs, 268 (6%) was given as fixed drug combination (FDC). The commonly prescribed FDCs were piperacillin-tazobactam, (80) followed by ipratropium bromide/levosalbutamol (71) and amoxicillin-clavulanic acid (15). DDD/100 bed-days of most commonly prescribed drug and most frequently prescribed antibiotics are shown in Tables 2 and 3, respectively.

**Discussion**

In a prospective study conducted for 8 months in adult MICU, about of 452 patients were included, of which the number of male patients (62.6%) were predominant to female (37.3%) admits which is in accordance to previous studies.[4‑6] In the present study, 32% of patients are above 65 years which is similar to other ICU studies where elderly populations are mostly admitted.[5,6] The most common underlying comorbid conditions were hypertension (40%) and diabetes mellitus (28%) which is similar to Kaur et al. and also provides evidence to existing increasing status of this condition as burden of developing and developed countries.[7] Advancing age and preexisting comorbidities seen in critically ill patients may influence the decision to provide ICU care, decisions regarding types and intensity of ICU treatment options, and outcomes.[8]

### Table 1: ATC code of commonly prescribed drugs in ICU

| ATC class                              | Number of medication (%) | ATC code |
|----------------------------------------|--------------------------|----------|
| Alimentary tract and metabolism        | 1226 (27)                | A02BC02  |
| Pantoprazole                           | 345                      | A04AA01  |
| Ondansetron                            | 343                      | A02BC04  |
| Rabeprazole                            | 93                       | A02BC04  |
| Blood and blood-forming agents         | 842 (18.8)               | B01AC06  |
| Aspirin                                | 167                      | B01AC04  |
| Clopidogrel                            | 105                      | B01AB05  |
| Enoxaparin                             | 75                       |          |
| CVS                                    | 777 (17.3)               | C03CA01  |
| Furosemide                             | 160                      | C10AA05  |
| Atorvastatin                           | 159                      | C08CA01  |
| Amiodipine                             | 84                       |          |
| Systemic hormonal preparations, excluding sex hormones and insulin | 135 (3)                  |          |
| Hydrocortisone                         | 68                       | C05AA01  |
| Thyroxine                              | 25                       | H03AA01  |
| Anti-infectives for systemic use       | 634 (14)                 | J01DD04  |
| Ceftriaxone                            | 140                      | J01CR05  |
| Piperacillin + tazobactam              | 57                       | J01CR05  |
| Nervous system                         | 468 (10)                 |          |
| Paracetamol                            | 110                      | N02BE01  |
| Tramadol                               | 47                       | N02AX02  |
| Respiratory system                     | 385 (8.6)                |          |
| Salbutamol                             | 87                       | R03AL02  |
| Ipratropium                            | 73                       | R03BB01  |

ATC: Anatomical therapeutic chemical, CVS: Cardiovascular system

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![Figure 1: Common cause for hospital admission](image)
In the present study, the average length of stay of patient is 4.8 days which is similar to Patel et al.[4] Prolonged stay in the ICU increases the overall costs and consumes more resources and also increases the risk of adverse drug reaction. Therefore, early discharge from ICU plays a major role in minimizing economic burden.[9]

In the present study, the average number of drugs prescribed per patient is 9.9 which are less than or higher than other studies.[5,6] The difference can be due to different hospital setups, patient characteristics, and drug policy. It is important to optimize the administration of drug to minimize drug-drug interaction and antibiotic resistance.

In the present study, the most frequent route of administration of drug is parenteral (52%) followed by oral route (42.8%). Other ICU studies also document that parenteral route is the most frequent route of administration.[5,6,10] Since patients admitted in ICU require rapid therapeutic intervention, parenteral dose can provide immediate onset of action.

