5-2024

Analysis of Medication Error Trends Occurring During the COVID-19 Pandemic

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BUTLER UNIVERSITY HONORS PROGRAM

Honors Thesis Certification

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Thesis title Analysis of Medication Error Trends occurring during the COVID-19 Pandemic

Intended date of commencement
May 10, 2024

Read, approved, and signed by:

Thesis adviser(s) _____ Date

Reader(s) _____ Date

_____ Date

_____ Date

Certified by _____ Date
Director, Honors Program

Analysis of Medication Error Trends Occurring During the COVID-19 Pandemic

A Thesis

Presented to the College of Pharmacy and Health Sciences

and

The Honors Program

of

Butler University

In Partial Fulfillment

of the Requirements for Graduation Honors

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May 10, 2024

Abstract

Prior to the COVID-19 pandemic, medication errors were the leading cause of preventable harm in hospitals, negatively impacting approximately 1.5 million American patients each year.[1] Since then, over thirty novel COVID-19 treatments have been authorized for patient use, introducing new challenges and exacerbating existing factors that contributed to medication errors.[2] This research aims to identify and analyze medication error trends associated with COVID-19 related medications, vaccines, and treatment algorithms. To determine the most prominent medication errors occurring in the United States healthcare system during the beginning stages of the pandemic, literature reviews were conducted to identify the active treatments and vaccinations used for the SARS CoV2 virus and the known medication safety issues associated with these regimens were analyzed. A questionnaire was then distributed to members of the Institute for Safe Medication Practices to assess the most persistent errors found to be occurring in hospitals across the nation. Missed doses of treatments and failure to engage in barcode medication administration were found to be the most prevalent errors across participants. The most common causes of errors in the study emerged as miscommunication and issues related to staff training and education. The responses were categorized and analyzed to formulate an updated list of the most frequent medication errors at the time, which validated the original identified errors from the literature review and recognized new concerns. The objective of this research is to assess recurring medication errors in the context of the COVID-19 pandemic and pinpoint additional errors unique to COVID-19 treatments. This research seeks to understand how the surge in contemporary COVID-19 treatment options impacts medication safety for patients receiving medical care in

American hospitals. This data can aid in medication error prevention and elimination strategies outside the context of the pandemic, thus reducing patient mortality rates, length of hospital stays, and medical expenses.

Acknowledgments

This research would not have been possible without the guidance and expertise of Dr. John Hertig, who served as my research mentor, and Dr. Jane Gervasio, who served as my thesis advisor. I would also like to express my gratitude to the Buter Summer Institute for funding this research. Additionally, I would like to thank the Institute for Safe Medication Practices for agreeing to participate in this research.

Introduction

Medication errors, defined as any "preventable event that may cause or lead to inappropriate medication use or patient harm[3]" have long been a pervasive issue in healthcare settings. Medication errors pose substantial risks to the overall efficacy of healthcare delivery, with potential adverse events such as death, increased hospitalization, and high medical costs.[3] Each year in the United States, up to 9,000 individuals die due to a medication error and the total cost associated with medication errors exceeds 40 billion dollars.[4] Errors related to medication mismanagement are responsible for up to 41% of all hospital admissions and 22% of readmissions after discharge.[1] Medication errors occur during preparing, ordering, prescribing, dispensing, administering, storing, or procuring a drug. Errors are most common at the ordering and prescribing stages, accounting for almost 50% of all medication-related errors.[1] There are many known risk factors common

in the United States healthcare system that contribute to a medication error occurring, including high patient volumes, inexperienced staff, poor communication, workplace culture, and lack of follow-up or patient monitoring.[5] However, the attitudes toward medication errors are gradually shifting away from blame and punishment of an individual provider to a more systems-based approach that address these risk factors and the creation of infrastructure that catches errors before they reach a patient.[6]

This research is significant for the field of patient safety because it offers contemporary and qualitative data on errors stemming from COVID-19 medications, vaccines, and therapies. While there are general studies that measure quantifiable medication rates, this research is original in the sense that it focuses on errors in the context of a global pandemic and offers empirical, firsthand accounts of those errors at play on the frontlines of the healthcare system. This research seeks to uncover ongoing errors that are being heightening by the COVID-19 circumstances and discover new errors that are direct results of novel treatment options. It is vital that the American healthcare system improves in medication safety and this research paper seeks to explore the multifaceted implications of medication errors during the COVID-19 pandemic, while identifying the underlying factors contributing to their occurrence. By analyzing the intersection between medication errors and the COVID-19 pandemic, this study aims to contribute to the ongoing dialogue surrounding medication safety and foster evidence-based practices to ensure quality patient care.

