Undergraduate Students, Health and Biomedical Sciences

Types and Severity of Medication Errors Associated with the Use of Automated Systems within the Medication Use Process: A Systematic Review

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Background

- Medication use process is complex with multiple stages which increases the risk of medication errors- preventable event that may cause inappropriate medication use or harm
- Leads to detrimental clinical and financial consequences
- Automated systems implementation reduces errors up to 37%.
- The use of these systems still requires human intervention and has been associated with new types of errors.
- However, there is lack of published data on the type of errors and their severity.

Objective

- To determine the types and severity of medication errors that are associated with the use of automated systems in the medication use process.

Methods

Design

- Systematic Review using PRISMA protocol
- Protocol has been registered on PROSPERO as CRD42020212900

Databases

- PubMed, EMBASE, Cochrane Library

Inclusion Criteria

- Observational studies including cross-sectional, case-control, nested case-control, cohort and case series,
- Experimental studies including quasi-experimental, randomized, non-randomized, controlled and uncontrolled
- English Language studies from 2000 to 2019
- Focused on types and severity of medication errors associated with automation
- Primary, acute, long-term, ambulatory and institutionalized care settings

Exclusion Criteria

- Case reports, reviews, abstracts, personal opinions, commentaries, and conference reports
- Animal studies

Quality Assessment

- Hoy et al. Tool

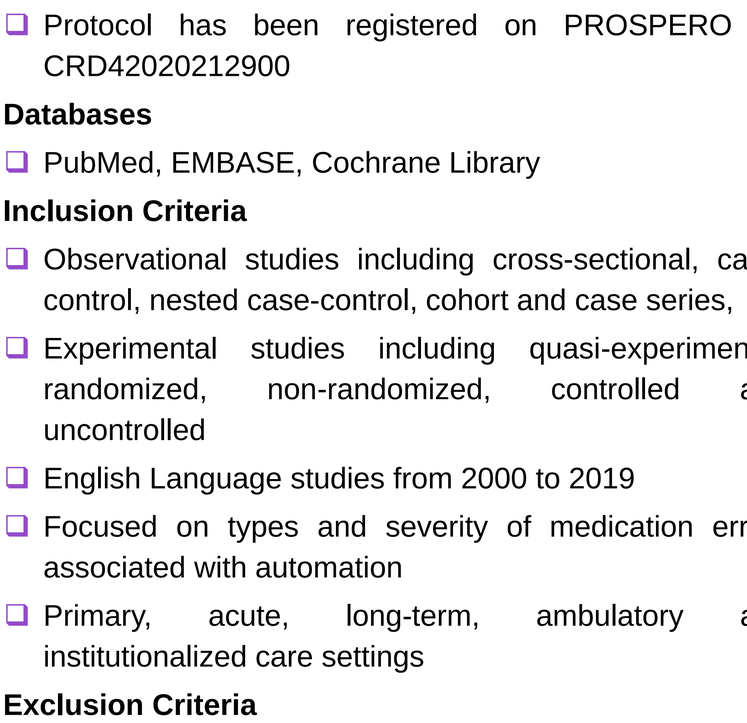

Figure 1. Data Extraction Tool

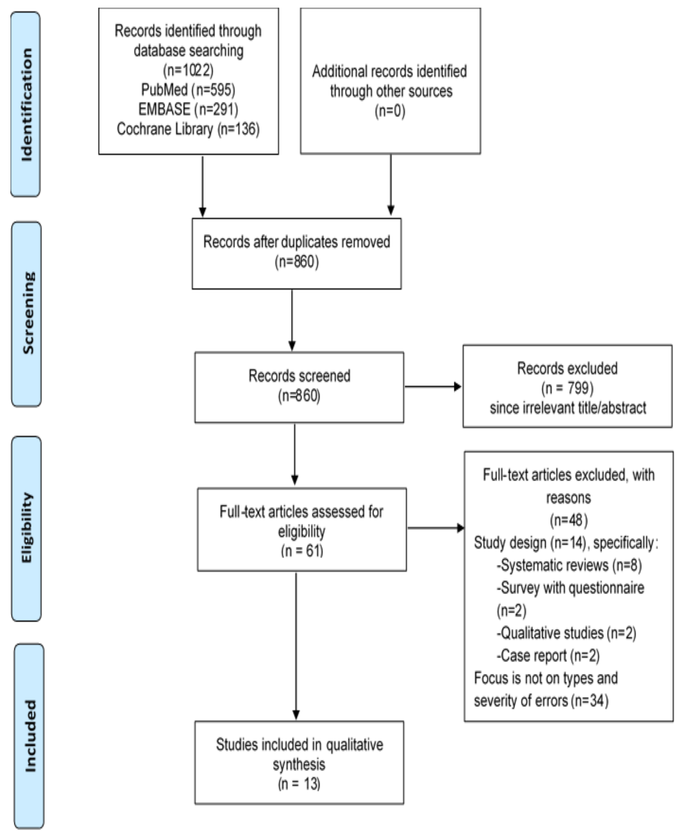

Figure 2. PRISMA Flow Diagram

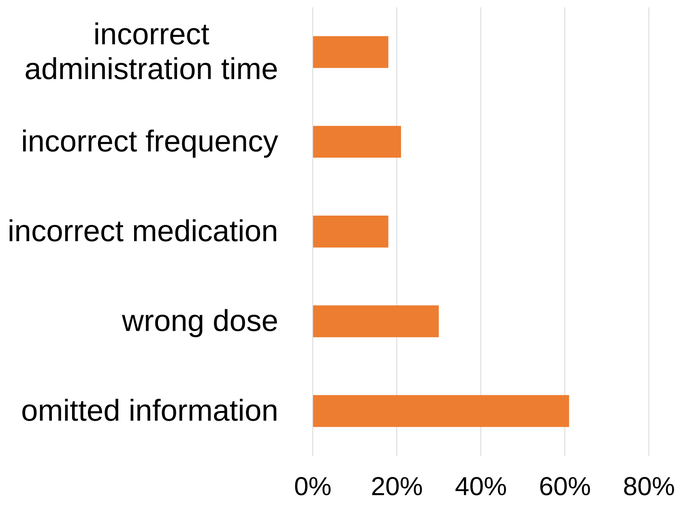

Figure 3. Frequency of Medication Errors Associated with Automation

Table 1. Quality Assessment of Included studies

Number of studies (n)	Overall Risk Score (0-3; 4-6; 7-9)	Overall Risk of Bias (low; moderate; high)
Eight	0-3	Low
Five	4-6	Moderate

Results

Screening and Inclusion

- Initially 1022 records, 860 after de-duplication
- 61 full text articles assessed for eligibility
- 13 full text articles were included (see figure 2)

Country

- Spain (n=4), United States (n=3), France (n=2), Netherlands (n=2), Australia (n=1), Brazil (n=1)

