

(REVIEW ARTICLE)



## A review of medication errors in overweight and obese patients

Pritha Singha Roy \*, Debnath Khottyal and Dibyendu Jana

Department of Pharmaceutics, Global College of Pharmaceutical Technology, Krishnanagar, Nadia, WB – 741102, India.

World Journal of Biology Pharmacy and Health Sciences, 2023, 15(01), 113–130

Publication history: Received on 26 May 2023; revised on 15 July 2023; accepted on 17 July 2023

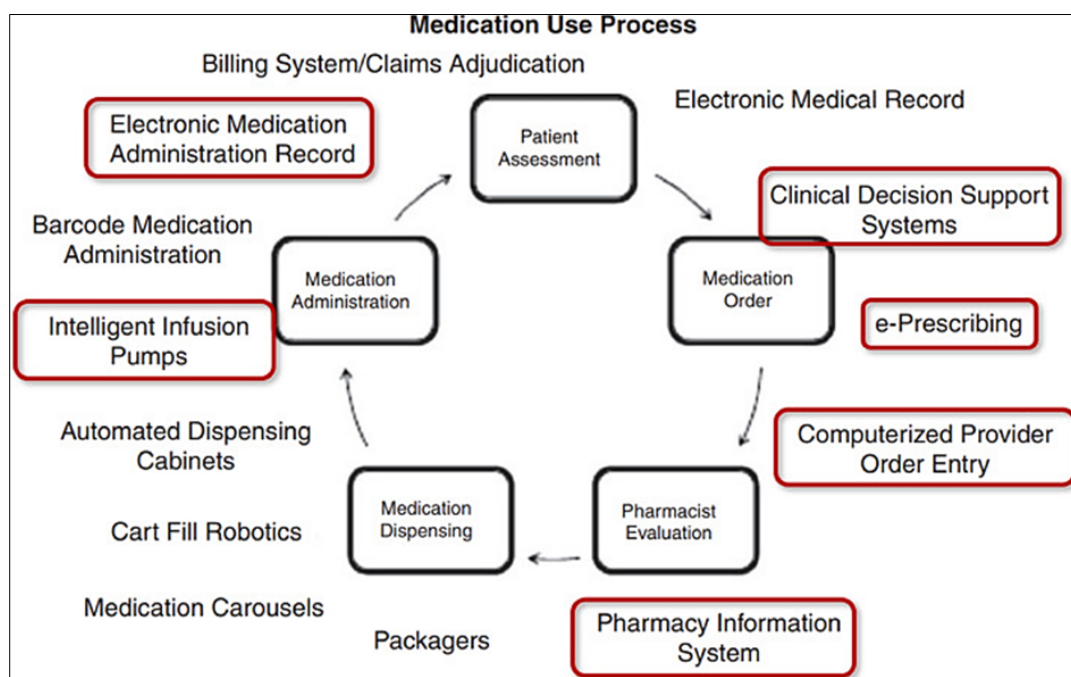
Article DOI: <https://doi.org/10.30574/wjbphs.2023.15.1.0296>

### Abstract

The increasing prevalence of overweight and obesity has posed significant challenges in healthcare, including medication safety. This review paper aims to provide an in-depth analysis of medication errors associated explicitly with overweight and obese patients. The report examines the factors contributing to medication errors in this population, explores the potential consequences, and suggests strategies for preventing and mitigating such errors. By addressing this critical issue, healthcare providers can enhance medication safety and optimise the health outcomes of overweight and obese individuals.

**Keyword:** Medication Error; Overweight; obese; Healthcare; Safety.

### Graphical Abstract



\* Corresponding author: Pritha Singha Roy

## 1. Introduction

### 1.1. Background

Overweight and obesity have become increasingly prevalent worldwide, posing significant challenges to public health and healthcare systems. The global prevalence of obesity has more than tripled since 1975, and in 2016, over 1.9 billion adults were classified as overweight, with 650 million of them classified as obese. This trend is not limited to adults; the number of overweight or obese children and adolescents has also increased dramatically.

The impact of overweight and obesity on healthcare systems is substantial and multi-faceted. Here are some key aspects:

#### 1.1.1. Chronic Diseases

Being overweight and obese are major risk factors for various chronic diseases, including cardiovascular disease, type 2 diabetes, certain types of cancer, respiratory problems, musculoskeletal disorders, and mental health issues. These conditions require long-term management and treatment, significantly burdening healthcare resources.

#### 1.1.2. Healthcare Costs

Treating obesity-related conditions is expensive. The direct costs associated with medical care, hospitalisations, medications, and surgeries for overweight and obesity-related illnesses are substantial. Indirect costs, such as productivity losses due to absenteeism and reduced work capacity, further add to the economic burden.

#### 1.1.3. Increased Hospitalizations

Overweight and obese individuals are likelier to be hospitalised than those with a healthy weight. They have a higher risk of complications during surgery and more extended hospital stays. Conditions such as heart disease, stroke, and diabetes often require hospitalisation for acute management, further straining healthcare resources.

#### 1.1.4. Primary Care Visits

Individuals with overweight or obesity often require frequent visits to primary care providers to manage chronic conditions. These visits include monitoring weight, blood pressure, and cholesterol levels and providing lifestyle counseling. This increased demand for primary care services can lead to longer waiting times and reduced access to care for other patients. (the Surgeon General (US), 2010)

#### 1.1.5. Emergency Services

Obesity-related emergencies, such as heart attacks, strokes, or respiratory distress, require immediate medical attention. The rising prevalence of obesity has contributed to increased emergency room visits and the demand for critical care services.

#### 1.1.6. Preventive Measures

Healthcare systems are increasingly focusing on preventive measures to address the rising prevalence of overweight and obesity. This includes promoting healthy eating habits, encouraging physical activity, and offering weight management programs. While these preventive efforts can be practical, they require additional resources and coordination within healthcare systems.

