Research Article

The Role of Drug Utilization in Optimal Pharmacological Treatment

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Received: 20-May-2024, Manuscript No. amhsr-24-136436;
Editor assigned: 22-May-2024, Pre QC No. amhsr-24-136436 (PQ);
Reviewed: 05-Jun-2024, QC No. amhsr-24-136436;
Revised: 12-Jun-2024, Manuscript No: amhsr-24-136436 (R);
Published: 19-Jun-2024, DOI: 10.54608.annalsmedical.2024.S8

Abstract

Drug utilization is integral to understanding the prescription and consumption dynamics of medications, with the aim of optimizing therapeutic outcomes. It serves as the backbone of the medical field, promoting rational drug use through research and analysis. Utilizing electronic databases, drug use studies have become crucial scientific tools, guiding the approval process for medications by demonstrating their efficacy when administered correctly to the appropriate patients, at the right dosage and duration. Misuse of medications can lead to compromised effectiveness, resulting in increased mortality and morbidity rates. Quantitative research relies on data such as patient demographics, illness, and dosage administration to provide insights into drug utilization patterns.

Two primary levels of drug utilization research exist, the first level focuses on the drug, area, and level of therapy, while the second delves into more specific aspects like individual or groups of drugs, patient compliance, and pharmacokinetics. Despite the availability of data, concerns persist regarding its presentation and interpretation, necessitating cautious analysis for qualitative investigations. Research on drug usage is fundamental to improving pharmaceutical therapy and prescription practices, guiding decision-making processes to enhance patient outcomes throughout the treatment journey.

Keywords: Adverse drug reaction; Drug utilization; Irrational drugs use; World Health Oraganization (WHO); Drug

Introduction

Drug utilization is determined as "administering, prescribing and dispensing of the drug" by involving of world health organization, then the World Health Organization (WHO) enhances that definition by adding some better words and enlighten us with exact determination of that definition. The WHO defines drug utilization: Marketing, distribution and prescription as "drugs in society, with a particular focus on the resulting medical, social, and economic consequences". When medications are misused, they frequently fall short of their promise, which increases mortality as well as morbidity of a list of patients within a defined group who take a certain drug within a specific time period, along with the illness or reason and administer the dose is useful for quantitative research, There are numerous concerns regarding the presentation and interpretation of the information that is accessible because they are simply approximations of this for various reasons for qualitative investigations, the optimal count is the amount of patients within a specified group, out of all those who obtained the drug within that population over that time frame, utilize it improperly.

Therefore, a study that aims to characterize, both statistically and qualitatively, the general group that consumers of a certain drug or class of pharmaceuticals and or the circumstances of use such as period of therapy, signs, dose, prior or related therapies, and compliance is known as a drug utilization survey. In research studies where medication consumption is the major focus on prescription process, like how the prescription is written and on which ground, that pharmaceutical substances or medicinal preparation is given to the consumer are inspected by highly qualified personnel or investigator [1].

Underprivileged managing and irrational use of drugs increases chances of morbidity and mortality [2].

History

The current state of pharmaceutical treatment must be treated primarily as a result of the 19th century advances in chemistry, physiology, and fundamental pharmacology. The majority of treatments in use at the early stages of that era were herbal cures with an unknown chemical composition. Though very few new medications were developed for medicinal purposes, significant advancements were made in both chemical and physiological sciences [3]. The start of drug utilization analysis can be found back to the early stage of 1960s, in 1964 a Toxicological event organized in Moscow by WHO, alike too many other growths at the time drug use had been flashed by the thalidomide tragedy. People come to the conclusion or realization that they were unable to evaluate how frequently and where the dangers if they were unaware about that substance and how to use such toxic substances, then maybe it's creating some complication in human body. In between 1966 to 1967, six European countries disclosed abundant alterations in medication usage. Oslo is presenting a data in conference, which is entitled as "The consumption of drugs" clearly definite that a worldwide accepted classification structure [1].