Study population and Size

- Sample size not specified (n= 5), study population not specified (n=11), population identified (n=2)

Study type

- Prospective cohort (n=6, 46%), retrospective cohort (n=2, 15%), controlled lab study (n=1, 8%), experimental study (n=1, 8%), longitudinal observational quantitative study (n=1, 8%), descriptive and analytical (n=1, 8%)

Study Setting

- Hospitals (n=11), tertiary care facility (n=1), nursing home (n=1)

Automated System

- CPOE (n=9, 69%), ESP (n=1, 8%), BCMA (n=1, 8%), distribution robot (n=1, 8%), CPOE and ADC (n=1, 8%)

Medication Use Stage

- Prescribing (n=8, 62%), administration (n=9, 69%), dispensing (n=2, 15%), not mentioned (n=1, 8%)

Error Type

- Incorrect medication (n=5, 1-18%), incorrect administration time (n=4, 3-18%), omitted information (n=8, 4-61%), wrong dose (n=8, 4-30%), incorrect frequency (n=5, 0.6-21%) (see figure 3)

Error Severity

- NCC MERP index (n=6, 46%), other scales (n=3, 23%), no severity assessment (n=4, 31%)

Error Classification

- For studies that used NCC MERP index: category B (n=4), followed by A (n=2) or C (n=4)

Quality Assessment

- low bias risk (62%), moderate bias risk (38%) (see table 1)

Limitations

- Only English Language studies included
- Short study period
- Critical gaps in the sampling procedure of included studies- sample size calculation, low response rate
- Risk of response and sampling bias
- Internal and external validity uncertain

Conclusions

- The findings suggest that the use of automation is associated with the occurrence of errors mostly in the prescribing and administration stage.
- Most frequently reported error type was omission error of dose, duration, or frequency because of complexity of automated systems and lack of adequate training
- May be reduced by using forcing functions
- Second most reported error was incorrect dose error that occurred during drug withdrawal or dosing calculation because of increased communication load and alert fatigue
- May be lowered by designing a more user-friendly interface during development
- No definite conclusion could be made about the severity and classification of errors
- Future Focus: on automation related errors in Asia and classifying the severity of errors using NCC MERP index
- Future study design: use of appropriate sample size and inclusion of patient characteristics