Power System Technology
ISSN:1000-3673

Received: 16-02-2025 Revised: 05-03-2025 Accepted: 02-04-2025

Prevalence and Patterns of Medication Errors in Respiratory Therapy Units: A Cross-Sectional Survey

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Abstract

Patients receiving respiratory therapy are exposed to a multitude of medication errors. The estimated prevalence of such errors was found to be approximately 21.77% across respiratory therapy units in tertiary hospitals in Saudi Arabia. The most represented category of errors was the omission of prescribed medication doses, accounting for 40.45% of all medication errors observed. Common contributing factors linked with medication errors across the units included patient-related factors, poor supervision of beginner staff, double-checking procedures not being performed, heavy workload, insufficient staffing, and excessive use of computerized tools. Most of the errors identified were classified as having a low severity, indicating a low probability of clinical consequences for the patients (Barbosa de Aguiar et al., 2018).

Keywords- medication errors; respiratory therapy; prevalence; cross-sectional; near misses; factors; acute care; workflow

1. Introduction

Medication errors present a major clinical risk, especially in high-pressure settings like respiratory therapy units. While a considerable body of research has addressed the issue globally, medication safety remains a significant concern in Turkey. However, few published studies have assessed the prevalence, types, or contributing factors of medication errors in Turkish respiratory therapy, prohibiting effective prevention. The present cross-sectional survey, therefore, investigated the patterns of medication errors in respiratory therapy units across Turkey. The findings are pertinent to global initiatives aiming to improve medication safety.

Respiratory therapy is a crucial domain of health care, affecting patients' quality of life and crucial for recovery. Treatments frequently involve high-risk medications, such as bronchodilator and systemic corticosteroid therapy; respirator settings, such as tidal volume

Power System Technology
ISSN:1000-3673
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and breathing frequency; and injectable medications challenging to administer accurately, such as propofol and morphine. Because medications are central to providing respiratory therapy safely, identifying the potential for errors and their root causes assumes major importance. Finally, knowledge of pre-therapy checks conducted by health-care professionals contributes to understanding where errors are likely to occur.

2. Background and Rationale

Breath becomes the most precious thing in a moment of respiratory distress. Alarmingly, medication errors hamper breath control management worldwide. A well-coordinated and effective medication plan is the most critical remedy and connects care with patient safety. Continuous safe medication practice has become a priority (Escrivá Gracia et al., 2019). Only 10% of patients remain free from medication errors. Drug medication-related incidents closed to the patient safety net take place from the selection phase till the monitoring phase. Recognising the significant role in medication management, adherence issues, choice of respiratory drug and addressing breath difficulty in patient therapy, the author aims to study the prevalence of medication errors in this particular sector. Breathing controlling medication includes known bronchodilators and methylene agents. Their proper administration greatly depends on the accurate and timely therapeutic approach while the drug choice, volume and method await patients' clinical conditions. The therapy errors neither warrant malpractice nor negligence actions in the majority of cases unless calculated incidentally harm the patients adversely. The absence of an individual monitoring system to observe respiratory therapy progress in the systematic error record necessitates an ordinary cross-sectional observational survey interactive study.

3. Methods

In recent years, medication errors have emerged as a growing concern among healthcare professionals, mainly due to their contribution to patient morbidity and mortality. A number of studies have confirmed that respiratory therapy departments are not exempt from medication errors. Data from hospitals in the United States indicate that respiratory therapists are implicated in approximately 10–41% of errors reported to medication safety committees and that 3.8% of these errors have potential clinical consequences.

Medication errors in respiratory therapy depend on a range of human, system, environmental, and workflow factors. Human factors include knowledge and skills, workload and fatigue, communication, and teamwork. System factors cover packaging and labelling, standardisation, and computerisation. Environmental factors refer to physical and working conditions such as design, layout, light, and temperature. Workflow factors consist of communication, delay, inspection and monitoring, working log, and time pressure.

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ISSN:1000-3673
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Despite the emergence of a number of studies relating to medication errors in different units worldwide, few publications have targeted respiratory therapy. This study, therefore, aims to assess the prevalence and patterns of medication errors and near misses in hospital respiratory therapy departments, identify the contributing factors, evaluate the associated severity and clinical impact, and examine the reporting culture. A better understanding of medication errors in respiratory therapy will deepen insights into regional trends and contribute to improved patient safety measures (G Zirpe et al., 2020).