- In 1803 Serturner's reports of morphine isolation
- In 1846 Morton proves the properties of ether in Anaesthesia

How to Cite this Article: Rath AP. The Role of Drug Utilization in Optimal Pharmacological Treatment. Ann Med Health Sci Res. 2024; S8 930-936

- In 1847 first use of chloroform in Anaesthesia reported by Sir James Young Simpson
- In 1944 Waksman, Schatz, Bugie announce discovery of streptomycin in between 1947 to 1952 only effective antituberculosis
- In 1948 chlorotetracycline introduce, the first tetracycline, then in 1952 tetracycline and chloramphenicol introduce, in 1950 oxytetracycline is introduce
- Isoniazid is Introduce in 1951 for the purpose of mitigation tuberculosis
- Colleagues and McGuire in 1952 discern erythromycin
- In 1954 confirmation of the medical properties of sulfonylureas in Diabetes
- 1957 Iproniazid is presented as a state of depressive disorder therapy option. Sternbach team creates chlorodiazepoxide.
- 1958 Kuhn acknowledges imipramine's antidepressant features.

Material and Methods

In drug usage research, observation studies are the most frequently used approach. It entails keeping an eye on the justification of prescribing practices in addition to keeping an eye on the accessibility of structures and other amenities needed for a successful delivery of medication for use, such as the availability of name lists and accepted therapeutic guidelines, the availability of vital drugs, and the accessibility of licensed professionals and dispensers [2]. In the early 1970s, significant research methods, tools for drug use investigates were developed, which made a great deal of comparable international and interregional study conceivable.

Fortunately, recent advancements as well as possibilities have made fresh approaches and experimental approaches necessary in this subject. If medication consumption research must follow certain ethical guidelines if they are to be credible. The most fundamental of these guidelines is the continued use of a globally recognized unit of indicators and a consistent medication categorization structure [3]. The drug defined dose approach is typically used in connection with the Anatomical therapeutic chemical classification system. The Norwegian health depot was the company that first created it, now it is the collaborating with WHO and gave facility for drug statistics analysis, now present at Norwegian Institute of Public Health [4].

Poison model

The poison model is one method for handling statistical analysis requiring quantities of occurrences per time period [5]. Analysis using ordinary least square allows for negative projections, which are incompatible with data that is not negative. Furthermore, the disturbing factors linked to ordinary least square regression equations including count data are generally heteroskedastic, non-normal, and left-skewed.

Maximum probability methods utilizing separate distributions may be more effective than Ordinary least square corrections because counts must be both not negative and numerals. These methods also have the ability to generate favorable forecasts and stronger judgement on the estimated variables.

Negative binomial model

Situation where the conditional variance is greater than the conditional mean, is a feature shared by many types of count data. A more generic specification ought to be used in these situations as the poison model's presumptions are not met. The cause of the over dispersion could be undetectable variations in use of drugs. If the gamma function distribution of probabilities is used for modeling this diversity, the negative binomial a regression framework emerges. By supplementing the conditional mean with an error term, the average density of the negative binomial is obtained.

Two part system

Drug usage surveys are being carried out more frequently in Latin America to support decision making and policy making, particularly in nations with comprehensive health care. It's recognized that in the continent of Latin America require their own ethical framework [6]. The health related variables were characterized using explanatory statistical methods. While continuous information like gender was expressed by the standard deviation and mean, categories. Within the first level anatomical therapeutic chemical medication codes, descriptive statistics were calculated for every clinical significance indication [7]. Throughout the study period, 2688 patients with a diagnosis of COVID-19 were admitted to CHU-sainte-justine hospital. The patients ranged in age from 0 to 95 years old, with an average age of 62.8 ± 19.9. There was a minor residual fraction of patients under the age of eighteen, with the majority of patients being male and 65 years of age or above. Clinical results showed that 1828 hospitalized patients, or 68.4% of them, made a full recovery. But in other hand 20.8% died due to some unknown causes [8].

