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Research Article

# Assessment of the Logical Prescription of Albumin Drug According to Guideline and Patient Safety for Inpatients in Intensive Care Units of Iranian Hospital: A Cross-Sectional Study

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**ABSTRACT**

**Background:** Medication errors in healthcare settings, including outpatient and hospital environments, pose a significant risk to patient safety. These errors can arise from incorrect dosages, drug interactions, contraindications, or inappropriate drug combinations.

**Methods:** This study aimed to assess the logical prescription of albumin according to guidelines and patient safety for inpatients in the intensive care units of Imam Reza Hospital in Mashhad through a cross-sectional study. Methods: Data were collected over a 3-month period from albumin prescriptions in intensive care units, using a checklist based on information from prescription forms, patient files, and consultations.

**Results:** The study found that 60.57% of albumin prescriptions were reviewed by DUE unit, with 51.53% complying with guidelines and 48.47% not. The highest prescription rate was in the Intensive Care Unit of Heart Surgery (ICUOH), at 36.83%, and the lowest in the Neonatal Intensive Care Unit (NICU), at 0.63%. The patient safety parameter, calculated based on correct/incorrect albumin prescriptions according to guidelines, showed an average safety of 67.10% across prescribing units and 62.34% based on indications. It reduced the financial burden caused by inappropriate prescriptions approximately $21,390 through DUE process.

**Conclusion:** The research highlights the importance of continuous guideline-base DUE on rational drug utilization, patient safety and hospitals costs.

## Introduction

Drug Utilization Evaluation (DUE) is a continuous, systematic program based on medical assessment criteria and a method for collecting information to identify drug-related issues [1-2]. According to the World Health Organization (WHO), the Drug Utilization Evaluation program includes medical, social, economic, marketing, distribution, prescription, and rational use approaches to drugs in society [3]. In a DUE program, drug prescribing and consumption are evaluated against predetermined standards and guidelines, and efforts begin to correct prescribing and consumption patterns that do not comply with these standards [4].

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The concept of patient safety has gained prominence since the Institute of Medicine's 1999 report "To Err Is Human." This landmark publication drew attention to preventable medical errors, leading to the emergence of patient safety as a critical area of focus in healthcare [5]. However, despite growing awareness, there remains no universally accepted consensus on how to measure patient safety effectively. As highlighted by Singla et al., assessing patient safety culture requires careful consideration of various measurement tools and approaches [6].

Drug safety is a fundamental concept that can also be used to measure patient safety. This concept includes many aspects, such as preventing side effects, medication errors, adverse drug events, and other drug-related issues [7]. Hospital wards are prone to medication errors, and prescription errors are the most common type of medication error [7]. These errors can be classified into two main categories. The first category involves errors such as incorrect dosage selection of a drug, lack of drug interaction check, contraindications, or misuse of a drug or inappropriate drug combinations. While, the second category of errors includes selecting an inappropriate therapeutic approach, such as insufficient drug prescription or failure to prescribe drugs according to conditions listed in drug therapy guidelines [8].

Recent studies also have emphasized the importance of DUE programs in improving patient safety and optimizing resource allocation in healthcare institutions. As noted by Hingorani et al., quality improvement processes can enhance antibiotic adherence in treatment of acute upper respiratory infections [9]. This aligns with the broader goals of DUE programs in addressing drug-related issues and improving patient outcomes.

Furthermore, the study's focus on measuring adherence to guidelines resonates with Davis et al.'s systematic review on changing physician performance through continuing medical education strategies [10]. Additionally, the emphasis on patient safety aligns with recent advancements in clinical decision support systems, such as those discussed by Garg et al. [11] and Roberts et al. [12], which have shown promise in improving prescribing practices and patient outcomes.

On the other hand, some prescribed drugs for hospital patients, besides being overused, also incur high costs for procurement and management. The high cost of prescription drugs significantly limits healthcare budgets and available funds for other areas where public investment is needed and has become a significant concern in healthcare. As noted by Vincent Rajkumar, the rising costs of prescription drugs pose challenges for both patients and healthcare providers [13]. This underscores the need for efficient drug utilization evaluation processes to optimize resource allocation within healthcare systems. Nevertheless, there are no alternatives for many drugs, it is clear that to support logical prescription and use of these drugs, there is a need for quantitative, qualitative, and safety-based evaluations [14].

In addition to the challenges posed by drug costs, there are concerns about the appropriate use of drugs in populations. Kimland et al.'s study on pediatric drug use in Swedish hospitals highlights the importance of careful consideration in prescribing drugs for children [15]. This emphasizes the need for thorough drug utilization evaluation processes, especially when dealing with vulnerable patient groups.

