Improving Medication Error Detection with the Application of Transformer-based Models in Clinical Settings

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BMI 6313: Scientific Writing in Healthcare

Introduction

Medication errors are a significant challenge in clinical settings, responsible for 5-41% of hospital admissions and 22% of readmissions, and traditional methods of detecting medication errors are often inefficient (Tariq et al., 2024). Implementing advanced technologies, particularly transformer-based models, is essential to improve medication errors in clinical settings by accurately and effectively detecting these errors. Transformer-based models, like computerized physician order entry (CPOE), clinical decision support systems (CDSS), ePrescribing, and artificial intelligence (AI), enhance medication error detection and improve efficiency by accelerating diagnoses, improving communication and documentation, and automating data analysis for personalized care (Devin et al., 2020).

Research Question

Do transformer-based models enhance the accuracy and efficiency of medication error detection?

Purpose

To investigate the application of transformer-based models in improving the detection of medication errors.

Methods

The method of investigation for this review involved comprehensive database searches via PubMed (n=64), EMBASE (n=18), and Medline (n=43) refined with Medical Subject Heading terms and keywords. After the removal of duplicate records (n=122), articles were screened according to the inclusion and exclusion criteria. A total of 16 studies were included in this review.

Inclusion Criteria

- Publication date in 2020 or later (n=97)

Exclusion Criteria

- Unrelated topic (n=24), wrong outcome (n=8), reported no impact (n=7), incorrect setting (n=11), unavailable for full-text access (n=9)

Primary Variables

- 16 included research articles

Control Condition

- Compare transformer-based models to traditional approaches

Tested Variables

- Drug, dosage, dispensing, administration, and patient-related medication errors

Results/Discussion

The findings revealed that traditional approaches for medication error detection exhibited significant shortcomings (Liang et al., 2021; Manias et al., 2020; Yoon & Sohng, 2021). The presence of transformer-based models reduced the likelihood of lost, misplaced, or missing medication orders and eliminated illegible handwritten orders (Liang et al., 2021; Manias et al., 2020; Yoon & Sohng, 2021). CPOE and CDSS integration decreased medication error rates, pediatric prescribing errors, and pediatric medication dose errors, and resolved alerts (Amir & Khan, 2022; Devin et al., 2020; Hajesmaeel et al., 2021; Liang et al., 2023; Manias et al., 2020; Ruutiainen et al., 2024; Satir et al., 2023; Zwietering et al., 2024). ePrescribing reduced medication errors, and AI decreased medication errors and reduced near-miss events (Damiani et al., 2023; Guilcher et al., 2023; Manias et al., 2021; Paris et al., 2024).

Medication errors were reduced across the included studies. Studies reported patterns of decreased drug, dosage, dispensing, administration, and patient-related medication errors. CPOE, CDSS, ePrescribing, and AI improved dispensing processes, data accessibility, prescribing error rates, and administration error rates, demonstrating the effectiveness in minimizing dosage and dispensing inaccuracies.

Limitations

- Model generalizability, the varied measurements across studies, high costs that prevent the likelihood of widespread adoption

Future Research

- Evaluate the financial benefit of transformer-based models over time and whether the profit outweighs the expenses and costs of implementation

Tables

Table 1

Characteristics of Included Studies (n = 16)

Authors (year)	Method	Setting	Age
Manias et al. (2020)	Literature Review	Inpatient	≥18
Devin et al. (2020)	Literature Review	Inpatient	All
Hajesmaeel et al. (2021)	Literature Review	Inpatient	All
Liang et al. (2021)	Direct Observation	Inpatient	≤18
Manias et al. (2021)	Direct Observation	Inpatient	All
Yoon and Sohng (2021)	Direct Observation	Inpatient	All
Amir and Khan (2022)	Self-report	Inpatient	All
Liang et al. (2023)	Direct Observation	Inpatient	≤18
Damiani et al. (2023)	Literature Review	Outpatient	All
Satir et al. (2023)	Direct Observation	Inpatient	≤18
Guilcher et al. (2023)	Literature Review	Inpatient/Outpatient	All
Tariq et al. (2024)	Self-report	NR	NR
Ruutiainen et al. (2024)	Literature Review	Inpatient/Outpatient	≤18
Zwietering et al. (2024)	Direct Observation	Inpatient	≥60
Mo and Wu (2024)	Retrospective Cohort	Inpatient	≥18
Paris et al. (2024)	Self-report	Inpatient/Outpatient	NR

Note. This table identifies the included studies, their method, clinical setting, and population age.

* Abbreviations: NR = Not Reported

Conclusion

An analysis of the 16 included publications concluded that transformer-based models improved medication error detection rates with CPOE, CDSS, ePrescribing, and AI integration in various clinical settings. This review supports the broader implementation of transformer-based models to reduce medication errors in clinical settings.

References

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Acknowledgments