JOURNAL OF PHARMACEUTICAL POLICY AND PRACTICE
2024, VOL. 17, NO. 1, 2431177
https://doi.org/10.1080/20523211.2024.2431177

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RESEARCH ARTICLE

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Effect of electronic prescription system modifications on reducing prescribing errors in a military hospital

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ABSTRACT

Background: The implementation of electronic prescription systems has become a crucial advancement in healthcare, intending to enhance the precision, safety, and effectiveness of the prescription process. Electronic prescription systems provide many solutions to reduce prescribing errors by allowing system modifications that streamline the prescribing process to improve communication between healthcare practitioners**.** In this study, we aimed to explore the effect of electronic prescription system modification on minimising prescribing errors.

Methods: This retrospective quantitative study assessed the effects of electronic prescribing system modification in a tertiary military centre in Saudi Arabia, specifically focusing on decreasing prescribing errors in different hospital departments. Collected data include all prescribing errors that occurred in the inpatient setting during the study period, while exclude prescribing errors for outpatient settings as they have different e-prescribing system. A total of 29,554 patient admissions were analysed to compare the frequency of prescribing errors before and after the introduction of electronic prescriptions modification.

Results: The findings from this study indicate a total reduction in prescribing errors after electronic prescription modifications from 1.43% to 0.51% (p-value < 0.001) across all departments, which is highly significant. Furthermore, there was a significant reduction of 49.8% in the overall prescribing error rate. The overall reduction in total errors occurrences after implementing e-prescription modifications suggests a systemic improvement, even if individual departments showed mixed results.

Conclusion: This study emphasises the advantages of electronic prescribing system modification in improving patient safety and optimising healthcare operations. However, the variance in results across departments highlights the

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need for tailored modifications and continuous system optimisation. By addressing the specific needs of each department, hospitals can maximise the benefits of e-prescribing system and achieve more consistent reductions in prescribing errors in clinical practice.

ARTICLE HISTORY Received 1 September 2024; Accepted 13 November 2024

KEYWORDS Medication errors; patient safety; health informatics; prescribing errors

Background

Medication errors are a critical concern in healthcare systems worldwide and contribute significantly to patient safety and quality of care (Justinia et al., 2021). The prevalence of such errors has been a growing concern owing to their effect on morbidity, increased healthcare costs, and, in some cases, mortality (Mistry et al., 2023). Medication errors are defined as any preventable event that can result in or lead to improper medication use or patient harm while the medication is controlled by healthcare professionals, patients, or consumers (Alsulami et al., 2019). Medication errors can be categorised into four main categories: prescribing, dispensing, administration, and monitoring (Mistry et al., 2023). Several studies have revealed that medication errors are a frequent cause of morbidity and mortality in healthcare settings, leading to economic burden on the healthcare system (Alhossan et al., 2023). These medication errors can be easily prevented, which can lead to relief in the healthcare system (Rasool et al., 2020). For instance, in the United States, the economic burden due to medication errors was reduced from 177.4$ billion in 2001 to 21 $ billion in 2014 owing to the implementation of effective strategies to control medication errors (Rasool et al., 2020).

Traditional prescribing methods, such as handwritten prescriptions, are often linked to the incidence of prescribing errors due to challenges such as illegible handwriting, miscommunication among healthcare providers, and interruptions in workflow, which can lead to errors in medication administration (Safi'i & Achadi, 2019). In contrast, electronic prescribing (e-prescribing) systems have emerged as transformative solutions aimed at minimising these risks by streamlining the medication ordering process and effectively enhancing communication among healthcare providers (Roumeliotis et al., 2019). Evidence suggests that e-prescribing systems can significantly lower the rate of medication errors by 50%, when implemented effectively (Qureshi et al., 2015). Prescribing errors, the most common type of medication errors, include incorrect indications, wrong drugs, dosages, frequencies, or routes of administration. These errors are particularly concerning in hospitals, where they can lead to significant patient harm (Alhossan et al., 2023; Velo & Minuz, 2009). This underscores the need for protective

measures, such as implementing electronic prescribing systems, comprehensive education for prescribers, and multidisciplinary medication management approach to enhance the quality and safety of patient care (Justinia et al., 2021).