The effectiveness of drug utilization evaluation programs can vary depending on factors such as the availability of guidelines and the level of training provided to healthcare professionals. As demonstrated by Westphal et al., enhanced physician adherence to antibiotic use guidelines can be achieved through increased availability of guidelines at the time of drug ordering in hospital settings [15]. This suggests that implementing similar strategies could potentially improve the overall efficiency and safety of drug utilization evaluation processes.

The drug utilization evaluation process is also carried out in some hospitals of Iran to increase the logical prescription of drugs and reduce the use of expensive hospital drugs. Among these drugs, which are evaluated after prescription until drug delivery in Iranian hospital units, albumin 5% or 20% can be mentioned, which is prescribed by a specialist doctor in Iranian hospitals. Albumin is prepared from human blood and is one of the most expensive and overused hospital drugs. This drug increases plasma volume or serum albumin levels. This drug is used to increase blood volume in emergencies and severe burns, as well as for treating hypoproteinemia caused by various clinical conditions, including major surgeries and organ transplants, dialysis, nephrotic syndrome, abdominal infections, liver failure, pancreatitis, respiratory distress syndromes, types of surgery, heart failure, plasmapheresis therapy, ovarian problems due to fertility drugs, and other diseases.

In this study, we aim to examine the logical prescription of albumin for inpatients in intensive care units of hospitals through measuring physicians' adherence to drug therapy guidelines when prescribing prescriptions, and by measuring the rate of prescription approval/rejection by the hospital's drug utilization unit and consistency with compliant/non-compliant prescriptions based on guidelines, and measuring the patient safety rate as appropriate prescriptions. We intend to use the results of this cross-sectional study in designing better future studies on providing technology-based interventions to facilitate the drug utilization evaluation process and improve patient safety

Also, this comprehensive examination of albumin prescription in ICUs not only addresses a critical issue in healthcare but also contributes to the broader discourse

on optimizing drug utilization and enhancing patient safety in hospital settings. By leveraging insights from DUE programs, patient safety initiatives, and technological innovations in healthcare, this study aims to provide valuable insights for improving drug utilization and patient outcomes in clinical practice.

## Methods

The Drug Utilization Evaluation Unit in Iranian hospitals daily receives numerous requests for prescription and drug consultation concerning selected expensive and overused hospital drugs, including albumin, to evaluate and consult logically and correctly before distribution and drug use. In the Drug Utilization Evaluation Unit of Imam Reza Hospital Mashhad, the correctness of the prescription of expensive and overused hospital drugs is assessed through pharmaceutical consultation forms and standard operating procedures. In this unit, a specialized clinical pharmacist reviews the patient's history and clinical condition, obtains necessary information such as laboratory metrics from the hospital information system, and examines other parameters needed for the requested drug prescription based on the chosen indication for the patient and drug therapy guidelines.

The request for drug prescription is then approved or rejected. Notably, in some cases, to assess vital signs and the general condition of the patient or access to some information included in the patient's file consistent with the determined indication in the consultation form and physical examination, the relevant expert is obliged to personally attend the patient's bedside in the ward and extract the necessary information for approving or rejecting the drug prescription and dispensing from the patient's file. Upon approval of the prescribed drug by the Drug Utilization Evaluation Unit, the drug is delivered to the ward by the hospital's clinical pharmacy upon registration of the drug request in the hospital's information system.

### Study design

Imam Reza Hospital Mashhad, with 856 beds, more than 17 inpatient departments, 10 specialized outpatient clinics, and paraclinical sections, is one of the largest primary educational and therapeutic centers in Iran. This study is descriptive cross-sectional research conducted to investigate the effect of drug utilization evaluation on the logical prescription and use of albumin for inpatients in the intensive care units of Imam Reza Hospital and to measure the patient safety rate based on the alignment of prescriptions with guidelines. The study was designed and conducted from May 22nd, 2023 to August 22, 2023.

### Study population and inclusion criteria

As mentioned earlier, the present study is a retrospective observational study. To determine the study population, initially, based on another secondary study, hospital wards with the highest rates of albumin prescription and consumption, as well as the widest range of indications set for albumin prescription, were identified. These include the intensive care unit of heart surgery, gastrointestinal, general, internal, pediatric, neonatal, and surgery intensive care units (ICUOH, ICUA, ICUC, ICUD, PICU, NICU, SICU). Based on this, participants in the study were included with below inclusion and exclusion criteria:

1. Clinical pharmacists and pharmacy residents in the drug utilization evaluation unit responsible for evaluating albumin prescriptions.
2. Specialized physicians from selected intensive care units who prescribe albumin and submit drug request forms to the drug utilization evaluation unit.
3. Study participants also included Nurses or authorized staff in the selected intensive care units who submit the drug request form and prescribed prescription on behalf of the physician to the drug utilization evaluation unit.