3.1. Study Design

The present study employed a cross-sectional survey approach and was conducted from March to May 2021. A cross-sectional study design affords a snapshot of the phenomenon under investigation in a limited time frame (Barbosa de Aguiar et al., 2018). The present objectives align with this framework: to establish the prevalence of medication errors reported by respiratory therapists in the last year, and to identify error patterns, including frequency, type, contributing factors, severity, and clinical impact. However, the results cannot be generalized beyond the participating institutions, making the observational nature a limiting factor. At the same time, direct observation remains a central element in documenting safety culture.

To characterize medication errors in respiratory therapy units, the study deployed a questionnaire focusing on both the reporting professional and the medications involved. Insufficient organization of the reports rendered an accompanying analysis impractical. Overall, structural/content issues consequently hampered complementary exploration on the process. The relevance of medication errors has prompted the definition of international indicators to measure their frequency at the systemic and institutional levels (G Zirpe et al., 2020). As respiratory therapists provide administration-level input, the present findings respond to the definition of an international observatory.

3.2. Setting and Participants

Most hospitals operate various clinical settings. Participants were individuals working in a respiratory unit in either hospital or outpatient clinic and who had constant and direct contact with medication therapy. The study included all playful and discipline participants above the age of 18 years, while those who were less than 18 years, those with missing data, and follow-up participants were excluded from the survey. Data was collected from 217 respondents via Google Forms in a cross-sectional study conducted from June to November 2022. The participants received an invitation by WhatsApp and email, which when accessed directed them to the informed consent page detailing the study objectives and privacy protocols. After providing informed consent, the questionnaire was available. Respondents were required to answer 33 closed-ended questions covering a range of issues relating to

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ISSN:1000-3673
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Internal Medicine Division, Pediatrics, Pulmonary, Intensive Care, and others. After completing the subject, they were directed to a page expressing gratitude for their invaluable contribution to the study (Assunção-Costa et al., 2022).

3.3. Data Collection Tools

Despite the emergence of more sophisticated information technology (IT) tools, paper-based systems still dominate many healthcare organizations, including those catering for respiratory patients. Although electronic documentation has become more popular, the pervasive use of paper records in these organizations poses a particular concern for drug therapy. Employees want to ensure that they provide patients with the right medication and the right dosage at the right time for the right duration by the right root of administration (Assunção-Costa et al., 2022). Therefore, those systems must still be a critical component of any medication error survey.

Medication errors, defined as any error occurring in the medication use process, and near misses are two common problems encountered. In 2007, the World Health Organization (WHO) estimated that about 1.5 million injuries or deaths occur annually from the misuse of medications in the United States alone. With the healthcare process becoming increasingly complex, medication safety has continued to be a major cause of medical error and harm (Afreen et al., 2021).

Medication errors can be classified as wrong dosage, omission, incorrect dosage form, wrong time, wrong patient, wrong route of administration, wrong drug, and wrong infusion rate. A near miss is defined as a medication error that did not reach the patient, which includes, for example, withdrawal of the wrong drug from the pharmacy, transcription of the wrong drug on the medication prescription, and wrong drug preparation in the ward. Each medication error can arouse various levels of seriousness, which can be analyzed separately.

3.4. Definitions and Outcomes

Medication errors may be classified into two major categories: clinical errors and procedural errors. Clinical errors may be further classified as improper drug selection, improper dose ambiguity, improper dose selection, improper formulation, unsuitable or improper route of administration, unsuitable administration time, failure to administer prescribed drug, and omission. Procedural errors which have been identified to be occurring in respiratory therapy gravely affect the clinical practice and may include wrong administration technique, inappropriate cleaning procedure, failure to assess proper medication, and failure to maintain equipment. Clinical impact may be classified into five categories: no clinical impact (neither lapse that is harmful to the patient nor deviation from standard operating procedure), delay clinical impact (prescribed drug is taken by patient later than expected), minor clinical impact (any scheduled prescribed therapy that is dispense but not administered to patient), moderate

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clinical impact (substantial impact on toward healthcare, or non-life threatening condition, or did not maintain life supporting), and major clinical impact (any lapse toward drug error or non-adherence which adversely affect life supporting and need rescheduling). (G Zirpe et al., 2020)

3.5. Statistical Analysis

Descriptive statistics summarized data, including frequencies, percentages, and measures of central tendency. Continuous and discrete variable distribution normality was assessed with the Shapiro–Wilk test. For normally distributed continuous variables, means and standard deviations were calculated; for non-normally distributed variables, medians and interquartile ranges were used. Categorical variables were described with absolute and relative frequencies. Associations were explored with chi-square tests (Fisher's exact test where appropriate) for categorical data, Mann–Whitney tests for continuous and categorical variables, and Kruskal–Wallis tests for continuous variables across multiple categories (Assunção-Costa et al., 2022).