#### 1.1.7. Healthcare Workforce Challenges

Managing overweight and obesity requires a multidisciplinary approach involving healthcare professionals such as doctors, nurses, dietitians, psychologists, and exercise specialists. The growing demand for these specialised services puts strain on the healthcare workforce, which may need to be expanded to meet the needs of overweight and obese individuals adequately. (Prendergast *et al.*, 2022)

## 1.2. Significance of the Issue

### 1.2.1. Prevalence of overweight and obesity

Overweight and obesity are major health concerns worldwide, with a high prevalence in many countries. According to the World Health Organization (WHO), overweight and obesity have nearly tripled globally since 1975. These conditions

increase the risk of various health problems, including cardiovascular diseases, diabetes, and hypertension. As a result, the population of overweight and obese individuals seeking medical treatment is substantial, making it essential to address medication-related issues specific to this group.

### *1.2.2. Pharmacokinetic alterations*

Overweight and obese individuals often experience pharmacokinetic alterations, including changes in drug absorption, distribution, metabolism, and excretion. These alterations can affect drug efficacy and safety, leading to potential medication errors. For example, some medications may require dose adjustments based on body weight or lean body mass. Failing to consider these adjustments can result in under or over-dosing, leading to treatment inefficacy or adverse drug reactions. (World Obesity Day 2022 – Accelerating Action to Stop Obesity, 2022)

### *1.2.3. Limited research and guidelines*

Despite the growing prevalence of overweight and obesity, there is limited research and specific clinical guidelines addressing medication use in this population. Traditional drug development and dosing guidelines primarily rely on studies conducted in non-obese individuals. Consequently, healthcare professionals may lack clear evidence-based recommendations when prescribing medications to overweight and obese patients, increasing the likelihood of errors and suboptimal treatment outcomes.

### *1.2.4. Increased medication complexity*

Overweight and obese patients often have multiple comorbidities, such as diabetes, hypertension, and cardiovascular diseases. Consequently, they may require several medications to manage these conditions simultaneously. The increased medication complexity raises the risk of errors, including drug-drug interactions, duplication of therapy, and confusion related to multiple medication schedules and instructions. Healthcare providers must pay special attention to minimising errors in this vulnerable population.

### *1.2.5. Adverse health outcomes*

Medication errors in overweight and obese patients can lead to adverse health outcomes, including therapeutic failure, drug toxicity, hospitalisations, and even mortality. Inappropriate dosing, incorrect medication selection, or inability to consider drug interactions can compromise treatment efficacy and patient safety. By understanding and addressing the specific medication challenges this population faces; healthcare professionals can mitigate the risks associated with medication errors and improve patient outcomes.

### *1.2.6. Patient-centered care*

Patient-centred care is a fundamental principle of modern healthcare. However, overweight and obese individuals may face stigmatisation and bias within the healthcare system, potentially affecting their quality of care. Considering the unique medication-related challenges in this population is crucial to ensuring equitable access to safe and effective treatments, enhancing patient satisfaction, and promoting trust between patients and healthcare providers. (Hruby & Hu, 2015)

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## **2. Methodology**

### **2.1. Literature Search**

#### *2.1.1. Dosing Errors*

Overweight and obese patients often require different dosing strategies than non-obese individuals. Medication doses are typically determined based on body weight or surface area, but these standard formulas may lead to inaccuracies in this population. Underdosing can result in ineffective treatment while overdosing can lead to toxicity. Studies have shown that dosing errors are more prevalent in overweight and obese patients.

#### *2.1.2. Pharmacokinetic Considerations*

Obesity can affect how drugs are absorbed, distributed, metabolised, and eliminated in the body. Increased adipose tissue can alter drug distribution, lowering drug concentrations in the bloodstream. Drug absorption and elimination rates may also be affected by changes in blood flow and organ function. These alterations in pharmacokinetics can contribute to medication errors if not adequately considered when prescribing and administering medications.

### 2.1.3. Medication Selection

Some medications have limited safety data in overweight and obese patients. The lack of specific guidelines and evidence-based dosing recommendations for this population can result in medication errors. Healthcare professionals may have to rely on their clinical judgment, extrapolate from data in non-obese patients, or adjust doses empirically, introducing potential errors. (May *et al.*, 2020)

### 2.1.4. Communication and Documentation

Effective communication between healthcare professionals ensures accurate medication prescribing and administration. However, miscommunication regarding weight-based dosing and medication orders can occur, especially during care transitions. Inadequate documentation or failure to update patient records with accurate weights can also contribute to medication errors in overweight and obese patients.

### 2.1.5. Patient Adherence

Medication adherence can be challenging for overweight and obese patients due to various factors, including complex dosing regimens, pill size, side effects, and psychological barriers. Non-adherence increases the risk of medication errors and can compromise the effectiveness of treatment. (Barras & Legg, 2017)

## 2.2. Data Extraction and Analysis

### 2.2.1. Define the research question

Determine the specific objectives of the analysis. For example, you might aim to identify the types of medication errors, assess their frequency, explore potential contributing factors, or evaluate the impact on patient outcomes in overweight and obese individuals.

### 2.2.2. Identify data sources

Determine the appropriate authorities of data for your analysis. This may include electronic health records (EHRs), incident reporting systems, medication error databases, clinical trials, or published studies. Ensure that the data sources contain information about medication errors and include relevant patient characteristics like weight and body mass index (BMI).

### 2.2.3. Data collection

Extract the necessary data from the identified sources. This may involve querying databases, accessing medical records, or using data extraction tools. Collect variables such as patient demographics, medication details, error descriptions, error severity, and other relevant information.

### 2.2.4. Data cleaning and preparation

Clean and organise the collected data to ensure accuracy and consistency. Remove duplicate or irrelevant entries, address missing values, and standardise the variables. Convert text-based information into structured formats suitable for analysis.

### 2.2.5. Descriptive analysis

Perform descriptive statistics to gain initial insights into the data. Calculate frequencies, proportions, means, medians, and other summary statistics to understand the prevalence and characteristics of medication errors in overweight and obese patients. Identify common mistakes, affected medications, healthcare settings, and potential contributing factors. (Charkhat Gorgich *et al.*, 2016)

### 2.2.6. Statistical analysis

Conduct statistical tests and modelling techniques to explore relationships and associations within the data. You can use techniques like chi-square tests, logistic regression, or survival analysis to assess factors influencing medication errors. Analyse the impact of weight, BMI, medication type, dosing regimens, or other variables on the occurrence and severity of errors.

