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Review Article

Analysis of Mortality, Morbidity, and the Provision of Pharmaceutical Care Services in Intensive Care Admitted Patients–An Overview

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ABSTRACT

Critical care pharmacist in the Intensive Care Unit (ICU) provides pharmaceutical care services to improve the quality of care for ICU patients by identifying and resolving drug-related problems and monitoring drug therapy for safety and efficacy. The clinical pharmacist plays a vital role in the care of critically ill patients. The morbidity and mortality of ICU patients vary depending on the patient's age, underlying health conditions, and severity of their illness. The mortality rate for ICU patients is high. According to the Society of Critical Care Medicine (SCCM), the average mortality rate for adult ICU patients was 10% to 29%. However, the mortality rate is much higher in patients with certain disease conditions, such as sepsis (30% to 50%), Acute Respiratory Distress syndrome (ARDs) (40% to 60%), and Acute Myocardial Infarction (AMI) (20% to 30%). Clinical pharmacists in the ICU team can help to reduce and prevent medication errors, drug-related problems, drug interactions, and adverse drug events and improve patient outcomes. Pharmaceutical care services include medication reconciliation, drug dosing calculation in patients with reduced renal and hepatic function, therapeutic drug monitoring, medication optimization, adverse event reporting, and patient counseling. Pharmaceutical care services in the ICU are designed to improve the safety and effective use of medications and the quality of care for critically ill patients.

Keywords: Pharmaceutical care services, Critically ill, Intensive care unit, Clinical pharmacist.

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INTRODUCTION

The Critical Care Unit (CCU) is a specialized division that offers advanced, ongoing treatment to seriously ill patients who need close observation and assistance for their health care or vital functions. Critical care intensivists physicians, nurses, respiratory therapists, clinical pharmacists, and other health care professionals collaborate to provide coordinated and individualized treatment to each patient along with specialized medical equipment.

The World Federation of Societies of Intensive and Critical Care Medicine (WFSICCM) defined "Intensive care is not just a clinical specialty but a system of care delivered by a skilled interprofessional team that includes physicians, nurses, respiratory therapists, physiotherapists, pharmacists, microbiologists, social workers, ethicists, spiritual care, and many others" in its task force report from 2017.[1] The importance of the ICU in a hospital lies in its ability to provide life-saving interventions and improve patient outcomes. Patients who require ICU care are often at a high risk of complications and mortality, and the advanced monitoring and interventions provided in the ICU can significantly improve their chances of survival and recovery.

Advanced cardiac life support, hemodynamic monitoring, Mechanical ventilation as well as other invasive and non-invasive interventions, advanced care, and monitoring for critically ill patients are all provided by ICUs, which are specialized units. In addition, the ICU team continuously evaluates and monitors the patient's vital signs, laboratory results, and treatment response, adjusting the treatment plan as necessary. ICUs are also associated with significant rates of mortality and morbidity, despite the availability of cutting-edge medical technology and highly trained healthcare professionals, both of which play a crucial role in enhancing patient outcomes. which might vary a lot based on

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things like the population of patients, the severity of the illness, and the quality of care that is provided. However, depending on the patient population and the severity of their illness, global estimates suggest that mortality rates in the intensive care unit can range anywhere from 10% to 50%.[2-10]

Due to the higher disease burden due to lifestyle changes and limited resources in developing nations, intensive care unit mortality and morbidity have been a source of concern. A 2018 study that looked at data from 111 intensive care units in 27 developing nations found that the intensive care unit mortality rate was 34.9%, which was higher than the rate reported in developed nations (16.6%). Additionally, the study found that respiratory failure and cardiac arrest were the next most common causes of ICU admission and death.[11]

Another study, which was published in the Indian Journal of Critical Care Medicine in 2019, looked at data from 4,243 admissions to the critical care unit in a tertiary care center in India. It found that 18.7% of patients died in the intensive care unit. Additionally, the study found that respiratory failure and neurological disorders were the next most common causes of admission and death. Sepsis was the most common cause of death.[12] In developing nations, critical care, and intensive care units face challenges with morbidity in addition to high mortality rates. Nearly 70% of ICU survivors in a Nigerian tertiary hospital had experienced physical, cognitive, or mental impairment according to the study published in the African Journal of Emergency Medicine 2017. Muscle weakness, anxiety, and depression were the most frequently mentioned impairments.[13]

India like other developing countries faces several other challenges in providing critical care services to its population. There is a paucity of data on ICU mortality and morbidity rates in India, but available studies suggest that mortality rates in ICUs vary widely depending on several factors, including the type of ICU, the patient population, and the underlying disease or condition and other comorbidities. A study conducted by Divatia *et al.* in 2016 analyzed data from 12 ICUs in India and found an overall ICU mortality rate of 18.9%. The study also found that mortality rates were higher in medical ICUs (23.1%) compared to surgical ICUs (11.3%).[14]

Another study by John *et al*. in 2017 reported an ICU mortality rate of 23.4% in a tertiary care hospital in South India. The study analyzed data from 1,375 patients who were admitted to the ICU over a period of two years and found that sepsis was the most common reason for ICU admission and mortality.[15] A more recent study by Kumar *et al*. in 2020 reported an ICU mortality rate of 31.3% in a COVID-19 ICU in India. The study analyzed data from 200 patients admitted to the ICU and found that older age, diabetes, and hypertension were independent predictors of ICU mortality.[16]

These studies suggest that critical care and intensive care in developing countries face unique challenges and countries like India with its relatively high ICU mortality rates, not only need better resource allocation and healthcare infrastructure, also require targeted interventions to improve patient outcomes.