Pharmacotherapeutic study

Due to the possibility that Sparsentan gradually induces its own metabolism, it has a time-dependent clearance. The apparent clearance of sparsentan after the initial 400 mg dose is 3.88 L/h. The apparent clearance rises to 5.11 L/h in constant state.

Need for drug use evaluation

It is necessary to enable rational utilization of medications in both population level settings and for patients on their own. It also provides knowledge for doctors to help them prescribe more wisely, including details regarding patient symptoms, lab results and their relationship to therapy, and drug related issues such as adverse drug reaction medication interactions, and other issues. According to WHO recommendations, there should be a single physician for every one thousand individuals. There are 1380 million people living in India. In 2019, the health ministry released its most recent data, showing that among the 1.16 million professionals in the country, only 0.9 million, or 80%, are actively practicing. Consequently, we have 0.68 doctors for every. Based on data, India needs an additional 4.3 million physicians to meet the world health organization requirements [9].

Pharmacist's role in prospective study: Before the medication

is provided, a prediction of the recipient's drug regimen is assessed. Any issues can be found and fixed according to this procedure, which happens before the individual ever gets their medication. Pharmacists perform a prospective evaluation as part of their routine practice, looking at patient data, prescription medication dosages and instructions, and possible interactions between drugs of therapy. Participants get training for pharmacists on the experimental drugs correct usage, dosage, adverse reactions, and complications. This guarantees adherence to the investigation procedure by participants and facilitates the early identification of drug related problems [10].

Registered medical practitioner and concurrent study: Concurrent assessment is carried out during the patient's therapy and comprises keeping an eye on the medication being given to the patient in order to support them. It gives doctors of pharmacy the chance to warn doctors about possible issues and respond appropriately when there are interactions among drugs, duplicate therapy, and misuse or fail to utilize, or an incorrect or inappropriate dosage [10].

History taking from patient: A retroactive drug utilization review assesses the recipient's regimen of drugs. Retrospective examination looks for patterns in script delivery or medication administration. Based on the current prescription usage patterns, tailored interventions and recommendations may be developed to prevent substance abuse and abuse in future decades. The results of this analysis could help physicians give the recipients superior treatment, either on an individual basis or for specific patient demographics [10].

Steps to be followed for drug utilization evaluation

Step 1-Assign accountability: The drug therapeutic committee is in charge of creating protocols for the execution of due programs; this involves designating a subcommittee or a responsible drug therapeutic committee member to oversee and keep an eye on the due procedure in the medical facility or medical centers. Ideally, the drug therapeutic committee should create yearly plans outlining the medications or health issues that are going to be covered by the due procedure [10].

Step 2-Establish the goals and the extent of action: The drug therapeutic committee is responsible for determining the due's goals and the extent of the necessary activities. The scope of the investigation can vary depending on the nature of the problem that has been identified. Examples of such problems include prescribing a more costly drug when a less costly option is available, using a medication inappropriately (indication, dose, and administration) as shown by patient charts, prescribing mistake publications, adverse drug reaction reports, inappropriate antibiotic selection as shown by resistance to antibiotics reports, and patient grievances or suggestions pointing to unacceptable distributing procedures. Because of how many medications a healthcare facility has on hand, to optimize the return on the work concerned, the diagnosis and treatment center should focus on areas that have a greater risk for difficulties: Vitally significant therapeutic areas, such as opioid analgesics, injectable medications, emergency, toxicological, cardiac disease, and emergency [10].

Step 3-Review of the medication: Significantly, the drug Therapeutic committee is in charge of creating an enforcing due standards. Due standards define appropriate drug usage in terms of different components. The hospital's conventional therapies guidelines should be used to determine parameters for the use of any medications. The application of criteria that were created after examining known information on the basis of evidence from reputable sources and consulting with physicians is what determines the due's dependability and staff acceptance [10].