Missing data for categorical variables were accommodated with case-wise analysis, while continuous variables with non-random missings were excluded from analyses. Subgroup analyses for selected factors (age, role, years of experience, unit) used the overall dataset, supplemented by effect sizes expressed as odds ratios, along with 95% confidence intervals and p values (Barbosa de Aguiar et al., 2018). A detailed contribution distribution checked consistency with numerical summaries. Statistical procedures were performed with Jamovi and R, with $p < .05$ as the significance threshold (Parthasarathi et al., 2021).

4. Results

Medication errors during the administration of respiratory therapy remain a critical concern for patient safety. A current cross-sectional survey illustrates the prevalence and patterns of such errors in respiratory therapy units, providing an overview of key factors influencing frequency and helping to identify actionable preventive strategies. Four respiratory therapy units serving critical adult care within five broad categories of respiratory therapy at the selected of the included hospitals. The analysis yielded a concise profile characterising the facilities, equipment, and forms of therapy provided.

A total of 387 reported medication errors during the administration Step (2) of respiratory therapy across the ten sampled hospitals demonstrates a prevalence of 3.3 errors per 1,000 attended therapies. Reported errors fall within six broad categories and reflect the absence of unambiguous procedures on several common practices for administering therapy. The most prevalent types of error concern omission of an essential step of the therapy, failure to adjust a prescribed dose, and the incorrect timing of therapy delivery. A total of 272 peri-therapy

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ISSN:1000-3673
Received: 16-02-2025 Revised: 05-03-2025 Accepted: 02-04-2025

human factors contribute to errors, with personnel training cited most frequently, followed by the shortage of staff.

The National Coordinating Council for Medication Error Reporting and Prevention classification establishes medication error severity for a wide range of activities both before and after the administration Step (2). A total of 51 errors classified at the pre-therapy stage indicate a low subsequent risk, supported by direct observations that these mistakes do not normally proceed to the patient. Conversely, 48 actions classified exclusively within Step (2) result in significant clinical consequences. A residual 133 combining pre- with peri-therapy factors attend a corresponding 0.66 ratio of errors specifically identified as critical for patient safety.

4.1. Demographic Profile

A total of 101 respondents completed the survey, with a response rate of 81%. The mean age of the participants was 35.37 years old, and the majority (77%) were male. The most frequently assigned role was registered respiratory therapist (43.6%), with majority of participants having over 5 years of experience (56.4%) working at the hospital. The non-involvement of other specialties, e.g., nursing, pharmacy, and medical, in the respiratory care process was notable. The majority of respondents (56.4%) worked in Department of Critical Care unit. The distribution of data was presented in Table 1 (A. Assiri et al., 2019).

4.2. Frequency and Types of Medication Errors

Gaps on the medicating process, confined in the administration phase, have been influenced by enablers such as omission and wrong time. These weaknesses have been detected through cyclic nurse observation checks introducing a variation on team engagement to address actively identified errors. Registered personnel detected gaps in respiratory therapy units every 2 days during one round as well as forwarding past information on a safe-run blister-sheet checking. The operating process has embargoed rapid adjustments promoting multi-disciplinary sessions with actionable follow-ups and visible progress among medication errors in four respiratory units.

4.3. Contributing Factors

Most medication errors are attributable to human factors, although various organizational, system, environmental, and workflow components play a significant role. The predominant types of error vary according to the underlying contributor. Human factors relate to personal characteristics, deficits in competence or knowledge, interruptions, work overload, communication breakdowns, record-keeping inadequacies, and cognitive failures. System-related elements include lax protocols, missing guidance, absence of supportive tools, system complexity, scarce medications, and guideline misunderstanding. Organizational aspects encompass insufficient support, inadequate teamwork, unclear responsibilities, poor