Several studies have demonstrated the critical role of electronic prescription systems in reducing medication errors, especially prescribing errors, and in enhancing patient safety. Electronic prescribing systems provide many solutions for reducing prescribing errors by allowing system modifications that streamline the prescribing process to improve communication between healthcare practitioners (Safi'i & Achadi, 2019). It has been shown that the implementation of tailored electronic prescribing system modifications will reduce prescribing errors, such as wrong dose, wrong medication, wrong route, and wrong dosage form (Alzahrani et al., 2021). Modifications to e-prescribing systems that implement features such as integrating clinical decision support systems, enhanced drug interaction alerts, and standardised drug dosing protocols can play a pivotal role in optimising medication safety and enhancing patient care (Williams et al., 2020).

While previous studies have documented the effectiveness of various e-prescribing systems (Alzahrani et al., 2021; Safi'i & Achadi, 2019), there is a notable gap in the literature regarding the specific adaptations required for military hospitals in Saudi Arabia. In Saudi Arabia, particularly within military hospitals, the prescribing errors are higher due to the unavailability of standard electronic prescribing system. These institutions serve a unique population, including active-duty military personnel and their families, who often have specific health needs and may experience higher exposure to medication errors due to complex medical conditions and operational pressures. At our organisation, King Fahad Military Medical Complex (KFMMC), medication is prescribed through a custom-designed electronic prescribing system created by the hospital's IT engineers, which resulted in a system that may not fully align with best practices and the specific needs of its users. Unlike standard e-prescribing systems, this system faced challenges, including persistent prescribing errors related to wrong doses, routes, and dosage forms. These issues originated from the system's design flaws, which limited its effectiveness in safeguarding against common prescribing errors. These discrepancies underscore the necessity for targeted e-prescribing system modifications to enhance medication safety. Recognising the need for improvement, we implemented standardised dosing protocols within the KFMMC electronic prescribing system.

In this study we aimed to evaluate the impact of e-prescribing system modifications on reducing prescribing errors at KFMMC by analysing data collected before and after the implementation. Our findings will contribute

to the existing literature on electronic prescribing system modifications and their role in enhancing medication safety, offering insights that could be applicable to similar healthcare settings both regionally and internationally.

Methods

Patients and methods

This study employed a retrospective, quantitative approach to assess the impact of e-prescribing modification on the rate of prescribing errors in a tertiary military hospital in Saudi Arabia.

Study population

The study population included all patients admitted to the hospital during the study period, for a total of 29,554 admissions. The e-prescribing system modification was implemented in June 2023. Data were collected from hospital e-prescribing system one year before the implementation of the e-prescribing system modification (from May 2022 to May 2023) and one year after the implementation of the e-prescribing system modification (from June 2023 to June 2024), focusing on the number of prescribing errors documented before and after the implementation of the e-prescribing system modification. The study design implements a control group that does not receive the modified e-prescribing system features. This allows for comparisons that can help isolate the effects of the modification. By implementing these strategies, the study can effectively control for potential confounding factors, thereby enhancing the reliability and validity of the findings regarding the impact of electronic prescription modifications on medication errors at KFMMC.

Data collection

The prescribing errors data were retrieved from the e-prescribing system and extracted on an Excel sheet without any patient or physician information. The categorisation of prescribing errors was based on drug classes and hospital departments, which allowed for thorough examination. The primary measure of success was the difference in the number of prescribing errors made in prescriptions before and after the e-prescribing system modification was implemented. The data collected included hospital department, admission date, medication name, and class.

Inclusion criteria: all prescribing errors that occurred in the inpatient setting during the study period.

Exclusion criteria: prescribing errors for outpatient settings were excluded as they have different e-prescribing systems.