Step 4-Implementation: The next stage after identifying a drug use issue is to think about possible solutions. Drug abuse improvement initiatives might take two forms, operational or educational. The educational intervention takes the form of seminars, meetings and letters to specific doctors, circulating protocols, etc. Shifting employees, altering normal treatment standards, altering the prescribed list, placing limitations on prescriptions, and other actions are examples of practical interventions. Monitoring taking drugs and prescribing trends is necessary to assess the effectiveness of the strategy reassessment [10].

Step 5-Reassessment: Assessing prescription and drug consumption statistics is crucial to evaluate the effectiveness of therapies and find out if consumption of drugs has enhanced. Usually carried out three to twelve months following the first implementation of the therapy, the follow-up assessment should gather the same data as the initial analysis [10].

Drug utilization study in pediatric patients

WHO core indicators for patient include the following criteria [11].

- Age and sex wise distribution.
- Average number of drugs per encounter.
- Prescribing Percentage of encounters with an antibiotic prescribed.
- Percentage of encounters with an injection prescribed.
- Percentage of drugs prescribed by generic name.
- Percentage of drug prescribed from Essential drug list formular

Results

Drug study in pediatric patients

The study's goal was to analyse drug utilization patterns among pediatric patients. Infants and children have tremendous growth and development. Infants and children account for a considerable proportion of the overall population in developing nations. The study of prescription habits is part of the medical audit, and it aims to monitor, assess, and, if required, advise changes to the way medications are prescribed in order to make medical care more reasonable and economically efficient. A record number of 286 patients' prescribed medicines were examined. In total, 156 (54.5%) patients were male and 130 (45.5%) were female [12]. Antibiotics have been prescribed for common childhood ailments in about 79.4% of children, with 96% of those prescriptions being for respiratory infections called Acute Respiratory Infections (ARI) [12].

The majority of medications provided were anti-infective medicines (339 (24.8%)). Anti-inflammatory agents (20.8%), IV fluids (19.0%), GI therapy (14.7%), respiratory system drugs (7.6%), dietary supplements (4.4%), central nervous system drugs (3.4%), hormone replacement therapy (3.4%), and medication for cardiovascular disease (0.5%) were additional categories of commonly prescribed medications [12]. Antibiotic use the study found that 16.87 percent of children's antibiotic prescriptions at the sample hospitals were unreasonable, indicating a reasonably high rate of irrational medicine use in healthcare settings. There are two potential causes for this occurrence. From the standpoint of prescribing physicians, doctors may not have a thorough understanding of the use of antibacterial drugs and thus disregard the guidelines for their clinical application. Alternatively, doctors may use antibiotics at arbitrary and fail to strictly adhere to the indications when selecting broad-spectrum antibacterial drugs. The prescribing behavior of doctors is influenced by various aspects, including their attitude and amount of medicine knowledge. Thus, medical facilities ought to aggressively undertake training programs aimed at improving pediatricians' understanding of antimicrobials knowledge of paediatricians, increase the amount of drug use and mandate peer supervision between reviewers and prescribing physicians to raise the standard of pediatric prescriptions. Children are seen as a unique group of patients whose bodies change and evolve with age. Doctors find it challenging to understand how children's bodies process and react to medications. Deriving pediatric pharmaceutical dosages from adult doses is a challenging and hazardous task, especially in light of the absence of guidelines for direct use in pediatric patients. When it comes to specific treatments, juvenile medicine lacks expertise and standards of care, therefore there is a lot of ambiguity. Moreover, pharmacokinetic research on pediatric patients have to be reinforced by integrating the physiological traits of patients of various ages, creating delivery schedules, and closely monitoring drug indications and dosages [13].

Top five antibiotics commonly used in paediatrics are amoxicillin/potassium clavulanate injection, cefmetazole sodium injection, ceftriaxone sodium injection, erythromycin lactate injection, according to prescription analysis [13].