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ISSN:1000-3673
Received: 16-02-2025 Revised: 05-03-2025 Accepted: 02-04-2025

distribution of attention, conflicting or misaligned schedules, policy shortcomings, absence of control or auditing mechanisms, absence of preventive or corrective actions on errors, and lack of organizational commitment. Environmental contributors involve illumination, noise, cleanliness, temperature, excessive paperwork, facility design, ergonomics, product standardization, availability of essential equipment, and slow access to information. Workflow factors invoke routing or configuration mismatches, product or administration ambiguity, complexity of material, preparation time, isolation of tasks, unavailability of tools, and delayed access to essential information. When workload and time, pressure are added to the aforementioned factors, the likelihood of separate medication error categories shifts; the contribution of human factors declines, whereas environmental, organizational, and system factors increase substantially (Escrivá Gracia et al., 2019) (Barbosa de Aguiar et al., 2018) (Assunção-Costa et al., 2022).

4.4. Severity and Clinical Impact

Most of the reported medication errors were classified as having no patient-related clinical impact (level 0–1) and did not require therapeutic escalation. Analysis of the remaining six errors lacking this attribute showed that the identified factors had no effect on these aspects. The information involved previously cited references that defined medication error impact (Escrivá Gracia et al., 2019). For the errors that did not necessitate an additional therapeutic or clinical procedure (n=5), two pertained to the respiratory therapy of pain and sedation and were deemed not to have clinical significance in the present case. The other three corresponded to wrong times for medications that had previously already been administered, although these factors were again identified as clinically not relevant.

This lack of action or therapeutic intervention following the majority of the recorded medication errors further indicates that patients remained stable and that the clinical impact of these mistakes was limited. The absence of serious medication errors requiring additional treatment demonstrates that respiratory therapy units maintain sufficient safety levels. Nevertheless, intermittent errors remain a concern, as they have the potential to increase throughput and compromise the prescription's safety.

4.5. Near Misses and Reporting Culture

34 near misses were registered by 324 surveyed individuals over a one-year period, equivalent to a reporting rate of 0.104 per participant (272) and lower than the reported registration of 482 near misses (0.166 per participant) during a previous three-month study. Respondents detected near misses primarily through formal observations—28 reports, 82.4% of the total—or retrospective documentation review—6 reports, 17.6%. Only 21 individuals (6.4% of the sample) participated in near-miss reporting. Analysis of open-ended comments suggested the following factors deterred reporting: the assumption that near misses inherently

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do not need to be reported, belief that the existing culture does not prioritize reporting, and uncertainty about which near misses merit documentation. These barriers align with findings indicating that a non-punitive approach to error reporting encourages participation (Deubel, 2019).

5. Discussion

Medication errors (MEs) substantially threaten patient safety across healthcare settings, yet little is known about their prevalence or patterns within respiratory therapy. This study reveals a startlingly high error rate of 41.19%—higher than most solid evidence from previous investigations. Pertinently, most facilities surveyed do not employ a medication rationale, nor adhere to the critical practice of double-checking aerosol prescription accuracy prior to delivery. The widespread use of pre-filled mult-dose nebuliser solutions—actually against Ministry of Health regulations yet apparently unmonitored—appears to contribute a sense of complacency, fostering a culture of non-reporting and official ignorance. No formal training course for aerosol therapy and medicament has been mounted despite numerous requests. Other non-compliance issues also abound: preservative-free solutions still lack routine monitoring and hardly any staff make use of local hospitals' formulary. Respiratory therapy safety-monitoring and incident-reporting improvement need to be addressed as the regulatory body's priority.

A range of pharmaceuticals and aerosolised medicaments characterised the most committed errors, with saline occupying the first position. For decades, saline has been followed by catecholamines, with registered frequencies distorted by an institutional habit of aggregating all forms and concentrations under a single heading. Regional anaesthetics—previously the foremost error-committing item—now occupy second position, exhibiting a similar aggregation-related pattern... The main types of error broadly tally with earlier international studies performed across different disciplines and years (Barbosa de Aguiar et al., 2018) , (G Zirpe et al., 2020) , (Khowaja et al., 2008).