The general conditions for entering the prescriptions into the study are as follows:

1. Selected attending physicians in these units, having prescribed albumin for patients, announce the need for albumin consumption by the patient. If the patient meets the conditions for receiving albumin from the perspective of the attending physician, in addition to registering the albumin request in the hospital information system, the albumin request form is completed for the patient and sent to the hospital's Drug Utilization Evaluation Unit.
2. The prescription of albumin for the patient is solely done by the attending specialist physician or by the resident department with the approval of the relevant specialist physician.
3. If nurses or staff register the drug prescription in the hospital information system and send it to the DUE unit at the direction of the attending physician, it is assumed that the nurse has been authorized by the attending physician of the department to send the prescription.
4. Patients for whom albumin has been prescribed are those accepted in these units regardless of gender and age group for whom albumin has been prescribed.

### Data collection

To investigate the conformity of albumin prescriptions with drug therapy guidelines based on the patient's clinical condition and standard guidelines in this study, and to measure the main outcomes of the study, structured data on 1040 albumin prescriptions made in intensive care units during the conduct of the study were organized and analyzed in spreadsheets similar to (Table 1), based on the studied units and different indications for albumin prescription. These data were collected based on the information included in the albumin prescription and consultation forms, the information included in the patient record in the hospital information system, and also by taking the patient's history directly from the patient or their companion, or from the nurse and attending physician. Additionally, to explore the indication status related to the albumin prescription, the

accuracy of the prescribed dose, and the administration schedule of the drug, along with the information entered in the aforementioned sources, information from online scientific resources and standard guidelines such as UpToDate and pharmacotherapy DPO was also utilized.

The extracted information from the electronic patient record in the hospital information system includes demographic information (including record number, gender, inpatient department, diagnosis), hemodynamic information if recorded in the patient record (heart rate and blood pressure), information related to the prescribed drug (including the requested drug dose, administration times, and history of other concomitantly prescribed drugs to assess the patient's history), and in some cases, information related to laboratory and paraclinical tests (including data related to lab markers, radiographic images, CT scans, etc.) has also been reviewed to assess the accuracy of the prescription based on drug therapy guidelines. To assess how the attending physician prescribes drugs or how a nurse submits an albumin request under the guidance of the attending physician, and to gain a deeper insight into the patient's clinical condition, direct bedside interviews were conducted with the patient or their companion, alongside the attending physician and nurse. These interviews were facilitated by clinical pharmacists serving as experts in the hospital's Drug Utilization Evaluation Unit.

**Table 1- used table for data collection and analysis.**

| Number | Value |
|---|---|
| Request date | Value |
| Patient record | Value |
| Ward name | . |
| Physician name | . |
| Patient sex | . |
| Patient age | . |
| Drug name | . |
| Drug indication | . |
| HIS registration status | . |
| Request Dosage | . |
| Usage time | . |
| Confirmed Dosage | . |
| Guideline based | . |
| DUE confirmation | . |
| Yes/No Guideline | . |
| Patient safety | . |
| DUE pharmacist | . |
| DUE comment | . |
| $P_1$(indication) | . |
| … | … |
| $P_n$(indication) | . |
| Clinical comment | Value |

The rate of albumin prescriptions conforming/ disconfirming to guidelines, as well as the patient safety parameter (determined by comparing the number of albumin prescriptions conforming/disconfirming to guidelines with the opinion of an experienced clinical pharmacist), were measured as the main outcomes of this study.

Secondary variables, including the total number of albumin prescriptions sent from the intensive care units, the number of prescriptions registered in the hospital information system, and the total number of prescriptions sent to the Drug Utilization Evaluation Unit for evaluation, along with the financial savings regarding unapproved or unsent prescriptions to the Drug Utilization Evaluation Unit, were calculated and reported as secondary outcomes of the study.

## Results

The study took place from May to August 2023 in the intensive care units of Imam Reza Hospital in Mashhad. It involved 1040 albumin prescriptions, with 906 (87.11%) recorded in the hospital information system and 134 (12.88%) not documented. Out of the total, 630 prescriptions (60.57%) were sent to the drug utilization evaluation unit.