Cefmetazole sodium for injection: Sodium cefmetazole injection the use of drugs by kids receiving injections of cefmetazole sodium was examined according to their age groups. The cDUI and PDD/cDDD were essentially less than 0.9 in all five age groups, indicating that various age groups of pediatric patients received an underdose of cefmetazole sodium injection.

Erythromycin lactobionate: Injectable erythromycin lactobionate drug use in children receiving injections of erythromycin cefose divided into age categories. The cDUI (taking the mean) and PDD (Prescribed Daily Dose)/CDDD (Child Defined Daily Dose) of newborns were less than 1 in the five age categories, and near 1 in the other age groups. This finding indicated that while the erythromycin cefaloctate injectable dosage was essentially suitable for other age groups, it was excessively low for neonates.

Amoxicillin/clavulanate potassium for injection: Amoxicillin and potassium clavulanate injectable Based on various age groups, the use of injections containing amoxicillin and potassium clavulanate was examined. Within the five age categories, newborns and infants had cDUI and PDD/cDDD values less than 0.9, babies had cDUI and PDD/cDDD values near 1, pre-school and school aged children had cDUI and PDD/cDDD values greater than 1.1. According to these findings, amoxicillin/potassium clavulanic infusion was overdosed in kids of all ages and underused in neonates and infants [13].

Ceftriaxone sodium for injection: Children treated with injections of ceftriaxone sodium underwent drug use analysis based on different ages. The children and adolescents had received an injection of ceftriaxone sodium at a dosage exceeding 1.1, as shown by the cDUI and PDD/cDDD values [13].

Drug utilization patterns in NICUs worldwide found to be the medications that are most commonly prescribed in NICUs. Caffeine, furosemide, multivitamins, and vitamin K came next. The 20 most often prescribed drugs in NICUs are shown in (Figure 1), along with a description of how each drug is categorized in the A-PINCH list. Nineteen of the most often utilized medications were identified as A-PINCH medications, encompassing antibiotics, morphine, fentanyl, and heparin. There were no appreciable variations in the kinds of prescription drugs used between the nations [14]. Between 23 and 409 distinct types of drugs were administered for the treatment of patients who were admitted to the NICU. The length of the studies may also be to blame for this wide variation in the pharmacological agents used. Over the course of several years, new active ingredients, drug formulations, and regimens may be introduced, and older, less effective medications may be discontinued. Three to eleven medications were used on average per patient; two patients in a German research were given as much as forty medications while they were in the NICU. According to the prospective cohort study that assessed 183 patients, the reason for the high average medication use per patient observed in their research was that their NICU was a highly specialized facility that saw greater numbers of very premature infants than other NICUs, which resulted in a rise of medications per patient. Overall, IV administration accounted for 47%-92.1% of all product uses. This was followed by taking orally (22%-23.1%), topical use (7.5%-9%), Intramuscular (IM), and endotracheal catheter delivery [14].

According to a prospective investigation conducted in India, preterm newborns received 81 prescriptions for medications on average in the NICU, while term infants received 43 prescriptions on average. The Brazilian study, which found a significant difference ($P<0.001$) between the average drug use in preterm and term neonates, lends further support to this. Additionally, they discovered a second link between patient weight and average medication use throughout their 6-month prospective observational analysis. When compared to kids weighing 2500 g or more, the average number of medications prescribed to Very Low-Birthweight (VLBW) babies (less than 1000 g) was around three times higher (Figure 1).