Statistical analysis

All statistical analyses were performed using the IBM® Statistical Package for Social Sciences (SPSS) Statistics version 25 (SPSS Inc., Chicago, IL, USA). Categorical data were presented as frequencies and percentages, and chi-square tests were used to compare the groups. Chi-square tests were employed to compare the rates of prescribing errors before and after the implementation of the e-prescribing system modifications. This test is appropriate for this dataset because it assesses the association between categorical variables and determines whether the observed differences in error rates are statistically significant. The chi-square test is particularly suitable here because it evaluates the independence of prescribing errors across different time periods (pre- and post-intervention). The study focused on types of prescribing errors that occurs due to the e-prescribing system, which include wrong doses, routes, and dosage forms. The study implemented a strategy to mitigate biases in the pre- and post-intervention phases by providing all healthcare providers with uniform training on the use of the modified e-prescribing system to minimise differences in implementation. The results are displayed in tables and figures, illustrating the distribution of errors and statistical significance of the observed discrepancies. The study methodology ensured a thorough assessment of the efficacy of e-prescribing system modification in decreasing prescribing errors and enhancing patient safety.

Table 1. Admissions before and after implementation of e-prescribing modification.

Department	Before e-prescribing modification	After e-prescribing modification	Total
AICU	43	26	69
Cardiac Ward	1501	1178	2679
CCU	27	79	106
CICU	8	13	21
Female Medical	1405	1342	2747
Female Surgical	2014	1988	4002
Male Medical	584	732	1316
Male Specialty	1158	1150	2308
Male Surgical	1395	1329	2724
Newborn Nursery	0	765	765
NICU	84	67	151
OB/GYN	3901	2910	6811
Pediatric	2698	2482	5180
PICU	10	11	21
Surgical ICU	34	33	67
SCBU	339	248	587
Total	15,201	14,353	29,554

Abbreviations: AICU, Adult Intensive Care Unit; CCU, Cardiac Care Unit; CICU, Cardiac Care Intensive Unit; NICU, Neonate Intensive Care Unit; OB/GYN, obstetrics and gynecology; PICU, pediatric Intensive Care Unit; Surgical ICU, Surgical Intensive Care Unit; SCBU, Special Care Baby Unit.

Results

During the study period, 29,554 patients were admitted to the King Fahad Military Medical Complex in the Kingdom of Saudi Arabia. Of these, 291 patients had prescribing errors. These prescribing errors also included cases from outpatient clinics that had no admission areas, including the Accidents and Emergency Department, daycase clinic, and endoscopy unit. Table 1 shows the number of patients admitted in each department before and after e-prescription modification.

Table 2 shows drug classes which involved in prescribing errors in the hospital and the number of errors for each class.

These data indicate that antibiotics accounted for the highest proportion of errors at (14.43%), followed by proton pump inhibitors (8.93%) and antiemetics (7.90%). Interestingly, these findings are consistent with findings from another study held in a tertiary hospital in Saudi Arabia, which indicated that antibacterials agents and proton pump inhibitors were the classes most often associated with prescribing errors (Alharaibi et al., 2021). This distribution suggests a need for enhanced monitoring and training focused on these specific drug classes, as they represent a significant share of the medication errors encountered.

Table 3 and Figure 1 show the distribution of prescribing errors in the different hospital departments. The study revealed varying degrees of reduction in prescribing errors across different departments following the implementation of e-prescribing modifications. In the Accident & Emergency (A&E) department, errors decreased from 14 (6.4%) to 3 (4.1%), with a *p*-value of 0.659 indicating no statistically significant change. This reduction, while positive, reflects persistent challenges in the high-demand environment of A&E, where workflow interruptions and time constraints can lead to hurried prescribing, which may increase the possibility of prescribing errors. In the Cardiac Intensive Care Unit (CICU), errors increased from 0 (0.0%) to 1 (1.4%), with a *p*-value of 0.565, due to potential workflow challenges that may arise from the complexity of patient cases and the reliance on verbal orders after open-heart surgeries. In addition, the Day Case department experienced a troubling increase in errors from 2 (0.9%) to 8 (11.0%), with a statistically significant *p*-value of <0.001, highlighting a potential area of concern where training and workflow dynamics may not have been adequately addressed. Further investigation showed that these eight prescribing errors occurred after the e-system modifications were all for the same medication order, which was performed by a newly hired resident doctor who did not attend the hospital orientation programme. He repeatedly enters the same order with the same error. The main cause was that he wasn't familiarised with the prescribing platform and was pressured by the workload.