The emergence of the COVID-19 pandemic brought unprecedented challenges to the American healthcare system, fundamentally reshaping the delivery of medical care. Amidst the urgency of combating the virus, attention to medication safety became

increasingly vital. The unique circumstances of the COVID-19 pandemic have amplified the complexity and significance of medication errors, posing new challenges to healthcare professionals and patients. As healthcare systems responded to the escalating demands of the pandemic, disruptions in healthcare delivery, supply chain disturbances, and workforce shortages created the perfect storm for medication errors to occur.[7] The rapid adoption of telemedicine and virtual care modalities, while essential for minimizing viral transmission, introduced novel communication challenges and increased the risk of medication-related mismanagement.[7] Global shortages of personal protective equipment, ventilators and other critical care equipment, testing supplies, and essential medications became a significant challenge.[8] The increased demand for healthcare services exceeded the supply of medical professionals who could provide it during the pandemic, especially with heightened illness and burnout in healthcare workers leading to absenteeism and turnover.[8] Moreover, the strain on healthcare resources and personnel, coupled with the urgency to treat COVID-19 patients, led to heightened stress levels and reduced attention to detail, predisposing healthcare workers to errors in medication prescribing, dispensing, and administration.

Against this backdrop, understanding the impact of the COVID-19 pandemic on medication errors is essential for informing targeted interventions, enhancing patient safety, and optimizing healthcare delivery during public health crises. This research is significant because it looks at this chronic issue of medication safety through the lens of a global pandemic, which poses new challenges to an already flawed system in terms of patient safety. Novel drugs have been approved for use, emergency treatments have been authorized, and regimens previously used for other health conditions have become

available in the fight against the SARS CoV-2 virus. This research seeks to understand how this overwhelming surge of treatment options, in combination with an influx of patients in hospitals and a shortage of providers, impacts the emphasis put on patient safety and in turn, the outcome on medication errors. This can fill in gaps of previous research by uncovering the most pronounced errors stemming from COVID-19 treatments through qualitative and narrative formats. Understanding the types, occurrences, and contributions to errors in COVID-19 treatments extends beyond the scope of the pandemic. The data can further aid in preventing and eliminating errors in the American healthcare system in a post-pandemic timeframe.

Existing Literature

The Institute for Safe Medication Practices (ISMP) is a leading patient safety organization focused on promoting the safe use of medication in healthcare delivery. The ISMP operates a medication error reporting system which collects voluntary and confidential reports of errors or near-misses experienced by both providers and consumers. The IMSP analyzes all reports by hand to identify patterns, trends, and contributing factors related to medication errors and then disseminates the findings to the medical community through various channels and offers recommendations of "best practices" in the realm of medication safety.[9]

In May of 2020, the ISMP published their first newsletter on the emerging risks associated with COVID-19 treatments.[10] The first report on the list was confusion with labeling of the investigational drug, Remdesivir, used to treat patients intravenously with severe COVID-19. This drug was used during a period of expanded access and through

an emergency use authorization issued by the Food and Drug Administration. The adult protocol was a loading dose of 200mg, followed by subsequent doses of 100mg. Vials contained 100mg of the drug, however subsequent doses were being prepared with two vials for a total of 200mg instead of the intended 100mg. It was reported that the packaging being used in clinical trials for Remdesivir were not clearly labeled and the information was crowded and in a small font. Additionally, the powder form of the drug stated the loading dosage in milligrams on the label, but the soluble forms listed the per milliliter strength or the total dose per total volume. One hospital where this error occurred noted that these differences in labeling contributed to the overdosing of Remdesivir, but also conformation bias and a lack of barcode medication administration. The providers who unintentionally used two vials to prepare the subsequent dosages had just gone through the exact same process for the loading dosages, leading to the belief that this was the correct preparation. Additionally, there were no barcodes available to scan on the Remdesivir vials, so barcode scanning could not be performed to verify the dosage.[10] Drug labeling confusion is not an uncommon issue, however. In a study published by the National Institute of Health National Library of Medicine, 85 over the counter drug labels were evaluated and 71 of them had the pharmacy name or logo as the prominent item, with an average font size of 13.6. Font sizes were even smaller for the medications' instructions (9.3), medication name (8.9), and warnings (6.5). Additionally, it was found that colors, boldfacing, and highlighting were most often used for information pertaining to the pharmacists, rather than the patients.[11]