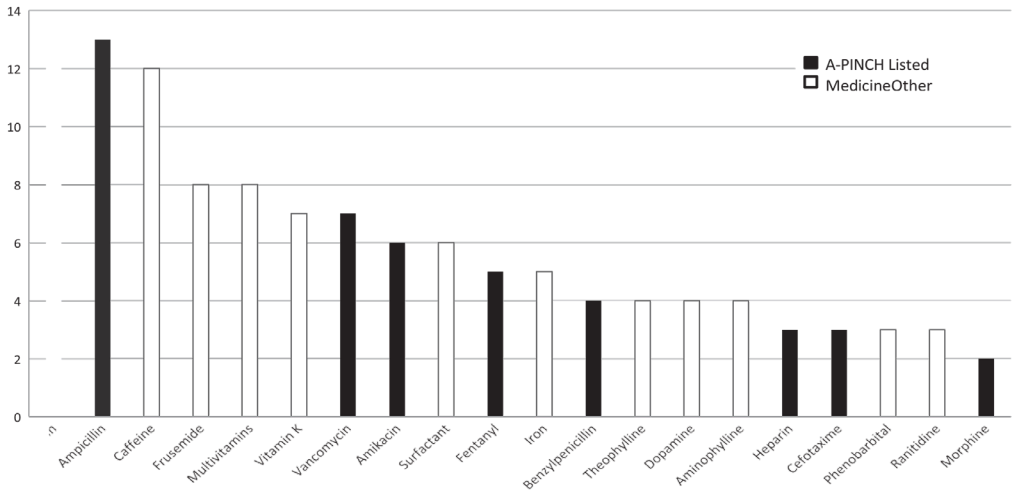

Figure 1. Most commonly cited medicines used in NICUS worldwide. **Note:** (■) A-PINCH listed; (▭) Medicine Other

Early neonates should not be given sulfadiazine due to the risk of developing neonatal jaundice. Meropenem is not suggested for babies under three months old due to inadequate information on efficacy and tolerance limits. Itraconazole is not recommended for pediatric individuals due to insufficient data. Unisolide is contraindicated in children under 4 years old. Phenobarbital and prednisolone neomycin should be administered IV instead of IM and through the nose instead of In an Israeli NICU, 199 prescriptions were provided at extremely high doses, including ampicillin, theophylline, amoxicillin, vancomycin, and imipenem.

High use of A-PINCH medicines

Misused or incorrectly administered drugs provide a higher risk of damage. Neonates are vulnerable because to their pharmacologic capabilities, and 9 of the 20 most regularly used drugs are classed as high-risk (Table 1). Therefore, it is crucial to prioritize neonatal safety. When prescribing these medications, it's important to follow established recommendations and safety procedures to guarantee proper dose and prevent misuse.

The management of high-risk drugs will be periodically examined in areas associated with patient care during separate medication safety walk round inspections, which are undertaken twice annually, and through analysis of information collected using the medication safety self-evaluation. This will be supervised by the medication safety pharmacy team. The usage of high-risk medications is linked to adverse events and hospital-acquired problems (Table 1). These will be examined to find ways to restructure systems and reduce these risks. The incident management policy and procedure shall govern the determination of the evaluation's degree and nature. If appropriate, the medication safety committee will coordinate corrective measures and assess suggestions from regional and national medication safety warnings and notices pertaining to high-risk drugs.

In accordance with the policy "Management of recalled, alerts, and product modifications," this task is not connected to, independent of, and handled independently of any safety notifications that are received. The healthcare safety and quality council or the corporation plan evaluation board will use an escalation process for alerts and safety notices that call for a high level organizational examination [14].

Table 1: List of high risk medicine groups.

High-Risk Medicine Groups	
A	Anti-infective
P	Potassium and other electrolytes
I	Insulin
N	Narcotics and other sedatives
C	Chemotherapeutic agents
H	Heparin and anticoagulants
Other	High-risk medicines identified at a unit level which do not fit the above categories

Use of narrow therapeutic index medicines

Drugs with a Narrow Therapeutic Index (NTI) are ones in which slight variations in dosage or concentration in the blood have the potential to cause major therapeutic failures, potentially fatal adverse drug responses, or long-term, severe impairment or incapacity.