FACTORS INFLUENCING ICU MORTALITY AND MORBIDITY

ICU mortality and morbidity can be influenced by factors, including disease-related factors, patient-related factors, and health-related factors.[17-19] Here are some common factors that contribute to ICU mortality and morbidity.

Age: Older age is associated with elevated morbidity and mortality in the ICU, as older patients may have more comorbidities and less physiological reserve.

Severity of illness: Patients with more severe illness or organ dysfunction are at higher risk for mortality and morbidity in the ICU.

Comorbidities: Patients with medical conditions, such as diabetes or heart disease, may prone to higher risk of complications and worse outcomes in the ICU.

Infection: Infections acquired in the ICU, such as pneumonia or bloodstream infections, can lead to increased mortality and morbidity.

Medication therapy problems: Medication errors, adverse drug reactions, and other drug therapy problems can contribute to adverse outcomes in the ICU.

Mechanical ventilation: Patients on mechanical ventilation are at increased risk for complications, such as ventilator-associated pneumonia, and may experience longer ICU stays.

Healthcare-related factors: Factors related to the quality and delivery of healthcare, such as staffing levels, the use of protocols and guidelines, and the availability of resources, can influence ICU outcomes.

It is worth noting that these factors are often interrelated and can have complex interactions. Healthcare professionals in the ICU must take a multidisciplinary approach to identify and manage these factors to improve outcomes for critically ill patients.

DRUG THERAPY PROBLEMS IN THE ICU

Several studies have investigated the prevalence and nature of drug therapy problems in the ICU.

Drug interactions: A study conducted in a medical ICU found that 73% of patients had potential drug-drug interactions, and 32% of patients had clinically significant drug-drug interactions. Another study reported that 45% of ICU patients had at least one major drug-drug interaction.[20]

Adverse drug reactions: 36 studies of systematic review reported that the incidence of adverse drug reactions in the ICU ranged from 1.3% to 25%, with an overall incidence of 10.6%.[21] Another study reported that 38% of ICU admissions had at least one adverse drug reaction, and 20% of ICU admissions had an adverse drug reaction that was likely preventable.[22] In a study of 250 ICU patients, 28% experienced an adverse drug event, and 42% of these events were considered preventable.[23]

Medication errors: In the ICU specifically, medication errors have been found to contribute to up to 56% of all adverse events.[24] Medication errors were associated with a 2.3-fold increased risk of ICU readmission.[25] Medication errors in the intensive care unit were found to occur at an overall rate of 12.7 per 100 patient days,[26] according to a meta-analysis and systematic review of 24 studies.

A study conducted in a medical-surgical ICU found that 22% of medication orders had at least one dosing error, and 8% of medication orders had a potentially harmful dosing error.[27]

A study reported that 50% of ICU patients received at least one medication that was prescribed outside of recommendation dosing guidelines.[28]

Serious errors and adverse events in intensive care patients were frequent and potentially fatal. Even though different types of medication errors were identified and failure to carry out intended treatment correctly was the leading category.[29]

Impaired drug metabolism and elimination: Drug toxicity and underdose- Critically ill patients are at increased risk of drug toxicity and may not receive the benefit of medications as well as not be able to absorb and distribute the drugs as well. To avoid these problems, it is important to monitor the intensive care admitted patients for signs of drug toxicity or underdose. The dosage of medications may need to be adjusted to account for the impaired drug metabolism and elimination.

Some specific examples of drugs that can be affected by impaired drug metabolism and elimination in the ICU:

Propofol is a sedative and Fentanyl is a pain medication commonly used in the ICU. It is metabolized by the liver. In critically ill patients with liver damage, the clearance of both drugs may be decreased, leading to prolonged sedation and increased risk of overdose.[30]

Digoxin is a heart medication eliminated by the kidneys. In critically ill patients with kidney damage, the clearance of digoxin may be decreased, leading to an increased risk of toxicity.

A study conducted in a medical ICU found that 81% of patients had at least one episode of subtherapeutic or supratherapeutic drug levels.[31] The study reported that 31% of ICU patients had at least one medication that required dosage adjustment due to renal dysfunction.[32]

These statistics highlight the high prevalence of drug therapy problems in the ICU and underscore the importance of appropriate medication management to improve patient outcomes. Healthcare professionals should be vigilant in monitoring patients for potential drug therapy problems and take appropriate measures to prevent and manage them.