### Review of albumin prescription compliance with guidelines

For each prescription sent to the hospital's Drug Utilization Evaluation Unit, compliance or non-compliance of the albumin prescription with guidelines was assessed by examining the information contained in the drug prescription form submitted to the unit and obtaining the patient's clinical conditions. Clinical pharmacists ensured compliance with the hospital's internal guidelines governing albumin prescription, the albumin consultation form, and the standard guidelines considered by the Drug Utilization Evaluation Unit. Evaluations conducted on 630 prescriptions sent to this unit revealed that 51.53 percent of the albumin prescriptions were compliant with guidelines (correct prescriptions) and 48.47 percent were non-compliant with guidelines (incorrect prescriptions). Departments ICUOH and ICUA had the highest rates of correct prescriptions compliant with guidelines at 73.71 and 72.15 percent, respectively, while NICU and SICU departments had the lowest rates of correct prescriptions compliant with guidelines at 25 and 32.28 percent, respectively. There was no statistically significant difference in the proportion of correct or incorrect prescriptions between different departments (p=0.16).

### Evaluation of prescriptions by the drug utilization evaluation unit

Furthermore, of all prescriptions sent to the hospital's Drug Utilization Evaluation Unit, 80.15 percent were approved and 19.84 percent were disapproved by the senior expert of the drug utilization evaluation unit following consultation and evaluation based on guidelines and the patient's clinical condition. The highest percentage of approved prescriptions belonged to the ICUOH and NICU departments at 97.41 and 100 percent, respectively, and the highest percentage of disapproved prescriptions was for the SICU department at 61.42 percent.

The frequency of prescriptions sent to the Drug Utilization Evaluation Unit from various departments and the number of prescriptions compliant and non-compliant with guidelines, based on the indication selected in the drug prescription form and the sending departments, are depicted in (Figures 1-2).

As you can see, the highest frequency of albumin requests sent to the Drug Utilization Evaluation Unit of the hospital comes from the Intensive Care Unit of Heart Surgery (ICUOH), amounting to 36.83 percent, while the lowest rate of albumin requests originates from the Neonatal Intensive Care Unit (NICU), at a frequency of 0.63 percent. 84.76 percent of the prescriptions issued were for indications determined for receiving albumin, and only 11.58 percent of the prescriptions were issued without determining an indication for albumin administration. Heart surgery was the leading cause for prescribing albumin, followed by paracentesis as the least common reason for prescribing albumin, with rates of 38.73 percent and 0.32 percent respectively in special care units.

**Measurement of patient safety rate**

The safety parameter of the patient is defined as appropriate prescription based on the compliance of the correct/incorrect albumin prescription done according to the guideline with the approval/non-approval of the relevant request by the clinical pharmacy expert. Therefore, out of all the prescriptions sent to the hospital's drug utilization evaluation unit, 74.92 percent of the requests were associated with patient safety, whereas 20.08 percent of the requests were prescribed without achieving patient safety. Additionally, on average, the patient safety rate in the requests sent based on different sending departments is 67.10 percent, and based on different indications for prescription, it is 62.34 percent.

The frequency of approved and rejected prescriptions by the drug utilization evaluation unit, along with the patient safety rate, is shown in (Figures 3 and 4) based on the selected indication in the drug prescription form and the departments sending the requests. (Tables 2 and 3) also detail the frequency of prescriptions sent along with the patient safety rate, broken down by different departments and indications, and the cost savings related to the prescription of this drug.

Investigation of cost savings due to inappropriate prescriptions

The hospital's information system data showed that out of the total 844 vials of albumin not sent to or approved by the DUE unit, only 131 vials (15.52 percent) were delivered to the requesting departments. Considering the price of a 20% albumin vial in Iran (30$), the total cost of albumin prescribed for these requests' amounts to approximately $25,320. The drug utilization evaluation process has achieved savings of $21,390 by preventing unnecessary prescriptions.