The next error on the ISMP's report was failure to engage barcode medication administration. It states that many COVID-19 related errors reached the patient without

being detected because there was an increase in staffing changes during the pandemic and providers were unfamiliar with the barcode medication administration processes of different units. One example offered on the report was of a redeployed operating room nurse who administered an albuterol inhaler instead of the intended fluticasone furoate and vilanterol (Breo Ellipta®) inhaler after failing to use the unfamiliar barcode medication administration technology.[10] A study published on the Patient Safety Network assessed error rates in an emergency department after the implementation of barcode medication administration technology. An 11% decrease in errors was noted, however many workarounds were identified which limits the overall effectiveness and safety of barcode medication administration.[12]

Another recurring error listed on the ISMP's newsletter is entering just the first few letters of a medication into the Automated Dispensing Cabinet (ADC). Providers then have an increased likelihood to choose the wrong drug and if they proceed to override the barcode administration, resulting in the wrong medication eventually being administered to the patient. One example that was mentioned was that of a 40-year-old intubated patient with Covid in the intensive care unit who received verapamil instead of midazolam (Versed®). A physician verbally ordered an increase in the dose-rate of the propofol infusion and to administer "Versed mg IV push." The nurse entered the first few letters of the drug into the ADC and selected a vial of verapamil (5 mg/2mL) which was available via override. The nurse went on to administer the verapamil, believing it was Versed®, and did not employ barcode medication administration because it was a verbal order from the physician and had not been documented in the health records.[10] This error is very similar in manner to a fatal error that occurred at Vanderbilt Hospital in 2017. This

was the case of a neurology intensive care unit patient who was in the radiology department for a positron emission tomography (PET) scan and requested Versed® to ease her claustrophobia-induced anxiety. The patient's physician put the order into the electronic medical record and a "floater/help-all nurse" went down to the radiology unit to administer the IV Versed®. This nurse had entered the first few letters into the ADC under the patient's profile, but because the patient had transferred units, the profile was still pending, and no medications populated the search results. Thus, the nurse initiated an override feature and selected the first medication that populated, which was Vecuronium, a paralyzing agent, rather than the intended Versed®, a mild sedative. The nurse went on to administer an unknown amount of the neuromuscular blocker and left the patient unmonitored. After about 30 minutes, the patient was found unresponsive, and was ultimately withdrawn from life support the next day due to anoxic brain injury.[13]

The next error on the ISMP'S report is especially unique to the COVID-19 pandemic, as the use of telehealth visits became more common. There was an uptick in inaccurate dosages of weight-based drugs being administered due the inability to record patients' weights during telehealth visits. In these cases, the electronic health record system did not flag providers when they were administering weight-based drugs, so they never verified the patient's weight and ultimately administered a dosage that did not correspond to the accurate weight of the patient. One such error occurred in an oncology clinic when a patient came in for their first chemotherapy treatment. The patient had been participating in telehealth visits for several months prior, during which weight measurements were not regularly updated. The chemotherapy plan was based on a weight measured prior to the pandemic and associated virtual visits, and the patient had lost

substantial weight since that time. Fortunately, the weight difference was noticed prior to the start of treatment, however since the plan had to be revised, the chemotherapy treatment had to be delayed.[10]

Finally, numerous reports of missed COVID-19 doses in the hospital setting were results of miscommunications between nursing and respiratory therapy staff. This is likely to be a result of the heavy patient load put on providers during the height of the pandemic. Missed doses of medication have been associated with adverse events in hospitalized patients prior to the pandemic.[10] Failure to administer scheduled drugs have received minimal attention in literature, despite administration errors making up 50% of all medication errors in hospitalized patients.[1] A retrospective analysis from the International Journal for Quality in Healthcare found clinical omissions of treatment to be of significant concern. The study evaluated over 23 million charted doses in hospitalized patients to detect overdue doses over a 239-week time period. It was found that a total of 2,121, 765 antibiotics and 25, 668,583 non-antibiotic doses were prescribed through PICS (a mean average of 8,878 and 10, 400 per week, respectively). Of these, 154, 412 (7.3%) antibiotics and 3, 293, 467 (12.8%) non-antibiotic doses were missed, equivalent to an average of 646 and 13, 780 per week, respectively.[14]