Table 2. Summary of drug classes involved in the prescribing errors.

Drug class	Count	Percentage
Antibiotic	42	14.43
Proton Pump Inhibitor	26	8.93
Antiemetic	23	7.90
Analgesic/Antipyretic	21	7.22
Antibiotic/Antiprotozoal	16	5.50
Non-Steroidal Anti-Inflammatory	14	4.81
Iron Supplement	11	3.78
Anticoagulant	10	3.44
Beta-Blocker	8	2.75
Corticosteroid	8	2.75
Antihistamine	7	2.41
Vitamin	7	2.41
Electrolyte	6	2.06
Lipid-Lowering Agent	5	1.72
Calcium Channel Blocker	5	1.72
Biologic Medication	4	1.37
Antihypertensive	4	1.37
Insulin	4	1.37
Antiplatelet	4	1.37
Antispasmodic	4	1.37
Anticonvulsant	4	1.37
Mucolytic	3	1.03
Laxative	3	1.03
Antipsychotic	3	1.03
Sedative	3	1.03
Vasopressor	3	1.03
Diuretic	3	1.03
Antiepileptic	3	1.03
Antifungal	3	1.03
Antineoplastic	3	1.03
Bowel Preparation	2	0.69
Hormone	2	0.69
Alkalinizing Agent	2	0.69
Bronchodilator	2	0.69
Antidiabetic	2	0.69
Vitamin D Analog/Corticosteroid	1	0.34
Plasma Volume Expander	1	0.34
Alpha Blocker	1	0.34
Immunosuppressant	1	0.34
Prostaglandin Analog	1	0.34
Analgesic	1	0.34
Various	1	0.34
Intravenous Solution	1	0.34
Antiarrhythmic	1	0.34
Anticholinergic	1	0.34
Potassium Binder	1	0.34
Corticosteroid/Bronchodilator	1	0.34
Antiviral	1	0.34
Diagnostic Agent	1	0.34
Thyroid Hormone	1	0.34
Local Anesthetic	1	0.34
Hematopoietic Agent	1	0.34
Lubricant	1	0.34
Immunoglobulin	1	0.34
Antigout	1	0.34
Electrolyte Supplement	1	0.34
Total	291	100.00

Table 3. Distributions of prescribing errors within the different hospital departments, before and after e-prescriptions modification.

Department	Before e-prescribing modification	After e-prescribing modification	Total	*P*-value
Accident & Emergency	14 (6.4%)	3 (4.1%)	17 (5.8%)	0.659
AICU	6 (2.8%)	0 (0.0%)	6 (2.1%)	0.339
CICU	0 (0.0%)	1 (1.4%)	1 (0.3%)	0.565
Cardiac Ward	13 (6.0%)	5 (6.8%)	18 (6.2%)	1.000
CCU	2 (0.9%)	1 (1.4%)	3 (1.0%)	1.000
Day Case	2 (0.9%)	8 (11.0%)	10 (3.4%)	<0.001
Endoscopy	1 (0.5%)	0 (0.0%)	1 (0.3%)	1.000
Female Medical	23 (10.6%)	7 (9.6%)	30 (10.3%)	0.991
Female Surgical	36 (16.5%)	7 (9.6%)	43 (14.8%)	0.210
Male Medical	14 (6.4%)	1 (1.4%)	15 (5.2%)	0.166
Male Specialty1	26 (11.9%)	6 (8.2%)	32 (11.0%)	0.509
Male Surgical	29 (13.3%)	9 (12.3%)	38 (13.1%)	0.990
NICU	2 (0.9%)	1 (1.4%)	3 (1.0%)	1.000
Obstetrics/Gynecology	34 (15.6%)	13 (17.8%)	47 (16.2%)	0.794
Pediatrics	12 (5.5%)	7 (9.6%)	19 (6.5%)	0.343
PICU	2 (0.9%)	0 (0.0%)	2 (0.7%)	0.998
SCBU	0 (0.0%)	2 (2.7%)	2 (0.7%)	0.102
Surgical ICU	2 (0.9%)	2 (2.7%)	4 (1.4%)	0.564
Total	218	73	291	<0.001