**Table 2- Additional details on albumin administrated by ICUs.**

| ICU name | Registered albumin in HIS | Unregistered albumin in HIS | Submitted requested albumin to DUE | Unsubmitted requested albumin to DUE | Confirmed requested albumin by DUE | Unconfirmed requested albumin by DUE | Guideline-base requested albumin | No-guideline-base requested albumin | Requested albumin with patient safetv | Requested albumin without patient safety | Patient safety rate | No Patient safety rate | Requested vials of submitted& confirmed | Requested vials of unsubmitted/unconfirmed | Cost of unsubmitted or unconfirmed requests ($) | Delivered vials of unsubmitted/unconfirmed | Cost of delivered vials of unsubmitted/unconfirmed requests ($) | Cost save ($) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ICUOH | 380 | 28 | 232 | 176 | 226 | 6 | 171 | 61 | 173 | 59 | 74.57 | 25.43 | 305 | 321 | 9630 | 108 | 3240 | 6390 |
| ICUA | 98 | 19 | 79 | 38 | 73 | 6 | 57 | 22 | 61 | 18 | 77.22 | 22.78 | 137 | 92 | 2760 | 5 | 150 | 2610 |
| ICUC | 113 | 2 | 53 | 62 | 39 | 14 | 27 | 26 | 39 | 14 | 73.58 | 26.42 | 73 | 143 | 4290 | 2 | 60 | 4230 |
| ICUD | 135 | 14 | 97 | 52 | 78 | 19 | 43 | 54 | 56 | 41 | 57.73 | 42.27 | 168 | 151 | 4530 | 5 | 150 | 4380 |
| NICU | 4 | 2 | 4 | 2 | 4 | 0 | 1 | 3 | 1 | 3 | 25.00 | 75.00 | 6 | 8 | 240 | 2 | 60 | 180 |
| PICU | 38 | 15 | 38 | 15 | 36 | 2 | 27 | 11 | 27 | 11 | 71.05 | 28.95 | 51 | 31 | 930 | 4 | 120 | 810 |
| SICU | 138 | 54 | 127 | 65 | 49 | 78 | 41 | 86 | 115 | 12 | 90.55 | 9.45 | 73 | 98 | 2940 | 5 | 150 | 2790 |
| Total | 906 | 134 | 630 | 410 | 505 | 125 | 367 | 263 | 472 | 158 | 74.92 | 25.08 | 813 | 844 | 25320 | 131 | 3930 | 21390 |
| Average Patient Safety Rate | | | | | | | 67.10% | | | | | | | | | | | |

**Table 3- Additional details on albumin administrated by ICUs based on indications.**

| Indication Name | Registered albumin in HIS | Unregistered albumin in HIS | Submitted requested albumin to DUE | Unsubmitted requested albumin to DUE | Confirmed requested albumin by DUE | Unconfirmed requested albumin by DUE | Guideline-base requested albumin | No-guideline-base requested albumin | Requested albumin with patient safety | Requested albumin without patient safety | Patient safety rate | No patient safety rate |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ARDS | 63 | 0 | 23 | 40 | 20 | 3 | 11 | 12 | 14 | 9 | 60.87 | 39.13 |
| Cirrhosis of the Liver with Refractory ascites | 28 | 5 | 19 | 14 | 15 | 4 | 9 | 10 | 13 | 6 | 68.42 | 31.58 |
| Heart failure | 29 | 4 | 25 | 8 | 21 | 4 | 14 | 11 | 18 | 7 | 72.00 | 28.00 |
| Heart surgery | 365 | 40 | 244 | 161 | 237 | 7 | 200 | 44 | 201 | 43 | 82.38 | 17.62 |
| Hepatorenal syndrome | 79 | 10 | 52 | 37 | 48 | 4 | 27 | 25 | 27 | 25 | 51.92 | 48.08 |
| Hypovolemia/sepsis | 8 | 1 | 8 | 1 | 8 | 0 | 1 | 7 | 1 | 7 | 12.50 | 87.50 |
| Major surgery | 146 | 52 | 133 | 65 | 55 | 78 | 46 | 87 | 120 | 13 | 90.23 | 9.77 |
| Nephrotic syndrome | 22 | 0 | 18 | 4 | 16 | 2 | 13 | 5 | 15 | 3 | 83.33 | 16.67 |
| Organ transplantation | 60 | 3 | 27 | 36 | 25 | 2 | 4 | 23 | 4 | 23 | 14.81 | 85.19 |
| Paracentesis | 1 | 1 | 2 | 0 | 2 | 0 | 2 | 0 | 2 | 0 | 100.0 | 0.00 |
| Spontaneous bacterial peritonitis | 8 | 0 | 3 | 5 | 3 | 0 | 0 | 3 | 0 | 3 | 0.00 | 100.0 |
| Therapeutic plasmapheresis | 2 | 1 | 3 | 0 | 3 | 0 | 3 | 0 | 3 | 0 | 100.0 | 0.00 |
| No indication | 95 | 17 | 73 | 39 | 52 | 21 | 37 | 36 | 54 | 19 | 73.97 | 26.03 |
| Total | 906 | 134 | 630 | 410 | 505 | 125 | 367 | 263 | 472 | 158 | 74.92 | 25.08 |
| Average Patient Safety Rate | | | | | | 62.34% | | | | | | |