Methodology

This research was conducted during June of 2021 as part of the Butler Summer Institute. The project took place in four phases over the course of nine weeks. The first phase was an extensive literature review of the treatment guidelines and specific medications and vaccines that were actively being used in Covid patients at that time. The

literature review was conducted utilizing a systematic search strategy to identify relevant scholarly articles. The PubMed database, as well as the Food and Drug Administration and the Center for Disease Control websites were searched. The search strategy for PubMed employed a combination of relevant keywords and controlled terms. These included “Covid Treatments,” “Covid Drugs,” “Covid Medications,” and “Covid Treatment Guidelines.” Articles were included if they met the following criteria: written in English, relevant to the topic of covid treatments and guidelines, and available in full text. Articles were excluded if they did not pertain directly to COVID-19 medications or meet inclusion criteria. Data extraction was performed by an independent researcher using a predefined data extraction form. The following types of therapeutics were extracted from the included articles: antivirals, adjunctive drugs, and nanotherapeutics. The extracted data was broken down to a variety of components specific to the medication, including active and inactive ingredients, dosage regimen, route of administration, instructions for patient use, and additional features such as combination therapies or specific delivery mechanisms. This information was not available for every medication analyzed but all relevant components of each treatment were extracted for completeness. The next phase consisted of a second literature review to determine the medication safety hazards that were already associated with each treatment. Effectiveness and adverse side effects were not included in this and are outside the scope of this research. The purpose of this phase was to come to a consensus on the most prominent and consistent errors correlated to COVID-19 treatments that were already dispersed in literature. PubMed was searched initially but limited results were yielded, so the ISMP was used as the primary source. The third phase was the creation and distribution of a

questionnaire that assessed the errors found in phase two. This survey was created through the Qualtrics tool and sent out to members of the ISMP through an email chain. The only inclusion criteria for participants were that that they were members of the ISMP. The survey did not question age, sex, or role in healthcare and there were no requirements in these categories, so a diverse population is expected. The ISMP comprises pharmacists, physicians, nurses, quality improvement specialists, healthcare administrators, researchers, and medication safety personnel. The ISMP membership, and thus this research sample, reflects the experiences of various stakeholders in the medication safety space. The Qualtrics tool recorded the approximate geographical location that responses came from. The following are the cities that participants completed surveys in with the number of responses from that city in parentheses: Indianapolis, IN (2); Baltimore, MD (6); Sacramento, CA (2); Raleigh, NC (2); Lincoln, NE (1); Miami FL (1); Wichita, KS (2); Kansas City, MO (2); Portland, OR (1); Detroit, MI (3); Boston, MA (3); Los Angeles, CA (1); Buffalo, NY (2); San Antonia, TX (1); St. Louis, MO (1); Chicago IL (1); Richmond, VA (1); Syracuse, NY (1); Oakland, NY (2); Jacksonville, FL (1). In the final phase, responses were recorded and analyzed on a rolling bases using criteria measures to ensure consistency in the analysis. A modified Delphi approach was followed, which used the literature reviews and input of the providers to reach a final consensus. The responses were categorized based on key words and themes using a systematic approach to determine an updated list of the most frequent medication errors occurring during that time of the COVID-19 pandemic. Initially, all participant responses were carefully reviewed to identify recurring keywords and concepts. These keywords served as the foundation for developing initial categories,

representing specific themes or topics inherent in the data. Subsequently, each response was systematically analyzed and assigned to one or more categories based on its content. This process involved continuous comparison and refinement of categories to ensure accuracy and consistency in data categorization. Additionally, emergent themes were identified through inductive analysis, allowing for the exploration of new patterns and insights within the data. Once all responses were coded, thematic analysis was conducted to identify overarching themes that encompassed the broader meaning and implications of the qualitative data. This methodological approach enabled a comprehensive analysis of participant responses, facilitating the identification of key insights and patterns relevant to the research objectives. The updated list of recurring medication errors was sent back out to members of the ISMP for assessment purposes in their own individual hospitals. The study's conclusions, general trends, and specific components of each prominent error were presented at the Butler Summer Institute Conference and Undergraduate Research Conference. This project was previously submitted for IRB approval and filed under one of the exempt categories.

Results

The study aimed to investigate various medication error types associated with COVID-19 treatments, focusing on the frequency of occurrences and the corresponding responses for the ISMP's five error types. Analysis of the collected data yielded a notable number of additional instances classified as medication errors. The survey was completed by 36 participants. Surveys with incomplete responses were not included for analysis. For each of the ISMP's five error types, participants were asked if they had committed the

error, seen the error occur, or heard reports of it occurring in their hospital. If they answered “yes”, participants then scored the frequency of that error occurring in their healthcare setting, on a scale of 1-5 (1 being rarely and 5 being very often). Among the identified error types, missed doses of treatments emerged as the most prevalent issue, garnering 16 affirmative responses (44.4%) from participants. The average frequency of missed doses was calculated to be 3.8 out of 5.0. Automated Dispensing Cabinet errors were reported in 11 of 36 instances (30.5%), with an average frequency of 3.0 occurrences. Telehealth associated weight issues also emerged as a notable concern, with 8 affirmative responses (22.2%) and an average frequency of 4.0 occurrences. Barcode Medication Administration Failure was identified in 16 of 36 responses (44.4%) with an average frequency of 3.8 occurrences. Lastly, remdesivir drug labeling confusion was reported in 5 responses (13.9%) with an average frequency of 4.25 occurrences per respondent.