#### 2.2.7. Data visualization

Create visual representations of the analysed data to enhance understanding and communication. Generate charts, graphs, and diagrams to present the prevalence of medication errors, highlight trends over time, compare error rates between different patient groups, or visualise factors contributing to errors. Visualisations can aid in identifying patterns and communicating findings effectively.

#### 2.2.8. Interpretation and conclusions

Interpret the analysis results in the context of the research question. Discuss the implications of the findings, potential limitations of the study, and areas for further investigation. Summarise the key insights and conclusions drawn from the data analysis.

#### 2.2.9. Reporting and dissemination

Prepare a comprehensive analysis report, including the methodology, results, and recommendations. Share the findings with relevant stakeholders, such as healthcare providers, policymakers, and researchers. Publish the results in scientific journals or present them at conferences to contribute to the body of knowledge in medication safety and patient care. (Mutair *et al.*, 2021)

### 2.3. Factors Contributing to Medication Errors

#### 2.3.1. Pharmacokinetic Changes

Regarding overweight and obese patients, several pharmacokinetic changes may occur, potentially impacting the efficacy and safety of medications. Here are some key details regarding these changes:

#### 2.3.2. Absorption

Medication absorption can be affected in overweight and obese individuals due to altered gastrointestinal transit time, increased stomach pH, and changes in blood flow to adipose tissue. These factors may result in variable drug absorption rates, leading to fluctuations in medication concentrations in the bloodstream.

#### 2.3.3. Distribution

The distribution of drugs throughout the body can be affected by changes in body composition. In overweight and obese patients, more adipose tissue has a lower blood supply than lean tissue. This can result in a larger volume of distribution for lipophilic drugs, potentially leading to lower drug concentrations in the plasma. On the other hand, for water-soluble drugs, increased body weight may lead to higher drug concentrations due to the larger volume of distribution.

#### 2.3.4. Protein binding

Many drugs bind to plasma proteins, such as albumin. In overweight and obese patients, there may be alterations in protein binding due to changes in plasma protein concentrations and composition. Additionally, adipose tissue can act as a reservoir for lipophilic drugs, potentially reducing the concentration of free drugs available for pharmacological activity. (Smit *et al.*, 2018)

#### 2.3.5. Metabolism

Hepatic metabolism, which is a significant route of drug elimination, can be influenced by obesity. Obesity is associated with changes in liver size, blood flow, and enzyme activity. Specific cytochrome P450 enzymes involved in drug metabolism, such as CYP2C9 and CYP3A4, may be altered in obese individuals. These changes can affect the rate and extent of drug metabolism, leading to variations in drug clearance.

#### 2.3.6. Renal elimination

Renal clearance of drugs can be influenced by obesity-related factors, such as alterations in renal blood flow, glomerular filtration rate (GFR), and tubular function. In some cases, the clearance of renally eliminated drugs may be increased due to increased GFR in obese individuals. However, for drugs that undergo active tubular secretion, the elimination may be reduced due to changes in renal function.

### 2.3.7. Pharmacodynamics

In addition to pharmacokinetic changes, obesity can also impact pharmacodynamics, which refers to the drug's effect on the body. Obese individuals may have altered drug sensitivity or responsiveness due to changes in receptor expression, signalling pathways, or other physiological factors. This can affect the therapeutic efficacy and safety of medications. (Cheymol, 2000)

## 2.4. Dosing Challenges

The dosing of medications in these patients can be complicated due to physiological differences, altered pharmacokinetics, and the potential for drug interactions. Here are some key factors to consider when addressing dosing challenges in medication errors in overweight and obese patients:

### 2.4.1. Pharmacokinetic changes

Obesity can lead to changes in drug distribution, metabolism, and elimination, resulting in altered pharmacokinetics. The distribution of lipophilic drugs may be affected as these drugs tend to accumulate in adipose tissue, leading to decreased plasma concentrations and potential underdosing. In contrast, water-soluble drugs may exhibit altered distribution due to increased lean body mass and expanded extracellular fluid volume, potentially resulting in higher plasma concentrations and increased risk of toxicity. Therefore, dosage adjustments may be necessary to achieve therapeutic levels.

### 2.4.2. Body weight considerations

Traditionally, drug dosing is often based on total body weight. However, in obese individuals, using total body weight alone may lead to overdosing, as adipose tissue does not contribute significantly to the pharmacological effect of most drugs. Alternatively, ideal body weight (IBW) or adjusted body weight (ABW) calculations may be more appropriate. IBW corresponds to a perfect body mass index (BMI) value (typically 25 or 30 kg/m<sup>2</sup>), while ABW considers the excess weight beyond the ideal weight. These weight-based calculations can help determine the appropriate dose for obese patients. (Hummler *et al.*, 2023)

### 2.4.3. Renal function

Renal function plays a crucial role in drug clearance, and obesity can affect renal function due to comorbidities such as hypertension and diabetes. Obesity-related glomerular hyperfiltration can lead to increased renal drug clearance, resulting in potential underdosing. However, obese individuals may also have impaired renal function due to obesity-related kidney disease or nephropathy. Therefore, adjustments in drug dosing based on renal function estimation, such as creatinine clearance calculations, may be necessary to avoid medication errors.

### 2.4.4. Drug interactions

Obesity can influence drug metabolism and clearance through various mechanisms, including the altered activity of drug-metabolizing enzymes and changes in hepatic blood flow. Additionally, obesity is often associated with comorbidities requiring multiple medications, increasing the risk of drug interactions. Drug interactions can lead to therapeutic failure or adverse drug effects. Pharmacokinetic and pharmacodynamic considerations and careful evaluation of potential drug-drug interactions are crucial to ensure appropriate dosing and minimise the risk of medication errors.