All medications require monitoring to make sure that the doses given are within their therapeutic range; nevertheless, medications with a small therapeutic index may quickly reach toxic concentrations, which could have unfavourable effects (Table 2). Has brought attention to the fact that theophylline and aminoglycosides are frequently utilized in NICUs. In order to stop the misuse of these medications, precautions must be taken to guarantee appropriate therapeutic drug monitoring and precise dosage [14].

Table 2: Pharmacokinetic research by injecting commonly used antibiotics in pediatric patients of various ages.

Drug product	Estimated toxic/ effective ratio	Sub-therapeutic concentrations lead to therapeutic failure therapeutic failure	TDM	Within-subject variability (AUC)	Small dose adjustment	NTI?
Carbamazepine	2.5	Yes	Yes	12.60%	Possible	Yes
Lamotrigine	10	Yes	Not routinely	10%	Possible	No
Levetiracetam	ND	Yes	No	27.70%	Possible	No
Phenytoin	2.7	Yes	Yes	10.60%	Possible	Yes
Topiramate	ND	Yes	No	8.50%	Possible	No
Valproic Acid	2-2.7	Yes	Yes	12.00%	Possible	Yes
Tacrolimus	~2	Yes	Yes	21.90%	Possible	Yes

Discussion

Factors affecting in Neonatal Intensive Care Unit (NICU)

Infant related factors include below mentioned factors:

Gestational age: Premature birth is a major determinant of NICU admission. Premature babies have underdeveloped organ systems, making them more susceptible to complications like breathing difficulties and infections. The earlier the gestational age, the higher the likelihood of needing NICU support.

Birth weight: Lower birth weight is often associated with a higher need for NICU care. These fragile new-borns may have underdeveloped lungs, weak immune systems, and difficulty regulating body temperature, requiring specialized care and close monitoring [15].

Congenital malformations: Babies born with birth defects may require immediate NICU admission for specialized interventions or ongoing care depending on the severity of the malformation.

Multiple gestation: Multiples (twins, triplets, etc.) are more at risk of complications like prematurity and low birth weight, increasing their chances of needing NICU support.

Delivery related factors inludes the below mentioned factors:

Caesarean delivery: While not always a risk factor, some complications during a caesarean section can lead to new-born health issues requiring NICU admission.

Birth asphyxia: If a baby experiences oxygen deprivation during delivery, they may require respiratory support and other interventions available in a NICU.

Maternal factors include below mentioned factors:

Prenatal care: Inadequate prenatal care can increase the risk of complications during pregnancy and delivery, potentially leading to a higher chance of needing NICU care for the newborn.

Maternal infections: Certain infections during pregnancy can be passed on to the baby and cause serious health problems that necessitate NICU admission.

Maternal health conditions: Pre-existing maternal health issues like diabetes or high blood pressure can increase the risk of complications during pregnancy and delivery, potentially impacting the new-born's health and need for NICU support.

Socioeconomic status: Limited access to prenatal care, inadequate nutrition, and certain social determinants of health can contribute to factors influencing a baby's need for NICU admission.

Distance to NICU: In some cases, the availability and accessibility of NICU facilities in a particular region can influence the decision to transfer a newborn requiring specialized care.

Length of stay: The factors mentioned above also play a role in determining the duration of a baby's stay in the NICU.

Severity of illness: New-borns with more complex medical conditions typically require a longer NICU stay for recovery and stabilization.

Response to treatment: How well a baby responds to treatment protocols and interventions in the NICU can influence their length of stay.

Conclusion

In conclusion, the “Drug utilization research” conducted in this

thesis sheds light on patterns, trends, and factors influencing the use of medications. The findings contribute to a better understanding of prescribing practices, patient adherence, and potential areas for improvement in healthcare delivery. This research underscores the importance of ongoing monitoring and evaluation to optimize drug utilization enhanced patient outcomes and healthcare efficiency.

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