Respondents also provided narrative context for each of the ISMP’s error types that they answered “yes” to observing. They were also offered an opportunity to discuss additional errors not presented in the survey through an open-ended format. The narrative feedback for each of the five listed errors as well as additional errors were grouped into five categories based on themes and key wording. Training and education emerged as a prominent factor, accounting for 26% of responses. Miscommunication was identified as another significant contributing factor, comprising 28% of responses. Staffing issues were reported in 18% of responses and equipment-related challenges accounted for 13% of responses. Additionally, labeling issues were reported in 15% of responses. Sample responses are included in Figure 2 and will be discussed further.

Discussion

The ISMP's list of top five medication errors during the COVID-19 pandemic was validated, and additional error types were identified. Missed doses of COVID-19 treatments and failure to engage in barcode medication administration were the most prominent of the five error types, followed by ADC errors, telehealth weight-related issues, and remdesivir drug labeling confusion. While labeling confusion in remdesivir was seen the least out of the five error types, it was the most frequent error in institutions where it occurred, highlighting challenges related to the accurate interpretation and application of medication labels. This finding underscores the importance of clear and standardized labeling practices to minimize the risk of medication errors, particularly in high-stress clinical environments. Clear and standardized labeling protocols, coupled with robust medication reconciliation processes, are essential for minimizing confusion and ensuring the safe and effective use of medications in clinical practice. Missed doses of treatments emerged as the most prevalent issue, with nearly half of the participants (44.4%) affirming its occurrence in their hospitals, indicating a concerning level of inconsistency in medication delivery. This finding underscores the critical importance of adherence to medication schedules and the significance of ensuring timely and accurate administration of medications to patients. The average frequency of missed doses, calculated to be 3.8 out of 5.0, indicates a moderate to high occurrence rate, highlighting the need for interventions to reduce such errors. Similarly, 30% of errors associated with the ADC reflect challenges in the automated medication dispensing process within healthcare settings. The relatively high number of reports suggests a considerable

occurrence of errors associated with this technology and while the average frequency of these errors was the lowest at 3.0 occurrences, it still signifies a notable concern that warrants attention and improvement in the use of automated dispensing systems. Despite the potential benefits of automation in medication dispensing, these errors highlight the challenges associated with technology implementation and the importance of rigorous quality assurance measures. Telehealth related errors in this study highlight discrepancies or inaccuracies in weight measurements conducted during telehealth consultations. This finding suggests a potential gap in communication or standardization of weight assessment protocols in virtual healthcare settings. As telehealth continues to gain prominence in healthcare delivery even beyond the pandemic, ensuring the accuracy of virtual patient monitoring data becomes increasingly crucial. Lastly, errors in barcode medication administration processes indicate challenges in accurately scanning medication barcodes during the administration process. This finding emphasizes the importance of proper barcode scanning techniques and system reliability to prevent medication administration errors. While barcode scanning has the potential to reduce medication errors, its effectiveness relies heavily on proper training, system integration, and user compliance.

Furthermore, the findings of this survey underscore the multifaceted nature of medication errors in healthcare settings and the urgent need for targeted interventions to address them. By prioritizing medication safety initiatives, investing in technology and training, and fostering a culture of continuous improvement, healthcare organizations can mitigate the risks associated with medication errors and enhance the quality of care delivered to patients. Moving forward, collaborative efforts among stakeholders,

including healthcare providers, administrators, regulators, and technology vendors, will be essential to drive meaningful change and improve patient outcomes in medication management.

The narrative context and feedback from participants were analyzed to identity common factors contributing to medication errors. Training and education emerged as the most prominent factor, with 26% of responses citing this as a significant issue. This underscores the importance of comprehensive training programs for healthcare professionals involved in medication administration, ensuring they possess the knowledge and skills necessary to perform their roles effectively and safely. Investing in ongoing education and professional development can help mitigate the risk of errors stemming from lack of knowledge or competency. Errors related to training and education included failure to engage in barcode medication administration, prescribing emergency use medications to patients who did not meet the criteria, discharging of patients before completion of therapy, and metric confusions causing errors in weight-based drugs. (Figure 3) Miscommunication was identified as another significant contributing factor, comprising 28% of responses. Effective communication among healthcare team members is essential for safe medication management, from prescribing to administration. Clear and concise communication channels, standardized protocols, and interdisciplinary collaboration can help minimize misunderstandings and reduce the likelihood of errors caused by communication breakdowns. Errors stemming from miscommunication included missed doses in transferring patients between units, dosages being duplicated after hospital admission, poor gathering of a home medication list resulting in inappropriate continued medication in the hospital, and verbal orders