### 2.4.5. Adherence and patient education

Overweight and obese patients may face unique challenges with medication adherence due to factors such as pill burden, complex dosing regimens, and socioeconomic barriers. Ensuring adequate patient education regarding medication dosing, potential side effects, and the importance of adherence is crucial. Healthcare providers should address any concerns or barriers hindering medication adherence in this population. (Barras & Legg, 2017)

## 2.5. Medication Selection

The selection of appropriate medications for overweight and obese patients requires careful consideration of several factors, including pharmacokinetics, pharmacodynamics, dosing, and potential adverse effects. Here are some key points to consider:

### 2.5.1. Pharmacokinetic

Pharmacokinetics refers to how the body processes a drug, including its absorption, distribution, metabolism, and elimination. In overweight and obese patients, there may be alterations in these processes due to changes in body composition, organ size, and blood flow. For instance, lipophilic drugs (drugs that have an affinity for fat tissue) may have altered distribution in obese patients, leading to higher apparent volumes of distribution and potentially prolonged drug action. Considering these factors when selecting medications is essential to ensure appropriate dosing.

### 2.5.2. Pharmacodynamics

Pharmacodynamics refers to how drugs exert their effects on the body. In overweight and obese patients, there may be alterations in drug-receptor sensitivity and drug-receptor interactions. Some medicines may have reduced efficacy in obese patients due to changes in receptor expression or signalling pathways. Conversely, other drugs may have enhanced effects in obese patients due to increased receptor availability or altered drug metabolism. Understanding these pharmacodynamic changes is crucial in selecting medications that will provide optimal therapeutic outcomes in overweight and obese patients. (Leykin *et al.*, 2011)

### 2.5.3. Dosing considerations

Medicating medications in overweight and obese patients can be challenging. Many drugs are dosed based on total body weight, but using total body weight alone may result in overdosing in obese individuals. Alternatively, standard dosing without considering the increased body weight may lead to suboptimal drug concentrations and reduced efficacy. Adjusting body weight, lean body weight or body surface area-based dosing strategies are often recommended to ensure appropriate drug exposure.

### 2.5.4. Adverse effects

Overweight and obese patients are at increased risk of specific medication-related adverse effects. For example, some drugs may have higher adverse effects, such as hepatotoxicity or cardiotoxicity in obese individuals due to altered drug metabolism or increased cardiac workload. It is essential to consider these potential risks when selecting medications and closely monitor patients for adverse effects during therapy. (Niederberger & Parnham, 2021)

To mitigate medication errors in overweight and obese patients, healthcare providers should consider the following strategies:

- Comprehensive assessment

Conduct a thorough evaluation of the patient's weight, body composition, organ function, and comorbidities to guide appropriate medication selection.

- Individualized approach

Tailor medication selection based on the patient's needs, considering efficacy, safety, and potential drug interactions.

- Collaborative care

Involve a multidisciplinary team, including pharmacists, dietitians, and other healthcare professionals, to optimise medication management and provide comprehensive care for overweight and obese patients.

- Education and counselling

Provide patient education and counselling regarding medication use, potential side effects, and the importance of adherence to therapy. Address any concerns or questions the patient may have.

- Regular monitoring

Monitor the patient's response to therapy, including therapeutic efficacy and adverse effects, and adjust the treatment plan as needed.

- Stay updated

Keep up-to-date with the latest evidence-based guidelines, research, and literature on medication use in overweight and obese patients. (Hodge *et al.*, 2021)

## 2.6. Prescribing Errors

Prescribing errors in medication administration can occur in various patient populations, including overweight and obese individuals. These errors can have significant implications for patient safety and treatment outcomes. Here, we'll discuss some common prescribing errors that may arise in overweight and obese patients.

### 2.6.1. Incorrect Dosage

One of the primary concerns when prescribing medications for overweight and obese patients is determining the appropriate dosage. Many drugs are typically dosed based on body weight or surface area to ensure adequate drug exposure. However, healthcare providers may need to pay more attention to this consideration or use outdated dosing guidelines that do not account for higher body weight. As a result, the prescribed dose may be insufficient or excessive, leading to either therapeutic failure or an increased risk of adverse effects.

### 2.6.2. Drug Selection

Certain medications may have altered pharmacokinetics or pharmacodynamics in overweight and obese patients. It is crucial to consider the specific characteristics of the drug and the patient's body composition when selecting medications. Failure to do so can result in suboptimal drug efficacy or an increased risk of toxicity. Additionally, some drugs may be contraindicated or require dosage adjustments in obese patients due to potential interactions with adipose tissue or changes in drug distribution. (Islas Ortega, 2019)

### 2.6.3. Lack of Monitoring

Overweight and obese patients often have comorbidities like diabetes, hypertension, or cardiovascular disease. These conditions may require multiple medications for effective management. However, healthcare providers may fail to adequately monitor the patient's response to treatment or assess for potential drug interactions. This lack of monitoring can lead to under-treatment or adverse events due to inappropriate combinations of medications.

### 2.6.4. Failure to Address Weight-Related Concerns

Overweight and obese patients may have unique considerations regarding medication prescribing. For example, particular drugs may have a higher risk of metabolic side effects, such as insulin resistance or dyslipidemia, in this population. Healthcare providers should be mindful of these concerns and select medications that minimise these risks whenever possible. They should also provide appropriate counselling on lifestyle modifications and weight management strategies alongside medication therapy.

### 2.6.5. Communication Issues

Communication breakdowns among healthcare providers can contribute to prescribing errors. In the case of overweight and obese patients, effective interdisciplinary communication becomes even more critical. Pharmacists, physicians, and other healthcare professionals must collaborate closely to ensure accurate medication prescribing, dosing adjustments, and monitoring plans for these patients.

To mitigate prescribing errors in overweight and obese patients, healthcare systems can implement several strategies. These include:

- Developing and implementing evidence-based guidelines and protocols for medication prescribing in overweight and obese patients.
- Providing regular education and training for healthcare providers to increase awareness of the unique considerations in medication therapy for this population.
- Utilizing electronic prescribing systems with built-in alerts and dosage calculators that consider body weight and other relevant patient parameters.
- Encouraging interdisciplinary collaboration and effective communication among healthcare professionals to facilitate comprehensive patient care.
- Conduct regular medication reviews and follow-up assessments to ensure appropriate medication selection, dosing, and monitoring. (Mahomedradja *et al.*, 2022)



### 3. Consequences of Medication Errors

#### 3.1. Therapeutic Failure

Therapeutic failure in medication errors refers to situations where the intended therapeutic effects of a medication are not achieved due to errors in its administration or management. Overweight and obese patients are particularly susceptible to medication errors and therapeutic failures due to various factors, including altered pharmacokinetics, dosing challenges, and potential interactions with comorbidities.