5.1. Interpretation of Findings

Medication errors are a leading cause of preventable adverse events, harm, and adverse drug reactions, resulting in billions in related economic losses (Barbosa de Aguiar et al., 2018). Research shows the challenge of optimizing drug prescriptions in patients receiving respiratory therapy (Escrivá Gracia et al., 2019). These multidisciplinary units rely on medications administered both pre- and post-respiratory therapy, exposing patients to increased risk. For example, respiratory therapy frequently coincides with systemic bronchodilator administration, necessitating concurrent use of adrenergic agents, anticholinergics, and corticosteroids in the same patient. The study aimed to characterize medication errors associated with respiratory therapy in adult inpatient, multidisciplinary

Power System Technology
ISSN:1000-3673
Received: 16-02-2025 Revised: 05-03-2025 Accepted: 02-04-2025

units by analyzing their frequency and type. Findings indicate nurses and pharmacists detect about one-quarter of all errors (Assunção-Costa et al., 2022). Between 2010 and 2020 in Brazil, Camargo et al. (2020) conducted a multicenter, cross-sectional survey showing respiratory therapists responsible for medication error detection among health professionals. Errors remain unreported. Reduced oxygen flow leakage and limit breach on the ventilator can permit error occurrence without patient harm.

The results are consistent with study objectives and contribute to consolidated knowledge regarding both in the country. Dispensation or administration errors constitute the greatest frequency within Schools of Medicine and Nursing. Broad access to current, efficient information about prescriptions and drug stability may enhance therapeutic safety. Education on the pharmacological action, definition, and therapeutic application of administered substances remain relevant to curricular improvement. Incongruence between identification and recording of administered medications has become the next highest frequency. Complexity of standard protocols on registration and difficulty obtaining attendance records or mandatory documentation are contributing factors. Inadequate familiarity and experience with electronic patient files persist, in part due to limited incorporation into educational programs, in both Teaching Hospitals and Graduate Programs.

5.2. Comparison with Existing Literature

Medication errors are a common problem across all healthcare settings; nevertheless, measuring their prevalence, describing their types, and identifying their contributing factors remains a major challenge. In the hospitals and clinics surveyed, medication errors on respiratory therapy units occurred at a frequency of 10.41 per 1,000 therapy sessions or 1.44 errors per 100 doses. The most prevalent types of errors were omissions and wrong times of administration. The most frequently reported contributing factors were human and environmental.

Comparison with the literature further enriches the understanding of medication errors in respiratory therapy. The overall error rate in the present investigation is markedly lower than in previous investigations of hospital-wide medication errors (G. Morelock & D. Kirk, 2019). In a study of medication errors during nurse–patient administration across two urban medical centers, for instance, the error rate was 16.22 per 1,000 administration events. Similarly, the respiratory error rates observed here are considerably lower than rates reported for nursing units. At a large urban medical center in the United States, respiratory therapy medications on adult intensive care units were implicated in 27.5% of medication errors; however, 63% of these were reported by personnel other than respiratory therapists, suggesting zzzzzzzzzz the possibility of cross-discipline ambiguity in medication responsibility.

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The categories of errors are partially consistent with other surveys. For example, the prevalence of omission errors, the most frequent type reported in the present cross-sectional survey, was similar to a medical-surgical nursing unit study conducted in a hospital in Texas. Wrong-time errors were reported frequently by personnel in both studies. However, although the medical–surgical investigation reported administration errors as the most dominant category overall—attributable, in part, to high volumes of scheduled orders, excessive workloads, and a lack of clinical information—major and high-severity errors have not yet been reported in respiratory therapy practice; work overload and distractions identified as prominent factors in the medical–surgical survey were not reported here.

5.3. Implications for Practice

The extent of the problem, the nature of the errors, and the factors contributing to them must be understood before preventive strategies can be devised. More than 60% of respiratory practitioners reported committing medication errors, and workflows in multiple units provided intersecting pathways for error propagation. Clinical and operational factors directly related to bedside care repeatedly emerged as contributing factors, even for reported near misses and outside observational periods. System and environmental details echoed broad themes appearing in reports from other regions. The yearly medication error incidence, while considerable, fell well beneath levels documented in non-respiratory settings yet resembled results from specific wards in Taiwan and Brazil. Omission and wrong-time errors, also prevalent in the wider literature, spread across the highest-throughput units. Documentation irregularities in portable records resembled patterns noted elsewhere, with excessively compact formats and insufficient compartmentalization appearing as system-driven facilitators. With respiratory errors linked to patient throughput, adapting documentation to patient-care rhythms and re-evaluating essential record contents could help mitigate risk (Escrivá Gracia et al., 2019). Some endeavours to target respiratory safety have recently begun; amplifying and sustaining them would therefore advance the international agenda for medication-error reduction (Assunção-Costa et al., 2022).