resulting in the wrong drug administered. (Figure 3) Staffing issues were reported in 18% of responses, highlighting the impact of workforce shortages, fatigue, and workload on medication safety. Adequate staffing levels and workload management strategies are essential for preventing errors related to fatigue or rushing through tasks. Healthcare organizations must prioritize staffing resources and implement strategies to support staff well-being and mitigate the risk of errors associated with staffing challenges. Errors that resulted from staffing changes included floating nurses between units in areas they were not familiar with, heavy workload on staff, and a provider checks not being able to be performed in isolation rooms. (Figure 3) Additionally, labeling issues were reported in 15% of responses, highlighting the importance of clear and accurate medication labeling practices. Ambiguous or misleading labels can lead to medication errors, jeopardizing patient safety. Standardizing labeling protocols, ensuring legibility, and incorporating human factors principles into label design can help reduce the risk of errors related to medication labeling. Errors due to labeling confusion included monoclonal antibody packaging, inconsistent labeling of drugs, and names of drugs being changed. (Figure 3) Equipment-related challenges accounted for 13% of responses, indicating that issues with technology, devices, or equipment can contribute to medication errors. Ensuring the reliability, functionality, and usability of medical equipment and technology systems is critical for safe medication administration. Regular maintenance, user training, and system optimization can help address equipment-related issues and minimize their impact on patient safety. Errors secondary to equipment and technology included medication dispensed from the incorrect patient profile in the ADC, new medications not being coded

into the software system for barcode scanning purposes, rooms not being fully equipped due to supply chain shortages, and misfiling of the ADC cabinet. (Figure 3)

Along with the ISMP's list, the following errors were recognized as major concerns to medication safety and should be evaluated in hospitals: monoclonal antibody labeling confusion, errors due to staff in areas they are not familiar with, remdesivir doses missed or duplicated due to transfer patients between units, and verbal orders resulting in misunderstanding of intended drug. These five errors were all reported three or more times by separate participants in the open-ended portions of the survey.

In conclusion, addressing medication errors in healthcare settings requires a multifaceted approach that addresses the underlying factors contributing to these errors. Training and education, effective communication, staffing optimization, equipment maintenance, and labeling standardization are key areas for intervention and improvement. By prioritizing these areas and implementing targeted strategies, healthcare organizations can enhance medication safety, minimize the risk of errors, and ultimately improve patient outcomes.

Limitations

While this study provides valuable insight into qualitative perspectives on medication safety, some limitations should be acknowledged. The sample size in this study was relatively small, which may limit the generalizability of findings. The sample was diverse in nature, yet future research with a larger sample could provide further insight into the types, frequencies, and severities of errors in Covid treatments. The data for this study was collected through self-reported surveys, which are subject to bias and

inaccuracies. Additionally, the data was analyzed by an independent researcher, which also may lead to misinterpretations or generalizations. Despite efforts to minimize these issues, more objective measurements and secondary interpreters could provide more significant results. Finally, due to time constraints, the data collection period was limited to two weeks. This limited timeframe may not capture long terms trends of medication errors during the COVID-19 pandemic.