Here are some key factors contributing to therapeutic failure in medication errors in overweight and obese patients:

##### 3.1.1. Pharmacokinetic changes

Obesity can significantly alter the pharmacokinetics of drugs, including absorption, distribution, metabolism, and elimination. The increased adipose tissue in obese individuals can affect the volume of distribution and protein binding of certain medications, leading to changes in drug concentration and activity. Therapeutic failure may occur if these factors are not considered when determining the dosage.

##### 3.1.2. Dosing challenges

Determining the appropriate dosage for overweight and obese patients can be challenging. Many medications are initially developed and tested in individuals of average body weight, which may not accurately represent the pharmacokinetics and response in overweight or obese individuals. Inappropriate or over- or under-dosing can result in therapeutic failure or adverse effects.

##### 3.1.3. Medication selection

Certain medications may be less effective in overweight and obese patients due to physiological differences or altered drug distribution. For example, some antibiotics may have reduced efficacy in obese individuals due to difficulty achieving adequate tissue concentrations. In such cases, alternative medications or adjusted dosing strategies may be necessary to ensure therapeutic success. (Wolfe *et al.*, 2018)

##### 3.1.4. Comorbidities and polypharmacy

Overweight and obese patients often have a higher prevalence of comorbidities such as hypertension, diabetes, and cardiovascular diseases. Managing multiple conditions and polypharmacy (using various medications) increases the risk of medication errors and therapeutic failures. Drug interactions and contraindications must be carefully considered to avoid adverse effects or diminished therapeutic response.

##### 3.1.5. Patient adherence

Medication adherence can be challenging in overweight and obese patients, leading to therapeutic failure. Factors such as complex dosing regimens, pill burden, and side effects may contribute to non-adherence. Healthcare providers should work closely with patients to address these barriers and provide appropriate support and education to improve adherence.

To minimise therapeutic failure in medication errors for overweight and obese patients, healthcare professionals should consider the following strategies:

- Individualized dosing

Tailor is based only on factors such as body weight, body mass index (BMI), and pharmacokinetic considerations. Adjustments may be needed to achieve optimal drug concentrations and therapeutic outcomes.

- Pharmacokinetic modelling

Utilize pharmacokinetic modelling and simulation tools that consider the specific physiological characteristics of overweight and obese individuals. These tools can aid in determining appropriate dosages and dosing intervals.

- Regular monitoring

Monitor drug concentrations, therapeutic response, and potential adverse effects to ensure the medication achieves the desired outcomes. Adjustments can be made based on individual patient responses.

- Patient education and counseling

Provide comprehensive patient education regarding the importance of medication adherence, potential side effects, and strategies to overcome barriers to adherence. Regular communication and counselling sessions can improve patient understanding and involvement in their treatment.

- Interprofessional collaboration

Foster collaboration among healthcare professionals, including physicians, pharmacists, and nurses, to ensure comprehensive medication management. Regular communication and sharing of patient information can help identify and address potential errors or challenges.

- Weight management and lifestyle interventions

Encourage overweight and obese patients to adopt healthy lifestyle modifications, including diet and exercise, to manage their weight. Weight loss can lead to improved medication response and reduced risk of therapeutic failure. (Westberg *et al.*, 2017)

### 3.2. Adverse Drug Reactions

Adverse drug reactions (ADRs) are unintended and harmful reactions in response to medication use. Medication errors, on the other hand, refer to mistakes made in prescribing, dispensing, or administering medications. Overweight and obese patients face specific challenges regarding ADRs and medication errors due to their altered physiology and potential comorbidities. Let's explore this topic in more detail.

#### 3.2.1. Pharmacokinetic Considerations

- **Absorption** Overweight and obese individuals may experience altered drug absorption due to changes in gastrointestinal motility, blood flow, and increased fat tissue in the body. This can lead to drug concentrations and bioavailability variations, potentially impacting the drug's efficacy and safety.
- **Distribution:** Lipophilic drugs may distribute more extensively in adipose tissue, resulting in lower plasma concentrations and potential suboptimal therapeutic effects. Conversely, hydrophilic drugs may have a larger volume of distribution, leading to prolonged drug exposure and increased risk of ADRs.
- **Metabolism:** Obesity can influence drug metabolism due to alterations in hepatic enzyme activity. Specific cytochrome P450 enzymes, responsible for drug metabolism, may be affected, leading to decreased or increased drug clearance. This can result in drug toxicity or therapeutic failure, respectively.
- **Elimination:** Obese patients may experience changes in renal clearance due to altered kidney function and increased renal blood flow. Drugs eliminated primarily by the kidneys may require dosage adjustments to prevent drug accumulation or inadequate drug elimination. (Alomar, 2014)

#### 3.2.2. Increased Risk of ADRs

- **Polypharmacy:** Overweight and obese individuals often have multiple comorbidities and may require several medications. This increases the risk of drug interactions and ADRs due to the complexity of drug regimens.
- **Adipose Tissue Accumulation:** Some drugs tend to accumulate in adipose tissue, prolonging their half-life and increasing the risk of ADRs. Lipid-soluble drugs, such as sedatives or certain anaesthetics, may have prolonged effects in obese individuals.
- **Cardiometabolic Effects:** Obesity is associated with an increased risk of cardiovascular disease, diabetes, and metabolic syndrome. Medications used to manage these conditions, such as antihypertensives or antidiabetic drugs, can have specific ADRs, including hypotension, hypoglycemia, or fluid retention.

#### 3.2.3. Medication Errors

- **Dosing Errors:** Calculating appropriate medication doses for overweight and obese patients can be challenging due to drug distribution, metabolism, and renal clearance variations. Healthcare providers must consider weight-based dosing, adjust for organ dysfunction, and monitor therapeutic drug levels closely.