ROLE OF A MULTIDISCIPLINARY TEAM IN MITIGATING ICU MORTALITY AND MORBIDITY

A multidisciplinary team led by an intensivist in the ICU consists of healthcare professionals from different disciplines who work together to provide comprehensive care for critically ill patients. The team is typically led by an ICU specialist or intensivist and includes nurses, respiratory therapists, pharmacists, dietitians, physical therapists, social workers, and other specialists as needed. Each member of the multidisciplinary team has a specific role and expertise in providing care to critically ill patients.[33-36]

Impact of clinical pharmacist services in ICU: It has a positive impact on patient outcomes in the ICU. Here are some examples of the impact of these services.

Improved medication safety: Critical care pharmacists can help to prevent drug-related problems and medication errors by reviewing medication orders, monitoring drug interactions, and providing education to healthcare providers. A study found that the implementation of a pharmacist-led medication safety program in the ICU reduced medication errors by 34%Therefore, clinical pharmacist plays a crucial role in the provision of safe and optimized medication therapy while reducing medication errors and adverse drug interaction[16,37] in critically ill patients.

Optimal drug dosing: Critical care pharmacists can also help ensure that patients receive appropriate dosing of medications, especially those with narrow therapeutic indices. One study found that pharmacist-led interventions in the ICU resulted in more appropriate dosing of antimicrobial agents and fewer cases of renal toxicity.[38]

Improved adherence to clinical guidelines: Critical care pharmacists can also help improve adherence to clinical guidelines for various disease states in the ICU. One study found that pharmacist-led interventions in the ICU improved compliance with sepsis management guidelines and reduced mortality rates.[39]

Reduced length of stay and healthcare costs: By improving medication safety and optimizing drug dosing, critical care pharmacist services can also lead to a reduction in the length of ICU stay and overall healthcare costs. One study found that pharmacist-led interventions in the ICU resulted in a 2-day reduction in ICU length of stay and a $3000 reduction in hospital costs per patient.[40]

Medication reconciliation: The critical care pharmacist can perform medication reconciliation, which involves comparing the

patient's current medication list to the medication orders in the ICU to identify any discrepancies or potential drug interactions. This process can help prevent medication errors and improve medication safety.[41]

Intravenous medication compatibility: The critical care pharmacist can ensure the compatibility of intravenous medications to prevent potential incompatibilities that can lead to adverse events.[42]

Therapeutic drug monitoring and Pharmacokinetic dosing: Critical care pharmacists can provide pharmacokinetic dosing recommendations for medications that require therapeutic drug monitoring, such as vancomycin and aminoglycosides. This helps ensure that patients receive appropriate doses that are safe and effective.[43]

Patient education: The critical care pharmacist can educate patients and their families on medication therapy, potential side effects, and proper administration techniques. This can help improve medication adherence and prevent medication errors.[44]

Adequate staffing for pharmaceutical care services in critical care units allows time for prescription review and maximal therapy optimization[46] Critical care pharmacists or clinical pharmacists improve the health-related quality of life and efficiency of medication therapy and reduce the economic burden on prolongation of hospital length of stay.[45-48]

Such a collaborative approach through a multidisciplinary team improves clinical outcomes[49] and reduces the associated mortality and morbidity among medical ICU patients.[34,50]

Intensive care units were found to be associated with shorter hospital stays and lower mortality rates for critically ill patients, according to a 2015 study that was published in the Journal of the American Medical Association (JAMA).

The study, which examined data from over 90,000 patients in 210 US hospitals, found that ICU care was associated with a 9.5% decrease in mortality rates and a 2.4-day decrease in hospital stays.[52] Patients with sepsis, a potentially fatal condition caused by a systemic inflammatory response to infection, had better outcomes when they received care in the ICUs, according to a second study that was published in Critical Care Medicine in 2021. A study that looked at data from over 100,000 patients in 465 US hospitals found that ICU care was linked to lower mortality rates, shorter hospital stays, and lower costs for treating sepsis patients.[51]

It is difficult to quantify the extent to which a shortage of specialized pharmacists contributes to mortality and morbidity in Intensive Care Units (ICUs) or critical care units. There is no single cause for these outcomes. Even though drug-related issues and medication errors are major contributors to poor outcomes in intensive care unit patients, they are just one of many factors that can affect outcomes.

Having a specialized clinical pharmacist on the ICU team, however, has been shown to improve patient outcomes and reduce medication errors. A systematic review and meta-analysis that was published in the Journal of Critical Care in 2018 found that having a critical care clinical pharmacist in the ICU was associated with a significant reduction in drug-related issues, length of hospital stay, mortality, and medication errors.[52]

CONCLUSION

The critical care unit is an imperative part of a medical care administration, giving high-level and concentrated care to intensive patients. It is crucial to improving patient outcomes, lowering mortality rates, and providing support to the patient's family members during a challenging time. The significance and efficacy of ICU care in enhancing patient outcomes and lowering healthcare costs by clinical pharmacist services. The drug-related issues were significantly reduced when clinical pharmacists were involved in critical care rounds. To reduce medication-related harm and improve patient outcomes, must prioritize the inclusion of specialized pharmacists in the intensive care units.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

ABBREVIATIONS

CCU: Critical care unit; **ICU:** Intensive care unit; **WFSICCM:** World federation of societies of intensive & critical care medicine; **JAMA:** Journal of American Medical Association; **US:** United states.

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