Tables and Figures

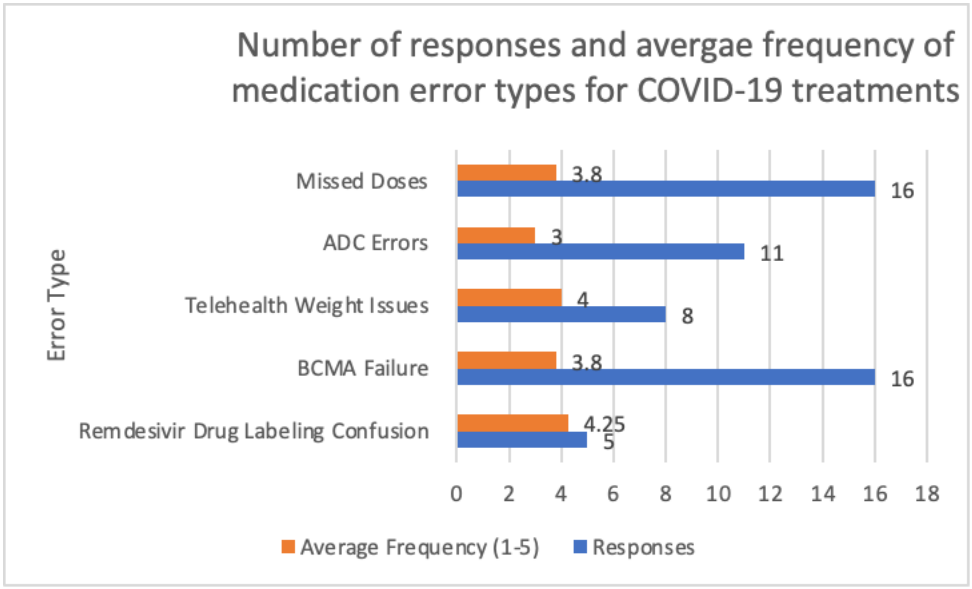

Figure 1: Number of responses and average frequency of medication error types for COVID-19 treatments. A questionnaire addressing the five error types was completed by 36 participants who responded to seeing or hearing reports of each error type and scored the frequency of that error in their health setting. The blue bar indicates the number of participants who saw or heard reports of that error type during the COVID-19 pandemic (out of 36 participants). The orange bar indicates the average score

(calculated from all 36 participants) of how often each error type occurred (ranging from 1-5). Participants could indicate several different responses.

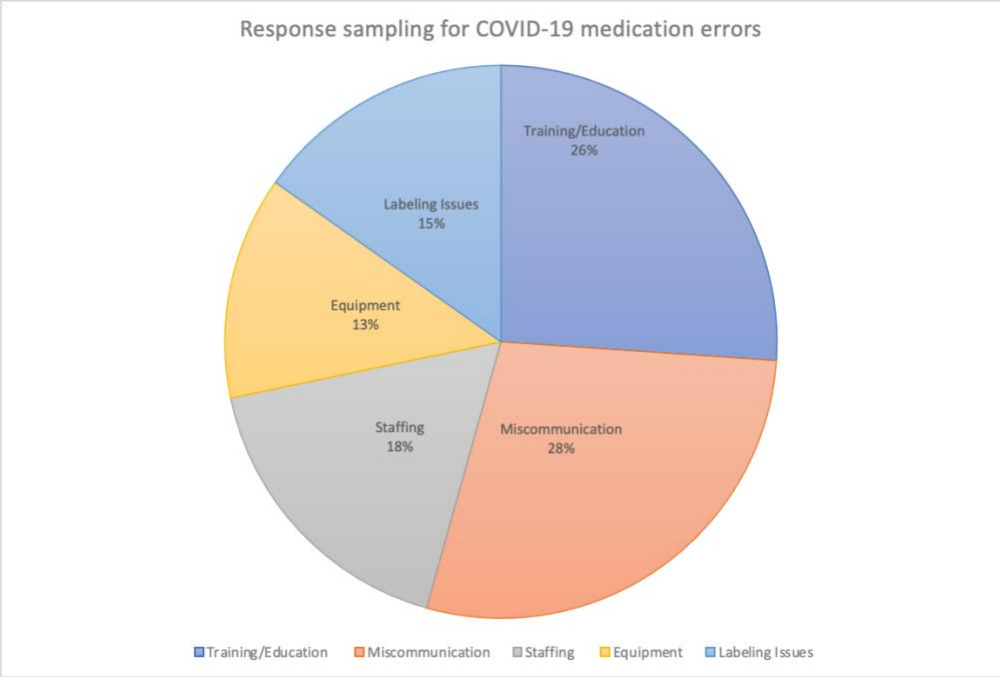

Figure 2: Response sampling for COVID-19 medication errors. Participants provided feedback on the five listed error types, as well as additional medication errors witnessed. Responses were grouped into five categories based on key wording and themes. Percentages are shown.

Miscommunication	-"When we get inter hospital transfer patients, we don't know how many days of remdesivir was already given prior to the transfer" -"1st visits done virtually - when patients then came in, nurse did not check ht/wt to confirm it was correct from what was self-reported." - "Adolescent patient did not weigh at least 88lbs/40 kg. Was almost given monoclonal antibody." -"Lack of captured weight or incorrect weight has lead to incorrect dosing near misses" -"Failure to obtain or confirm an accurate/current weight during telemedicine visits has occasionally been the source of error" - "Lack of patient understanding instructions." - "Discharge before complete remdesivir therapy." -"Doses of Remdesivir returned to pharmacy with no explanation." - "Doses charted as not given/not available when RN unable to locate medication or dose delayed by pharmacy." - "Transfer between units/discharge timing related." -"Poor gathering of home medication information resulting in inappropriate list of continued medications in the hospital, meds omitted or meds or administered when PCP had stopped them." - "Remdesivir bolus dose duplicated in ED and after admit."
Training/Education	-"Multiple metric confusion at system level, RN entering kilograms some enter pounds resulting in adult and pediatric dosing."