- **Equipment Limitations:** Standard equipment used in healthcare settings, such as blood pressure cuffs, may not accommodate larger-sized patients. This can lead to inaccurate measurements, potentially resulting in medication errors.
- **Limited Research:** Clinical trials often underrepresent overweight and obese individuals, leading to a lack of data on optimal dosing and safety profiles for this patient population. Healthcare professionals must rely on extrapolations from available data or individualised medication prescription approaches.

To mitigate ADRs and medication errors in overweight and obese patients, it is crucial for healthcare providers to:

- Consider individualised dosing strategies based on weight, organ function, and therapeutic goals.
- Monitor drug levels and clinical response closely to adjust medication regimens accordingly.
- Promote regular communication and collaboration among healthcare professionals, including pharmacists, to review medication lists and identify potential interactions.
- Utilize electronic prescribing systems and decision support tools to provide dose recommendations tailored to the patient's weight and clinical characteristics.
- Educate patients about their medications, potential ADRs, and the importance of adherence. (Lavan & Gallagher, 2016)

### 3.3. Health-related Complications

Medication errors can occur in any patient population, but overweight and obese patients may face unique health-related complications when such mistakes happen. Here are some potential complications associated with medication errors in overweight and obese patients:

#### 3.3.1. Dosing Errors

Overweight and obese patients often require higher medication doses due to increased body weight. If healthcare providers fail to adjust the medication dosage accordingly, it can result in under-dosing, leading to ineffective treatment. Conversely, if the dosage is miscalculated and the patient receives too much medication, it can lead to potential toxicity and adverse reactions.

#### 3.3.2. Pharmacokinetic Changes

Obesity can alter how medications are distributed and metabolised in the body. Adipose tissue, more abundant in overweight and obese individuals, can act as a reservoir for lipophilic drugs, leading to prolonged drug action. Additionally, altered blood flow, organ size, and function changes can impact drug absorption, distribution, metabolism, and elimination. Medication errors that do not account for these pharmacokinetic changes may result in suboptimal therapy or an increased risk of adverse effects.

#### 3.3.3. Polypharmacy and Drug Interactions

Overweight and obese patients often have multiple comorbidities, increasing the likelihood of polypharmacy (using various medications). This can increase the risk of medication errors, including drug-drug interactions. Medication errors that occur in the context of polypharmacy can lead to unpredictable interactions between medications, resulting in adverse effects or reduced therapeutic efficacy.

#### 3.3.4. Reduced Medication Compliance

Overweight and obese patients may face challenges with medication compliance due to various factors, such as difficulty swallowing larger pills, medication side effects, or non-adherence to complex dosing regimens. Medication errors can exacerbate these issues, decreasing patient compliance and suboptimal treatment outcomes.

#### 3.3.5. Impact on Chronic Conditions

Overweight and obese individuals often have higher rates of chronic conditions such as diabetes, hypertension, and cardiovascular disease. Medication errors in managing these conditions can have severe consequences, including uncontrolled blood sugar levels, elevated blood pressure, or increased risk of cardiovascular events.

#### 3.3.6. Surgical Complications

In some cases, overweight and obese patients may require surgical interventions. Medication errors in the perioperative period can lead to complications such as inadequate pain management, improper administration of anaesthesia, or

increased risk of surgical site infections. These errors can have profound implications for patient safety and recovery. (Wilborn *et al.*, 2005)

### **3.4. Strategies for Preventing Medication Errors**

#### *3.4.1. Healthcare Provider Education*

Healthcare provider education on medication errors in overweight and obese patients is crucial for ensuring patient safety and optimising healthcare outcomes. Overweight and obese individuals have unique physiological characteristics that can impact medication dosing, metabolism, and distribution. Lack of awareness and knowledge among healthcare providers regarding these considerations can lead to medication errors, compromised treatment efficacy, and potential harm to patients. Therefore, providing comprehensive education to healthcare providers on this topic is essential. Here's an overview of the critical areas that should be covered:

#### *3.4.2. Physiology of obesity*

Healthcare providers should be educated on the physiological changes in overweight and obese patients. These changes include altered drug absorption, distribution, metabolism, and excretion. Understanding these differences is critical for determining appropriate medication dosages and dosing intervals.

#### *3.4.3. Drug pharmacokinetics*

Healthcare providers must be familiar with the pharmacokinetic alterations in overweight and obese patients. These alterations can affect drug absorption, distribution, metabolism, and excretion. Providers should learn how to adjust medication doses based on total body weight, lean body mass, and surface area to ensure optimal therapeutic outcomes.

#### *3.4.4. Medication dosing considerations*

Education should cover the principles of dose adjustment for commonly used medications in overweight and obese patients. Providers should understand the importance of individualising medication dosing based on factors such as body weight, body mass index (BMI), and specific drug characteristics. This knowledge can help prevent underdosing or overdosing on medications. (Vaismoradi *et al.*, 2020)

#### *3.4.5. Adverse drug reactions*

Overweight and obese patients may be at increased risk of adverse drug reactions due to altered drug metabolism and distribution. Healthcare providers should be aware of this population's potential for medication-related complications. Education should focus on recognising signs of adverse drug reactions and implementing appropriate monitoring strategies.

#### *3.4.6. Communication and patient-centred care*

Healthcare providers should be trained on effective communication strategies when discussing medication use with overweight and obese patients. This includes using respectful language, understanding potential sensitivities, and promoting a non-judgmental environment. Encouraging open dialogue can help patients feel more comfortable discussing their medication concerns and adherence.

#### *3.4.7. Multidisciplinary approach*

Education should emphasise the importance of a multidisciplinary approach to managing overweight and obese patients. Collaboration among healthcare professionals, including physicians, pharmacists, dietitians, and nurses, is essential for optimising medication therapy and addressing the unique needs of this patient population.

#### *3.4.8. Ongoing learning and updates*

Healthcare providers should be encouraged to stay updated with current research and guidelines related to medication use in overweight and obese patients. Continuing education programs, workshops, and conferences can help providers enhance their knowledge and skills in this area. (Apovian *et al.*, 2015)

### **3.5. Individualized Treatment Plans**

Individualized treatment plans for medication errors in overweight and obese patients are essential to ensure patient safety and optimise therapeutic outcomes. When prescribing medications for overweight and obese individuals,

healthcare providers must consider altered pharmacokinetics, potential drug interactions, and each patient's needs. Here is a detailed overview of the components involved in individualised treatment plans for medication errors in overweight and obese patients:

#### *3.5.1. Assessment of Body Composition*

It is crucial to assess the patient's body composition, including body mass index (BMI), waist circumference, and body fat percentage. This information helps determine the severity of obesity and provides insights into fat distribution, which can affect drug absorption, distribution, metabolism, and excretion.