In the present study, the most commonly prescribed drug is pantoprazole which has been documented in Balaji et al. and Patanaik SK et al.[6,7] Pantoprazole suppresses gastric acid secretion, prevents upper gastrointestinal bleeding, and promotes mucosal healing. Finding in the present study is sensible since Mohebbi and Hesch observed that between 75% and 100% of ICU patients had stress-related mucosal disease within 24 h of admission. As a result, administration of acid suppression therapy for stress ulcer prophylaxis in the ICU is well recommended to prevent gastrointestinal bleeding.[11] In the present study, use of anti-infective as prophylaxis is a higher accounting about 14% of total drugs prescribed. It has been documented that the incidence of nosocomial infection in ICU is about 2–5 times higher than in the general inpatient hospital population.[12] Mythri and Kashinath show 17.7% incidence of nosocomial infection in MICU patients. This might be one of the probable reasons for the increased number of anti-infective prescription.[13] Of total drugs prescribed, only 6% were FDC. Shah et al. have documented about 70.83% of FDC prescription.[14] It is difficult to independently adjust the dose of drugs in FDC and to identify the therapeutic effect and adverse effect of one particular drug content. In the present study, there is relatively minimal use of FDCs reflecting the rational use of drugs.

In the present study, the DDD of pantoprazole and furosemide was 25.7 and 20.2 DDD/100 bed-days, which is less than a study reporting 48.9 and 23.7 DDD/100 bed-days. 26 DDD/100 bed-days of ceftriaxone is also less than the Patanaik et al. which is 23.7 DDD/100 bed-days.[5]

Our study has some limitations. The data pertaining to our study cannot be generalizable to critical care units with a substantial different means of the severity of illness or markedly different patient types such as surgical and neurological ICUs as well as the nonteaching hospital. Moreover, in our study, we have not assessed the cost of drug therapy which would have helped to understand the financial burden of ICU patients.

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Conflicts of interest
There are no conflicts of interest.

References
1. Introduction to Drug Utilization Research; 2013: Chapter 1: What is drug utilization research and why is it needed?: 1.1. Definition and domains; Available from: http://apps.who.int/medicinedocs/en/d/Js4876e/2.html. [Last accessed on 2018 Jul 23].
2. Lat I, Micek S, Janzen J, Cohen H, Olsen K, Haas C, et al. Off-label medication use in adult critical care patients. J Crit Care 2011;26:89-94.
3. WHOCC – Definition and General Considerations. Available from: https://www.whocc.no/ddd/definition_and_general_considera/. [Last accessed on 2018 Feb 27].
4. Patel MK, Barvaliya MJ, Patel TK, Tripathi C. Drug utilization pattern in critical care unit in a tertiary care teaching hospital in India. Int J Crit Illn Inj Sci 2013;3:250-5.
5. Patanaik S, Pattanayak C, Prasad A, Chauhan A. Drug utilization pattern in an Intensive Care Unit setting in Eastern India. Int J Basic Clin Pharmacol 2015;4:1136-41.
6. Balaji V, Aithal S, Geetha S, Swetha ES. Utilization pattern among geriatric patients admitted in medical Intensive Care Unit of a tertiary care teaching hospital. Asian J Pharm Clin Res 2015;8:281-3.
7. Kaur S, Rajagopalan S, Kaur N, Shafiq N, Bhalia A, Pandhi P, et al. Drug utilization study in medical emergency unit of a tertiary care hospital in North India. Emerg Med Int 2014;2014:973578.
8. Esper AM, Martin GS. The impact of comorbid [corrected] conditions on critical illness. Crit Care Med 2011;39:2728-35.
9. Perez A, Chan W, Dennis RJ. Predicting the length of stay of patients admitted for intensive care using a first step analysis.
Health Serv Outcomes Res Methodol 2006;6:127-38.
10. Al-zakwani I, Al-thuhli M, Al-hashim A, Al Balushi K. Drug utilization pattern in an Intensive Care Unit at a tertiary care teaching hospital in Oman. Asian J Pharm Clin Res 2017;10:194.
11. Mohebbi L, Hesch K. Stress ulcer prophylaxis in the Intensive Care Unit. Proc (Bayl Univ Med Cent) 2009;22:373-6.
12. Dasgupta S, Das S, Chawan NS, Hazra A. Nosocomial infections in the Intensive Care Unit: Incidence, risk factors, outcome and associated pathogens in a public tertiary teaching hospital of Eastern India. Indian J Crit Care Med 2015;19:14-20.
13. Mythri H, Kashinath K. Nosocomial infections in patients admitted in Intensive Care Unit of a tertiary health center, India. Ann Med Health Sci Res 2014;4:738-41.
14. Shah S, Patel J, Desai M, Dikshit R. Critical analysis of antimicrobial and respiratory fixed dose combinations available in Indian market. Int J Med Public Health 2015;5:161.