	- “Nurses scanning wrong barcode when multiple are present.” - “Failure to complete both drug and patient scans.” - “Failure to understand the alert being given and actions to take.” - “Lack of barcode scanning in some areas has removed this safety check and we had a few issues occur, lack of barcode scanning has definitely led to med errors.” - “I saw this occur in ED, floor, and outpatient infusion. Nurses skipped barcode scanning because it was time consuming. This resulted in tylenol and benadryl being given before blood infusion when it wasn't actually ordered (pyxis override).” - “Scanning of both patient and med only occurred 65% of administrations.” - “Deviation from barcode scanning.” - “Not limited to Covid meds--failure to scan pump for bidirectional programming, scanning med after it has been administered.” - “Confusion about COVID-19 MABS, specifically not recognizing the difference between anti-inflammatory MAB (tocilizimab), therapeutic MAB (bebtelovimab, sotrovimab, regen-COV, etc) and preventative MAB (tixgavimab/cilgevimab). Providers have ordered one when they meant to order the other not recognizing the difference b/w the different products, just referring to them as COVID MAB.”

	-“ Improper use of narcotics in Covid like promethazine and codeine, guaifenesen with codeine, poor or total lack of data support proton pump inhibitor famotidine or protonix.” - “Incorrect volume drawn up for COVID vaccines in retail setting.” - “Prescribing management concerns with use of novel COVID treatment under FDA EAU in patients not meeting criteria for use.”
Staffing	**-** “Misadministration of IV meds, especially high turnover and newer staff unfamiliar with some of the meds.” **-** “The nurse called Pharmacy for a max concentration Levophed (norepinephrine). The inexperienced technician misheard and prepared to restock the Pyxis with Levaquin (levofloxacin).” -“Doses were usually late not missed completely. Nurses busy caring for other patients, didn't recognize it was due. Several of our LPNs could not administer IV drugs and RNs were busy.” -“Failure to obtain consent in a timely manner, omissions due to workload/staffing - errors due to staff turnover and staff shortages (nurses and pharmacy staff).” - “High alert medication errors (heparin) due to nurse staffing issues.” -“ Live in NYS which required mandatory vaccination for healthcare workers. We lost a lot of experienced, talented people and are suffering

	from staffing shortages. Burn out is real in NYS. More medication errors overall due to high demand on existing staff and inexperienced staff." - "I think many things are related to staffing and floating nurses to areas where they don't normally work." - "Covid19 vaccination errors; administration errors not detected b/c team check was not performed due to contact isolation." - "Increased use of NMBAs during pandemic alongside nursing shortages/sicker patients-not seeing appropriate ancillary medications (sedation not titrated to appropriate level prior to initiating NMBA)."
Labeling Issues	-"Confusion with flu and or Covid vaccines." -"Mislabeling of remdesivir and sotrovimab." -"Etomidate mistaken for ceftriaxone and hung as a PB." -"Barcitanib wrong dose given due to confusing label." -"Missed dosing when only 1/2 pill should have been given." -"Inconsistent presentation, different drug names as regiments change." -"Peds/adults vaccine labeling issues. No incorrect doses administered, but experienced near-miss that led to us changing our practice." -"Confusion with monoclonal antibodies (EUA doses changing, packaging issues)." -"Compounding errors with new mab medications with unclear labeling."

Equipment	**-** "Devices not being able to scan barcode (Rover device with Epic for example)." - "Misfiling of Pyxis medication cubbies and bins either from pharmacy or nurse misfiling when restocking." **-** "In the beginning remedesvir wasn't coded in our software system." - "Change in workflow due to covid, not taking equipment into room (if room not equipped with dedicated computer/scanner)." -"This just happened at our institution- VER, nurse pulled and gave verapamil when ahe was to pull Versed. We just changed our ADC to read midazolam only without reference to brand name." - "Pyxis required generic entry build that should match hospital CPOE dictionary." - "Medication dispensed from incorrect patient profile within Pyxis ADM." - "ADEs relating to glycemic control in patients on steroids for COVID."

Figure 3: Categorized responses from open-ended questions. All responses from the open-ended questions are shown and categorized based on themes and key wording. Responses are presented exactly how they were recorded in the survey.

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