#### *3.5.2. Pharmacokinetic Considerations*

Overweight and obese individuals often exhibit alterations in drug pharmacokinetics. Increased adipose tissue can lead to changes in drug distribution, as many medications tend to accumulate in fat cells. This can sometimes result in prolonged drug exposure and increased half-life. Dosage adjustments may be necessary to achieve optimal therapeutic levels and avoid potential drug toxicity.

#### *3.5.3. Medication Selection*

Certain medications may be more appropriate for overweight and obese patients due to their pharmacokinetic properties. For instance, lipophilic drugs readily distributed into adipose tissue may require dosage adjustments, while hydrophilic drugs with limited distribution into fat may be preferred. Healthcare providers must carefully select medications with consideration of their efficacy, safety, and potential impact on weight management.

#### *3.5.4. Dose Adjustments*

Dosage adjustments are often necessary for overweight and obese patients to account for altered pharmacokinetics, potential drug metabolism, and elimination changes. Healthcare providers may need to increase or decrease the initial dose based on factors such as BMI, organ function, and the therapeutic index of the medication. Close monitoring of drug levels and therapeutic response is crucial to ensure optimal dosing. (FitzGerald, 2009)

#### *3.5.5. Drug Interactions*

Overweight and obese individuals may be taking multiple medications, increasing the risk of drug interactions. Healthcare providers must evaluate potential drug-drug interactions that can impact the safety and efficacy of the prescribed medications. This involves reviewing the pharmacokinetic and pharmacodynamic properties of the drugs and adjusting the treatment plan accordingly to minimise adverse effects and maximise therapeutic outcomes.

#### *3.5.6. Lifestyle Modifications*

Besides medication management, lifestyle modifications are crucial in treating overweight and obese patients. Healthcare providers should emphasise the importance of adopting a healthy diet, regular physical activity, and behaviour modification strategies to support weight loss and overall well-being. Collaborative efforts with dietitians, exercise specialists, and psychologists may be beneficial to develop comprehensive treatment plans.

#### *3.5.7. Patient Education and Monitoring*

It is essential to educate patients about the rationale behind individualised treatment plans, including the impact of obesity on medication effectiveness and safety. Patients should be informed about potential side effects, the importance of adherence to prescribed medications, and the need for regular follow-up appointments for monitoring and dose adjustments. Regular monitoring of weight, BMI, blood pressure, and relevant laboratory parameters can help assess treatment efficacy and detect any adverse effects. (Cannon & Kumar, 2009)

### **3.6. Multidisciplinary Collaboration**

Medication errors are a significant concern in healthcare settings, and overweight and obese patients present unique challenges in medication management. Multidisciplinary collaboration plays a crucial role in addressing medication errors in this population, as it involves the involvement of healthcare professionals from various disciplines to ensure patient safety and optimal treatment outcomes. Let's delve into the details of multidisciplinary collaboration in medication errors in overweight and obese patients.

### 3.6.1. Identification of the Problem

The first step in addressing medication errors in overweight and obese patients recognises the issue. Healthcare providers should be aware that these patients may require specialised medication dosing, different drug formulations, or alternative treatment strategies due to altered pharmacokinetics and potential comorbidities associated with obesity.

### 3.6.2. Multidisciplinary Team Formation

A multidisciplinary team should be established to address medication errors in overweight and obese patients. The team may consist of healthcare professionals such as physicians, pharmacists, nurses, dieticians, and other relevant specialists. Each team member brings their expertise and perspective to develop comprehensive solutions.

### 3.6.3. Assessment and Monitoring

The team collaboratively assesses and monitors the medication regimen of overweight and obese patients to identify potential errors. They consider factors like body weight, composition, organ function, and associated conditions that may impact medication efficacy or safety. Regular monitoring helps ensure that medication regimens are adjusted appropriately and reduces the risk of errors. (Zanon *et al.*, 2022)

### 3.6.4. Tailoring Medication Regimens

Medications may need to be tailored specifically for overweight and obese patients to achieve optimal therapeutic outcomes. The multidisciplinary team works together to develop personalised treatment plans that consider factors such as dosage adjustments based on body weight or lean body mass, choice of medications with favourable pharmacokinetic profiles, and potential drug interactions.

### 3.6.5. Education and Communication

Effective communication and education are crucial to multidisciplinary collaboration. The team members share their expertise and knowledge, as well as with the patients, to ensure a comprehensive understanding of the medication regimen. Patient education should focus on medication adherence, potential side effects, and the importance of regular follow-ups to monitor treatment effectiveness and safety.

### 3.6.6. Integration of Technological Tools

Technological tools such as electronic health records (EHRs), computerised physician order entry (CPOE), and clinical decision support systems (CDSS) can enhance collaboration and reduce medication errors. These tools facilitate communication, provide real-time information on drug-drug interactions or dosing adjustments, and assist healthcare professionals in making informed decisions.

### 3.6.7. Ongoing Evaluation and Quality Improvement

The multidisciplinary team continuously evaluates interventions' effectiveness and identifies improvement areas. Regular quality improvement meetings and discussions help refine medication management strategies for overweight and obese patients, reduce errors, and enhance patient outcomes.

### 3.6.8. Research and Evidence-Based Practices

Multidisciplinary collaboration fosters research and the development of evidence-based practices to address medication errors in overweight and obese patients. By conducting studies and sharing findings, healthcare professionals can further refine medication management protocols and contribute to the overall understanding of optimal treatment strategies in this patient population. (Mutair *et al.*, 2021)

## 3.7. Technological Solutions

Medication errors can have severe consequences for patients, and overweight and obese individuals may face unique challenges regarding medication management. Fortunately, several technological solutions can help mitigate medication errors in this population. Here are some detailed technical solutions that can be employed:

### 3.7.1. Electronic Health Records (EHRs)

EHR systems allow healthcare providers to access and update patient information electronically. For overweight and obese patients, EHRs can store specific information about their weight, body mass index (BMI), and other relevant

health metrics. This information can help healthcare providers calculate appropriate medication dosages based on the patient's weight, reducing the risk of errors caused by inaccurate dosing.