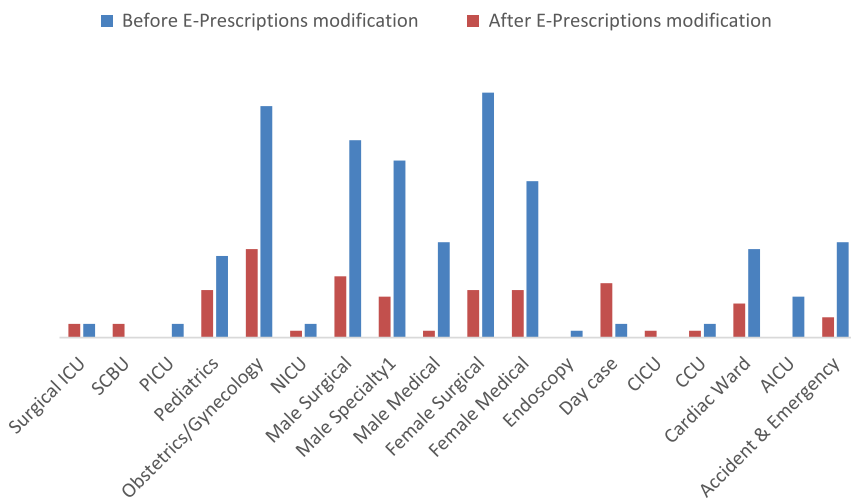

Figure 1. Distribution of prescribing errors within the different hospital departments, before and after e-prescribing modification.

This case was discussed at a pharmacy and therapeutic committee meeting in the hospital and a letter was issued to all the healthcare practitioners about the need of attending the hospital orientation programme.

Table 4. Prescribing errors as percentage of admissions, before and after implementation of e-prescribing modification.

Department	Before e-prescribing modification: Errors (%)	After E-prescribing modification: Errors (%)	Total (%)	*p*-value
AICU	13.95%	0.00%	8.70%	0.069
Cardiac Ward	0.87%	0.42%	0.67%	0.197
CCU	7.41%	1.27%	2.83%	0.170
CICU	0.00%	7.69%	4.76%	0.564
Female Medical	1.64%	0.52%	1.09%	0.019
Female Surgical	1.79%	0.35%	1.07%	0.001
Male Medical	2.40%	0.14%	1.14%	0.006
Male Specialty	2.24%	0.52%	1.39%	0.003
Male Surgical	2.08%	0.68%	1.40%	0.003
NICU	2.38%	1.49%	1.99%	1.000
OB/GYN	0.87%	0.45%	0.69%	0.043
Pediatric	0.44%	0.28%	0.37%	0.453
PICU	20.00%	0.00%	9.52%	0.140
Surgical ICU	5.88%	6.06%	5.97%	1.000
SCBU	0.00%	0.81%	0.34%	0.098
Total	1.43%	0.51%	0.99%	<0.001

Overall, the total errors count decreased significantly from 218 to 73 ($p < 0.001$) indicated a statistically significant reduction in the occurrence of prescribing errors post-prescribing system modification with a significant reduction of 49.8% in the overall prescribing error rate. However, the variability across departments underscores the need for targeted interventions tailored to specific departmental challenges to optimise the e-prescribing system and enhances patient safety.