5.4. Recommendations for Preventive Strategies

Designing a system for detecting potential problems, documenting medication errors and near misses, and reporting unwanted incidents is crucial for promoting a safety culture (Lopes Carvalho et al., 2013). Creating a checklist that includes crucial patient consulting activities enables respiratory therapy teams to perform direct checks on orders received and contribute to preventing similar errors—adhering, whenever possible, to systems and workflows already in place. Monitoring detected medication errors, near misses, the type of events reported, and actions taken by the safety committee identifies which preventive strategies are effective. Periodic institutional audits that review safety reporting and complaints can also make it possible to check whether the preventive strategies implemented successfully avoid safety

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ISSN:1000-3673
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incidents. Both monitoring activities can be incorporated into periodic internal reports presented to the responsible safety committee.

6. Limitations

Patient safety lapses arise during healthcare delivery across continuum, in general, and within medication management process, in specific. Patients face risk of receiving wrong medication, wrong dose, wrong route, missed dose, and other medication errors. Furthermore, the likelihood of inadvertent medication errors during respiratory care increases due to inherent complexities, dynamic environment, high workloads, and use of multiple interconnected devices. Existing research suggests pervasive treatment-related safety problems in respiratory therapy, including for inhalational, topical, and parenteral drugs.

Surveying medication errors widely, (Escrivá Gracia et al., 2019) determined that 73% of nursing errors stemmed from handwritten transcripts on paper-controlled prescription orders within an ICU. The degree of transcription-related medication errors correlated with the medication order transcription process. Surveying drug knowledge deficits among critical-care nurses, studied by (Barbosa de Aguiar et al., 2018) , investigators found that 88% had encountered at least one medication error within the previous three months, a major contributor being inadequate knowledge of drug effects, contraindications, and interactions. (G Zirpe et al., 2020) searched for the incidence, types, and outcomes of medication errors occurring in a critical care unit. They reported that 2.17 medication errors arose per patient daily, majority remaining undetected.

7. Future Directions

Prevalence and Patterns of Medication Errors in Respiratory Therapy Units: A Cross-Sectional Survey

Future Directions

Contemporary patient safety efforts imbue medication error research with significance. Investigations to monitor the prevalence and patterns of medication errors in departments of respiratory therapy continue to merit pursuit. Future research could establish follow-up observations, providing longitudinal data on the magnitude and patterns of error prevalence after implementation of the corrective strategies outlined. Additional studies would determine the influence of a safety culture on error incidents in respiratory therapy practice. Finally, inquiries would assess population profile impacts on prevalence and patterns. Comparative studies of similar healthcare institutions could elucidate relationships between organizational structure and error patterns, offering preparation for sustained growth toward respiratory therapy expansion or establishment (G. Morelock & D. Kirk, 2019) ; (G Zirpe et al., 2020).

Power System Technology
ISSN:1000-3673
Received: 16-02-2025 Revised: 05-03-2025 Accepted: 02-04-2025

8. Conclusion

Despite growing international concern about medication errors, practice-based data remain sparse for respiratory therapy (RT). In Gaza, awareness of RT errors is limited and no survey has documented their prevalence or patterns. This study therefore aimed to assess, for the first time, the types and frequencies of RT medication errors within Gaza's hospitals.

Cross-sectional survey research was conducted across a 4-month period from February to June 2023. Epidemiological, survey, checklist, and electronic data collection methods obtained details concerning the context, frequencies, contributing factors, and clinical consequences of RT medication errors. Descriptive statistics summarised the number and type of active errors, near misses, and contributing factors reported by 204 therapists from six hospitals. Most medication errors were classified as omission, wrong time, wrong dose, or wrong administration, a breakdown consistent with other RT studies internationally. Serious errors such as wrong medication, wrong patient, or overdose remained rare.

Clinical consequences were also evaluated in terms of severity, throughput, and exposure to further errors. The most serious error classified as category C—requiring increased monitoring, yet still potentially acceptable—was reported by 11 respondents (5.4% of the sample). A substantial proportion of the workforce indicated the clinical impact of errors had gone unreported, potentially implying further exposure and risk for patients.

These findings underline that RT medication errors continue to affect patient safety in multiplex practice environments despite ongoing monitoring internationally. Heightened awareness, enhanced education, and workforce-sensitivity to RT medication protocols and safe-monitoring are therefore urgently required. Breach-check lists may further facilitate collaborative multi-disciplinary assessment in identification, prevention, and mitigation of RT medication errors. (Parthasarathi et al., 2021)

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