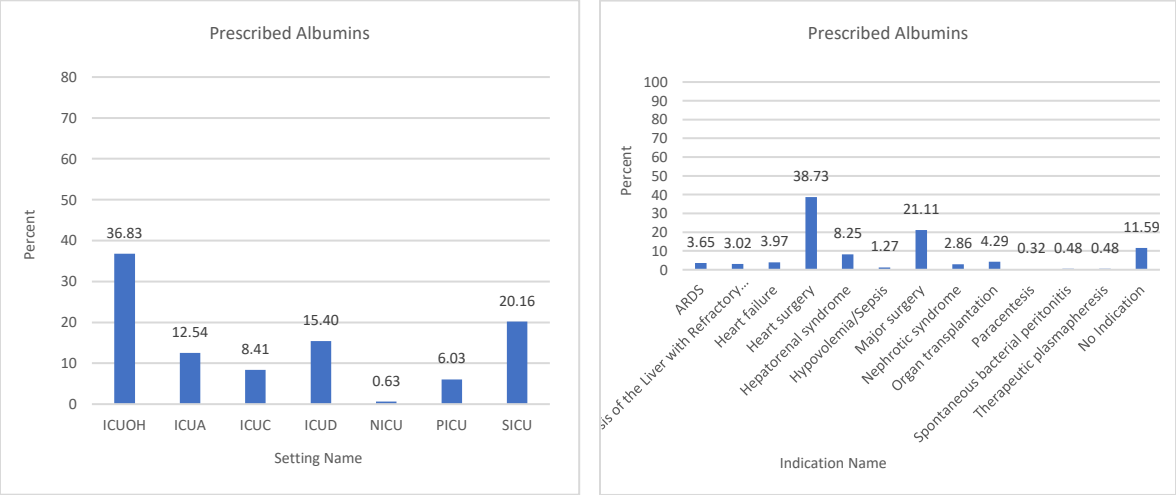
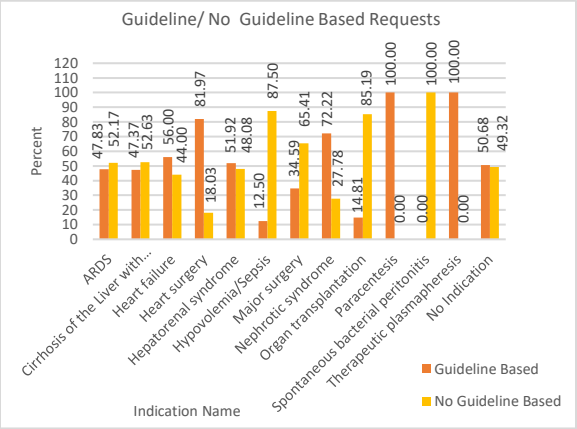



**Figure 1- prescribed albumins which have been submitted to DUE**



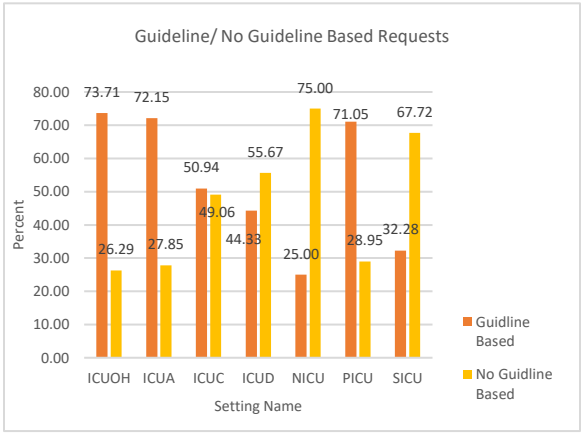
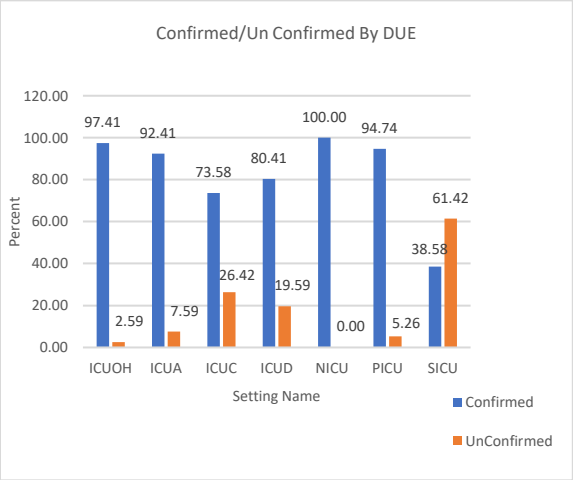