The percentages of errors out of total admissions were calculated using the following equation:

$$\text{Error percentage} = \left(\frac{\text{Number of Admissions}}{\text{Count of Errors}}\right) \times 100$$

Table 4 shows the prescribing errors as a percentage of admissions before and after implementation of e-prescribing modification. A total *p*-value of <0.001 demonstrates a statistically significant reduction in errors following the implementation of e-prescribing modification. Implementing e-prescribing modification resulted in statistically significant reductions in prescribing errors in the Female Surgical, Male Medical, Male Specialty, and Male Surgical departments, as evidenced by their *p*-values (all $p < 0.05$). The Obstetrics/Gynecology and Female Medical departments exhibited substantial decline ($p < 0.05$).

Discussion

The implementation of e-prescribing systems is increasingly becoming a standard practice in healthcare settings because of their potential to

reduce errors, enhance efficiency, and improve patient safety. However, the impact of such systems can vary significantly across departments and in healthcare contexts. The results of this study provide a mixed picture of the effects of modifications in e-prescribing across various hospital departments. In this study, the implementation of e-prescribing modifications showed a statistically significant reduction in error rates across several departments, aligning with existing literature that highlights the benefits of electronic prescribing systems in healthcare settings (Dossari et al., 2020). The overall error rate dropped from 1.43% to 0.51%, indicating that modification to the e-prescribing system can enhance medication safety and reduce adverse events. This aligns with findings from another study, which demonstrated that changes to the e-prescribing system can enhance the quality and safety of medication ordering (Schiff et al., 2018).

The Accident & Emergency department saw a reduction in prescribing errors from 14 (6.4%) to 3 (4.1%) post-modification. E-prescribing systems are known to enhance the legibility and completeness of prescriptions, which are crucial in high-pressure environments such as emergency departments. Many studies have shown that e-prescribing in Emergency Department can significantly improve the accuracy of medication orders, thereby reducing errors (Hitti et al., 2017). Although the reduction in our study was not statistically significant (p-value = 0.659), this trend suggests an improvement in the accuracy of medication orders during emergencies and draws our attention to the need of more tailored modification.

The Adult Intensive Care Unit (AICU) showed a dramatic reduction in prescribing errors from 13.95% to 0.00% (p-value = 0.069). Although not statistically significant, the complete elimination of errors after implementation underscores the potential of e-prescribing system modification in critical care settings, where the accuracy of medication orders is paramount. The literature supports these findings, indicating that e-prescribing system modification can reduce prescribing errors in these high-risk areas (Dionisi et al., 2022). Similarly, the Pediatric Intensive Care Unit (PICU) showed a significant reduction in errors from 20.00% to 0.00% (p-value = 0.140). The complete elimination of errors after implementation underscores the potential of e-prescribing systems modification in pediatric intensive care settings where precise medication dosage is critical for patient safety (Ghezaywi et al., 2024). The literature supports these findings, indicating that the e-prescription system modifications can reduce prescribing errors in pediatric care units by providing real-time decision support and error-checking mechanisms (Howlett et al., 2020). The Surgical Intensive Care Unit (SICU) showed a slight increase in errors from 5.88% to 6.06% (p-value = 1.000). This non-significant change suggests that further refinements and modification in the e-prescribing system are needed to address specific challenges in surgical intensive care, such as managing complex medication regimens and ensuring

accurate dosing orders after surgeries (Cuesta-Montero et al., 2015). This mixed result necessitates further analysis, as critical care environments often deal with complex medication regimens where error reduction is vital (Ghezaywi et al., 2024; Howlett et al., 2020).