### *3.7.2. Computerized Physician Order Entry (CPOE)*

CPOE systems enable healthcare providers to enter medication orders electronically, replacing traditional handwritten prescriptions. These systems can incorporate safety checks and alerts, such as drug-drug interactions, contraindications, and dosage recommendations based on the patient's weight or BMI. By integrating these safety features, CPOE systems can help reduce errors related to incorrect prescriptions or dosages.

### *3.7.3. Barcode Medication Administration (BCMA)*

BCMA systems use barcode technology to verify the "Five Rights" of medication administration: right patient, proper medication, correct dosage, right route, and the right time. When administering medication to overweight or obese patients, BCMA systems can help ensure that the correct medication and dosage are provided based on the patient's weight or BMI. This technology helps minimise the risk of medication errors caused by confusion or mix-ups. (O'Driscoll *et al.*, 2008)

### *3.7.4. Medication Dispensing Robots*

Automated dispensing systems or robots can help improve medication management in healthcare facilities. These robots store and dispense medications based on prescriptions provided electronically. In the case of overweight and obese patients, the robots can be programmed to consider the patient's weight or BMI when selecting and dispensing medications. This helps ensure that appropriate doses are provided, reducing the chances of errors due to incorrect dosing.

### *3.7.5. Mobile Health Applications*

Mobile health apps can assist overweight and obese patients manage their medications effectively. These apps can provide reminders for medication schedules, offer educational information about drugs, and allow users to input their weight and receive personalised dosage recommendations. Additionally, some apps can provide interactive features for medication tracking, enabling patients to record medication administration and share the data with healthcare providers for better monitoring and management.

### *3.7.6. Telehealth and Remote Monitoring*

Telehealth services and remote monitoring technologies can benefit overweight and obese patients by providing continuous support and supervision in medication management. Through virtual consultations, healthcare professionals can assess the patient's condition, adjust medication regimens, and address any concerns or questions. Remote monitoring devices, such as wearable sensors or smart scales, can transmit data regarding weight, vital signs, or medication adherence to healthcare providers, allowing for proactive interventions and reducing the risk of errors. (Gadde *et al.*, 2018)

## **3.8. Policy and System-level Interventions**

Medication errors in overweight and obese patients can have significant consequences due to altered drug metabolism, dosing inaccuracies, and potential drug interactions. Various policy and system-level interventions have been proposed and implemented to address this issue to reduce medication errors and improve patient safety. Here are some detailed interventions:

### *3.8.1. Development of Weight-Based Dosing Guidelines*

Policy-level interventions involve developing and disseminating weight-based dosing guidelines for medications commonly used in overweight and obese patients. These guidelines provide healthcare professionals with standardised recommendations for determining appropriate medication doses based on the patient's weight. This approach helps minimise dosing errors and ensures adequate drug exposure while considering the patient's body size.

### *3.8.2. Electronic Health Record (EHR) Alerts*

EHR systems can provide real-time alerts and warnings to healthcare providers when prescribing medications for overweight and obese patients. These alerts can highlight potential dosing errors, drug interactions, and other safety considerations specific to this patient population. By incorporating weight-related information into the prescribing process, healthcare providers can make more informed decisions and reduce the risk of medication errors.

### 3.8.3. *Interprofessional Communication and Collaboration*

Effective communication and collaboration between healthcare providers are crucial to ensuring patient safety. Policy interventions can encourage interprofessional teams, including physicians, pharmacists, and nurses, to work together and exchange relevant information about medication management for overweight and obese patients. Regular team meetings, shared decision-making, and standardised protocols can facilitate improved coordination and reduce the likelihood of errors. (Wolfe *et al.*, 2018)

### 3.8.4. *Pharmacist Involvement in Medication Reconciliation*

Pharmacists play a vital role in medication reconciliation, especially for patients with complex medication regimens. Policy-level interventions can promote pharmacist involvement in medication reconciliation, particularly for overweight and obese patients. Pharmacists can review the patient's medication list, assess dosing appropriateness, identify potential drug interactions, and recommend optimising therapy. Their expertise can significantly contribute to reducing medication errors.

### 3.8.5. *Staff Training and Education*

System-level interventions include providing comprehensive training and education to healthcare professionals regarding medication management in overweight and obese patients. This training should focus on the unique challenges associated with this population, including dosing adjustments, drug selection, and potential drug-drug interactions. Enhancing healthcare providers' knowledge and awareness can minimise the likelihood of medication errors.

### 3.8.6. *Standardized Protocols and Order Sets*

Standardized protocols and order sets can help streamline medication management in overweight and obese patients. These protocols can include specific dosing algorithms, recommendations for therapeutic drug monitoring, and guidance on adjusting doses based on weight. Standardisation promotes consistency in prescribing practices and reduces the potential for errors stemming from inconsistencies or variations in care.

### 3.8.7. *Patient Education and Empowerment*

It is essential to involve patients in their care and empower them to understand the importance of medication management. Policy interventions can promote the development of educational materials and resources tailored to overweight and obese patients. These materials should provide information on medication use, potential side effects, adherence strategies, and the importance of communication with healthcare providers. Empowering patients to actively participate in their treatment can help identify and prevent medication errors. (Alsulami *et al.*, 2012)

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## 4. Conclusion

Medication errors in overweight and obese patients are a significant concern that requires attention from healthcare professionals, policymakers, and regulatory bodies. By understanding the contributing factors and implementing preventive strategies, such as weight-based dosing guidelines, enhanced education, improved medication labeling, and comprehensive medication reconciliation processes, the frequency and impact of medication errors can be significantly reduced. Ultimately, improving medication safety in overweight and obese patients will lead to better patient outcomes, increased patient satisfaction, and a safer healthcare system overall.

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## Compliance with ethical standards

### *Disclosure of conflict of interest*

No conflict of interest to disclosed.

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