**Figure 2- prescribed albumins compliant/non-compliant to guideline.**



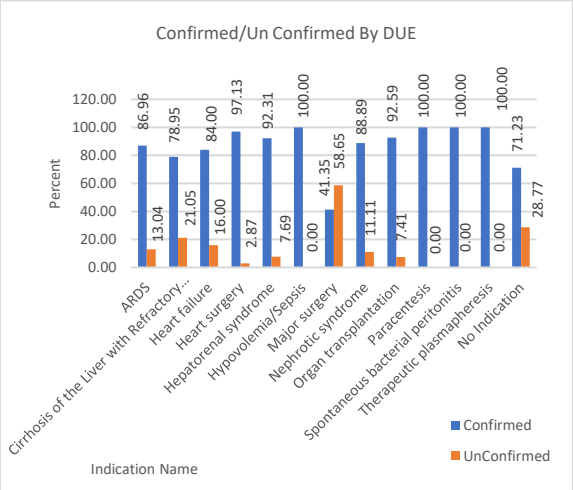
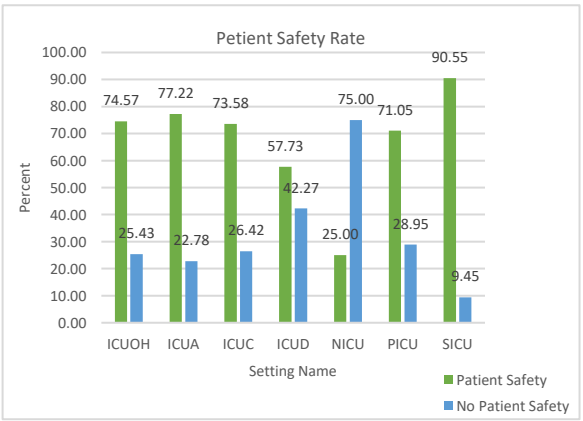




**Figure 3- prescribed approved/rejected by the drug utilization evaluation unit.**



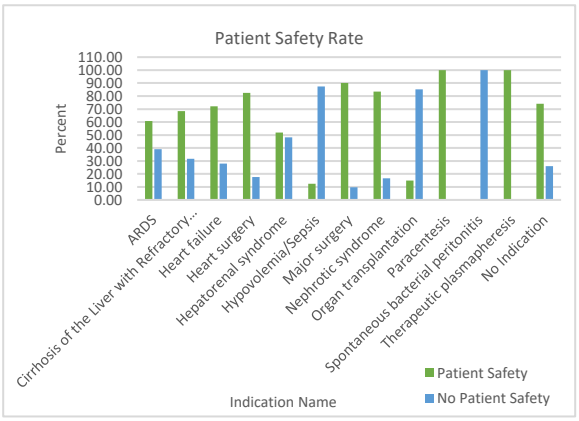




**Figure 4- patient safety rate.**

## *Discussion*

Drug Utilization Evaluation (DUE) provides insights into prescribing trends based on guidelines, marking a fundamental step towards rational drug use and evidence-based pharmacotherapy. DUEs often focus on drugs that cause significant side effects, are costly, or require dosage adjustments, making them a recommended method for detecting inappropriate or unnecessary drug

use. This promotes logical drug therapy monitoring, evaluation, and promotion [3]. Drug review and evaluation aim to achieve consensus on pharmacotherapy to optimize drug effect while reducing medication-related problems. This is typically done in hospitals for inpatients. DUE can be defined as a structured and ongoing program to improve drug use quality within a healthcare organization. In this program, drug prescribing and consumption are evaluated against predetermined standards, initiating efforts to correct patterns of use that do not align with these standards [4]. Despite advancements, drug use by physicians remains inadequate in both outpatient and hospital settings. Some prescribing errors stem from choosing an unsuitable treatment method, insufficiently prescribing a drug, or failing to prescribe the right drug [8].

Given the widespread use of medications, they constitute a significant part of health research. Medication errors are among the obstacles faced by healthcare providers in ensuring patient safety, especially inpatients in hospitals. On the other hand, treating hospitalized patients with incorrect selection of needed drugs and prescribing incorrect therapeutic orders not aligned with guidelines can significantly contribute to hospital mortality, prolonged hospital stays, increased healthcare costs, and ultimately reduce patient safety. Therefore, the necessity of correct drug treatments based on pharmacotherapeutic guidelines to prevent medication errors and their consequences of non-compliance treatments with pharmacotherapeutic guidelines during prescription, is of utmost importance.

Based on the discussed topics regarding the importance of drug utilization evaluation, drug safety, and the occurrence of medication errors, particularly concerning the prescribing of high-consumption hospital drugs for inpatients, we aimed in this study to examine the logical prescription and consumption of albumin in intensive care units for inpatients through the hospital's drug utilization evaluation process. By investigating the extent to which physicians adhere to pharmacotherapeutic guidelines in prescribing prescriptions, we also sought to measure patient safety in this descriptive, retrospective cross-sectional study.