Interestingly, while the Cardiac Care Unit (CCU) demonstrated a reduction in errors from 7.41% to 1.27% (p-value = 0.170), the Cardiac Intensive Care Unit (CICU) showed an increase from 0.00% to 7.69% (p-value = 0.564). The disparity in these results is attributed to the different workflow patterns and complexities of the medication regimens in these units. Studies suggest that while e-prescribing systems generally improve accuracy, their effectiveness can vary depending on the specific clinical environment and the complexity of the cases managed (Mohsin-Shaikh et al., 2019). The CICU unit receives more severe cases of patients after open-heart surgery, which may increase the chance of prescribing errors. This anomaly highlights the necessity for tailored e-prescribing system modification, training on an e-prescribing platform and continuous monitoring to ensure its efficacy (Brown et al., 2017). The literature suggests that effective training and user support are critical for successful adoption of e-prescribing system modification, which may explain the discrepancies noted in certain departments (Brown et al., 2017).

The daycase unit is an outpatient clinic where a patient receives parenteral medication. The errors increased from two (0.9%) to eight (11.0%) post-modification, resulting in a highly significant p-value (<0.001). Those errors were due to resident physician who didn't attend the orientation programme. This demonstrates the importance of training and tailored modifications to the unique workflow and requirements of the daycase unit, which often involve high turnover and rapid patient processing (Hareem et al., 2023). Literature supports the notion that e-prescribing systems can significantly improve the accuracy and efficiency of medication orders in such settings (Safi'i & Achadi, 2019).

Significant reductions were observed in critical departments, such as Female and Male Medical wards, which exhibited significant reductions in error rates. The Female Medical ward reduced errors from 1.64% to 0.52% (p-value = 0.019), and the Male Medical ward from 2.40% to 0.14% (p-value = 0.006). These statistically significant improvements highlight the effectiveness of the e-prescribing system modifications in standard inpatient wards, where a controlled environment and consistent workflows facilitate the optimisation of medication management processes (Odukoya & Chui, 2013). The Female Surgical ward showed reduced errors from 1.79% to 0.35% (p-value = 0.001), and the Male Surgical ward from 2.08% to 0.68% (p-value = 0.003). These significant reductions indicate that e-prescribing systems are particularly beneficial in surgical settings, where the accuracy of medication orders is critical for pre- and post-operative care (Cuesta-Montero et al., 2015). These findings are consistent with studies that

emphasised the importance of integrating e-prescription systems with surgical workflows to enhance patient safety (Cuesta-Montero et al., 2015).

The Neonate Intensive Care Unit (NICU) showed a slight reduction in errors from 2.38% to 1.49% (p-value = 1.000), while the Special Care Baby Unit (SCBU) increased from 0.00% to 0.81% (p-value = 0.098). The non-significant changes in these units may be due to the unique challenges associated with neonatal care, such as the need for precise dosing and the management of complex medication regimens for vulnerable patients. These findings align with another study performed in Saudi Arabia, which indicate that further customisation of e-prescription system is necessary to address these specific needs for these specific patients (Ghezaywi et al., 2024). The Obstetrics and Gynecology (OB/GYN) department reduced errors from 0.87% to 0.45% (p-value = 0.043), indicating a significant improvement. The reduction in errors aligns with findings from other studies suggesting that modifications to the e-prescribing system can effectively meet specific medication management needs in obstetric and gynaecological care, where precise medication orders are essential for maternal and fetal health (Howlett et al., 2020).

The total reduction in prescribing errors after e-prescribing modifications, from 1.43% to 0.51% (p-value < 0.001) across all departments, was highly significant. There was a significant reduction of 49.8% in the overall prescribing error rate. This suggests that the modification had a broad impact across the hospital system, potentially altering the workflow and outcomes in ways that can enhance medication safety and reduce adverse events (Joy et al., 2012). This aligns with findings from other studies conducted in Saudi Arabia that highlighting the benefits of e-prescribing system modification in reducing medication errors by as much as 55%, thus enhancing patient safety and improving the quality of care (Joy et al., 2012; Qureshi et al., 2015). Although the statistical significance of the overall reduction is compelling, it is essential to consider a broader context. It is advisable to utilise more advanced software of the e-prescribing system and to integrate artificial intelligence to enhance the effectiveness of measures aimed at reducing prescribing errors. This recommendation was also highlighted in a similar study conducted in Saudi Arabia (Alharaibi et al., 2021). In addition, ongoing training and a robust feedback loop are essential to maintain and enhance these e-prescribing improvements (Hareem et al., 2023). However, it is important to note that while the overall change was significant, the impact was not uniform across all departments. This suggests that a one-size-fits-all approach may not be sufficient and that departments may require specific strategies that align with their unique operational dynamics. This highlights the importance of customising e-prescribing system modification to meet specific department needs. Factors such as complexity of medication regimens, workflow patterns, and staff training levels play a significant role in the effectiveness of e-prescription systems modification (Gates et al., 2021).