In this study, aiming to evaluate the logical prescription and consumption of albumin through assessing prescription indicators and adherence to guidelines, and measuring patient safety, information about 1,040 albumin prescriptions made from May 22st to August 22nd, 2022, in the intensive care units of the hospital was collected and analyzed. Out of the prescriptions reviewed, 630 were sent to the hospital's drug utilization evaluation unit, of which 367 were guideline-adherent (58.25%) and 263 were not (42.75%), prescribed by treating physicians in the intensive care units for inpatients in these units. The highest rate of albumin prescription was in the intensive care unit of heart surgery (ICUOH) at 36.83%, and the lowest was in the neonatal intensive care unit (NICU) at 0.63%. For inpatients in intensive care units with a heart surgery indication, the highest request for albumin prescription was 38.73%, and for those with a paracentesis indication, the lowest was 0.32%.

The patient safety rate, based on the compliance of the correct/incorrect albumin prescription done according to the guideline with the approval/non-approval of the relevant request by a clinical pharmacist specialist, is also reported as the rate of appropriate prescriptions. The average patient safety rate based on the prescribing department is 67.10%, and the average patient safety rate based on the indication in the prescribing departments is 62.34%. The SICU had the highest patient safety rate at 90.55% and was considered the safest unit for albumin prescription, while the NICU had the lowest patient safety rate at 25% and was considered the riskiest.

Finally, the intensive care units have requested a total of 844 vials of 20% albumin for unsubmitted request to DUE unit or unconfirmed requests by DUE pharmacists, out of these, 131 vials are delivered to the prescriber units. Considering the cost of prescribing a 20% albumin vial, which averages around $30 in Iran, the drug utilization evaluation process within the hospital has significantly reduced the financial burden of incorrect albumin prescriptions. Specifically, this process has led to a decrease in costs associated with albumin prescriptions in ICUs, amounting to approximately $21,390. This reduction in expenses is not only beneficial for albumin but could also potentially lead to further savings in the prescription of other drugs through a comprehensive drug utilization evaluation.

This study faced several limitations. First, it focused exclusively on the logical prescription of albumin, a commonly consumed and expensive hospital drug, specifically in intensive care units, while other commonly consumed and expensive hospital drugs and various clinical departments might yield different results regarding the logical use of drugs, adherence to pharmacotherapeutic guidelines, patient safety calculations, and hospital costs. Second, the study was conducted in only one public hospital, which might limit its generalizability. Albumin is prescribed in public hospitals considering the state insurance, as well as the availability of drug subsidies for patients. Therefore, conducting this study in at least one private hospital is necessary to observe more significant results regarding guideline-based prescribing, patient safety considering higher drug costs, and the availability of the mentioned drug. Lastly, participants in this study were physicians who prescribed drugs for inpatients in the hospital and nurses in the studied units, under the supervision of the physician. It is assumed that all prescription requests made by nurses in the unit were certainly informed and approved by the treating physician. However,

considering that a significant percentage of albumin prescriptions (31.79%) were registered in the hospital's information system but never sent to the drug utilization evaluation unit, alternative approaches are needed to ensure that all prescriptions for common and expensive drugs are sent to the drug utilization evaluation unit.

## Conclusion

Drug utilization evaluation is a vital tool for identifying and addressing issues related to drugs, enhancing patient safety, and improving the quality and cost-effectiveness of healthcare services. Our study also demonstrated that continuous evaluation processes lead to improvements in patient safety and the logical prescription of drugs in hospital departments, as well as reducing hospital costs and financial burdens resulting from the prescription of incorrect medications.

### Future Research

Therefore, the development and integration of electronic drug utilization evaluation systems, possibly with decision support tools for drug prescription, could significantly improve the management of high-cost and frequently used hospital drugs. Our future studies maybe focus on creating decision support systems for drug prescription based on therapeutic guidelines to further enhance patient safety and facilitate drug utilization assessment.

### Acknowledgements

Our sincere appreciation goes out to all who contributed to the successful completion of this study. A special acknowledgment is extended to the physicians and nurses of the selected departments, and the pharmacists at the Imam Reza Hospital in Mashhad and the entire team from the Drug Utilization Evaluation Unit. Furthermore, we are deeply thankful to the distinguished managers of Mashhad University of Medical Sciences and faculty members of Medical Informatics and School of Pharmacy departments for their unwavering support throughout the research endeavors.

### Ethics Approvals

This study is an integral part of a broader research initiative, which has been scrutinized and granted approval by the Ethics Committee of Mashhad University of Medical Sciences. Additionally, it has received endorsement from the university's Research Vice-Chancellor and is registered under the university's ethical guidelines with number 990947.

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