The findings of this study can significantly influence the design and implementation of future e-prescribing system modification, particularly in terms of customisation and adaptability. As the current system is home-designed, there are several considerations for enhancing its generalisability to other hospitals. The future design of e-prescribing system should incorporate a modular design that allows departments to customise features according to their specific needs. This flexibility can enable hospitals to adapt the system to varying workflows, medication regimens, and staff training levels. Engaging end-users – physicians, nurses, and pharmacists – in the design process can help create a more intuitive interface that aligns with their workflows and minimises the potential for user errors. Using data analytics to monitor error rates and identify trends across departments can guide targeted interventions and system adjustments. Hospitals should evaluate the overall impact of modifications on patient safety and clinical outcomes, using this data to inform ongoing improvements.

Conclusion

Overall, these findings support the assertion that e-prescribing modification can significantly reduce prescribing errors and improve patient safety. The modifications to the e-prescribing system led to a notable decrease in prescribing errors, especially in high-risk areas such as intensive care units and surgical wards. Although some departments showed smaller improvements, the overall impact underscores the need for tailored modifications and continuous system optimisation. To further enhance the effectiveness of the e-prescribing system modifications, hospitals should consider several actionable recommendations. First, developing targeted training programmes that address the unique workflows and challenges of each department will ensure that staff are well-equipped to use the system effectively. Second, implementing a modular design that allows departments to customise e-prescribing features based on their specific needs will help adapt the system to varying medication regimens and operational dynamics. Finally, establishing regular feedback loops to gather input from healthcare providers will facilitate ongoing improvements and help identify areas where the system may need adjustments. By focusing on these strategies, hospitals can maximise the benefits of e-prescribing, enhance medication safety, and ultimately improve patient outcomes across all clinical settings.

Limitations

Despite the promising results of this study, several limitations should be acknowledged. The relatively short duration of the post-implementation phase may fail to capture long-term trends and stability in the error rates. Furthermore, the results and impacts of medication errors, as well as the severity

and occurrence of adverse drug events, were neither evaluated nor measured. Additionally, the most notable limitation is the variability in error reduction across different departments, which may reflect unique workflow challenges, staff training levels, and the complexity of patient cases in each area.

Some suggestions for future modifications may include implementing tailored training programmes for each department based on their specific challenges and error profiles. Also, modifying the e-prescribing system to include clinical decision support tools that provide real-time alerts for high-risk medications, potential interactions, and dosing recommendations. The findings of this study can inform the implementation and enhancement of e-prescribing systems in similar healthcare settings by emphasising the importance of a tailored e-prescribing systems modification, integration of best practices guidelines into the training and operational protocols and focusing on high-risk areas.

Future work

Our future efforts will focus on addressing these challenges by involving end-users in the modification and implementation processes, providing ongoing education, and conducting regular system evaluations to ensure continuous improvement. In addition, we will focus on expanding the scope of modifications to include advanced decision support tools and integration with other hospital information systems.

Acknowledgements

The authors extend their appreciation to the entire researcher team members for the successful development, implementation, and revision of this research.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Ethical considerations

The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Review Board of the Armed Forces Hospitals Eastern Province Institutional Review Board (Institutional Review Board Approval No. AFHER-IRB-2024-030, 12 August 2024).

Data availability statement

The data presented in this study are available upon request from the corresponding author.

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