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Causes of Medication Administration Errors in Hospitals: a Systematic Review of Quantitative and Qualitative Evidence

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Underlying systems factors have been seen to be crucial contributors to the occurrence of medication errors. By understanding the causes of these errors, the most appropriate interventions can be designed and implemented to minimise their occurrence.

This study aimed to systematically review and appraise empirical evidence relating to the causes of medication administration errors (MAEs) in hospital settings.

Nine electronic databases (MEDLINE, EMBASE, International Pharmaceutical Abstracts, ASSIA, PsycINFO, British Nursing Index, CINAHL, Health Management Information Consortium and Social Science Citations Index) were searched between 1985 and May 2013.

Inclusion and exclusion criteria were applied to identify eligible publications through title analysis followed by abstract and then full text examination. English language publications reporting empirical data on causes of MAEs were included. Reference lists of included articles and relevant review papers were hand searched for additional studies. Studies were excluded if they did not report data on specific MAEs, used accounts from individuals not directly involved in the MAE concerned or were presented as conference abstracts with insufficient detail.

Data Appraisal and Synthesis Methods

A total of 54 unique studies were included. Causes of MAEs were categorised according to Reason's model of accident causation. Studies were assessed to determine relevance to the research question and how likely the results were to reflect the potential underlying causes of MAEs based on the method(s) used.

Slips and lapses were the most commonly reported unsafe acts, followed by knowledge-based mistakes and deliberate violations. Error-provoking conditions influencing administration errors included inadequate written communication (prescriptions, documentation, transcription), problems with medicines supply and storage (pharmacy dispensing errors and ward stock management), high perceived workload, problems with ward-based equipment (access, functionality), patient factors (availability, acuity), staff health status (fatigue, stress) and interruptions/distractions during drug administration. Few studies sought to determine the causes of intravenous MAEs. A number of latent pathway conditions were less well explored, including local working culture and high-level managerial decisions. Causes were often described superficially; this may be related to the use of quantitative surveys and observation methods in many studies, limited use of established error causation frameworks to analyse data and a predominant focus on issues other than the causes of MAEs among studies.

As only English language publications were included, some relevant studies may have been missed.

Limited evidence from studies included in this systematic review suggests that MAEs are influenced by multiple systems factors, but if and how these arise and interconnect to lead to errors remains to be fully determined. Further research with a theoretical focus is needed to investigate the MAE causation pathway, with an emphasis on ensuring interventions designed to minimise MAEs target recognised underlying causes of errors to maximise their impact.

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The reality that medical treatment can harm patients is one that the healthcare community has had to come to terms with over recent years [

The key to implementing a successful intervention that minimises MAEs is to understand how and why they occur. As nurses find themselves as the ‘last link in the drug therapy chain’ where an error can reach the patient [

In order to determine the cause of error, one must appreciate the intentions of the person responsible for it [

Whilst some have summarised the literature on the causes of MAEs [

Literature Search Method

The following electronic databases were searched by RNK: MEDLINE, EMBASE, International Pharmaceutical Abstracts, Cumulative Index for Nursing and Allied Health Literature, PsycINFO, Health Management Information Consortium, Social Science Citation Index (all 1985–May 2013), British Nursing Index (1994–May 2013) and Applied Social Sciences Index and Abstracts (1987–May 2013).

Search terms used fell broadly into three groups: description of error [including error(s); medication error(s); incident report(s); near miss(es); drug error(s); treatment error(s); medication safety, drug safety, preventable adverse event(s), adverse event(s), medical error(s), clinical incident(s), adverse drug event(s), adverse health care event(s), health care error(s), medication incident(s)], variable of interest [cause(s); factor(s); reason(s); aetiology; etiology; causality; causalities; predictor(s); association(s)] and error type [including drug/medication/medicine administration(s); dose/drug/medicine/medication preparation(s); drug/medication/medicine delivery; omission(s); drug utilisation; commission(s); drug/medication/medicine supply; drug/medication/medicine handling; self medication; self administration]. Depending on database functionality, some terms underwent slight modification.

The reference lists of included studies and relevant review articles were hand searched to identify additional eligible studies. Study authors were not generally contacted for additional data. Once all database searches had been conducted, duplicate citations were identified and excluded using reference management software (EndNote X3

Inclusion and Exclusion Criteria

Studies that reported data on the causes of MAEs made in inpatient hospital settings published between 1985 and May 2013 were sought. Studies were included if they were published in English and identified causes in relation to specific errors or near misses that staff members either made themselves or were directly involved with. Relevant review articles were excluded, though their reference lists were hand searched for additional studies. Conference abstracts were excluded if they did not provide enough relevant data. Studies that reported on results based on simulation, or concerned with only one subtype of MAE, were excluded, as were studies reporting results obtained from incident or case reports as it could not be determined whether the person reporting the incident had been directly involved.

Data Extraction Method

The following details were extracted from all publications meeting the inclusion criteria: core details (including year of publication, first author, country of origin, study period), study background (including study type, setting, sampling strategy, drug administration route(s) studied, details of observers, subject details, definitions of administration error, error detection method(s), cause detection method(s), error framework categorisation if used), results (causes of MAEs), and additional information (including relevance of study to review aims). Data were extracted independently by RNK, JC and SDW; the authors met to resolve any differences in their results.

An MAE was defined as ‘a deviation from the prescriber’s medication order as written on the patient’s chart, manufacturers’ instructions or relevant institutional policies’ [

Causes were defined as ‘reasons reported to the researcher by the person directly involved with a specific administration error or near miss as being wholly or partly responsible for said error’. Direct observation could also provide data on causes of MAEs, provided it did not depend upon researcher opinion on causality.

Extracted data on causes were aggregated and summarised according to theme, with Reason’s model of accident causation [

Reason explains that systems such as healthcare have in place barriers or safeguards (e.g. double checking in healthcare) that protect a particular process or task from erroneous behaviour or subversion [

Reason’s model of accident causation as applied to medication administration errors in hospitals [

Quality assessment was integrated into the review process in two ways by RNK. First, by filtering out studies in which authors speculated as to the causes for MAEs, or where participants were asked to report on the causes of errors more generally, we ensured that only ‘empirical’ data based on specific error experiences were included.

The second stage of quality assessment occurred after data extraction. Due to the heterogeneity of study designs, in-depth quality analysis was impractical; instead broad quality criteria were applied by RNK and considered relating to three main interests: the relevance of the study to the aims of this

review; the method of sampling/sample size and finally the method of MAE causes data collection.

In all, 55 publications were eligible for inclusion. Three studies reported data from two countries [

Study identification and exclusion process

Study Characteristics

Twelve (12/54, 22.2 %) unique studies each originated from the UK [

Background information for included studies

general medicine, general surgery, geriatrics, private

2 × medical-surgical wards (USA), 2 × medicine, 2 × surgery, 2 × geriatric (UK)

USA (1 month), UK (2 months)

5 ICUs, 4 × non-obstetric general medical care units, 2 × non-obstetric general surgical care units

18 weeks (2 per ward)

2 × H: 1 × medical ward per H

2 × medical ICU, 3 × surgical ICU, 4 × medical general care, 2 × surgical general care units

1 × female geriatric ward

Hartley and Dhillon [

2 × general surgical wards, 1 × general medical ward

(1 × UK, 2 × Germany)

two adult wards at each site

1 × H: 1 × medical, 1 × surgical ward

Fasting and Gisvold [

Various units: general medical, general surgical, care of elderly, paediatric, neonatal, haematology, renal, obstetric/labour

1 × H: 1 × medical admissions ward

10 × units, including ICU, paediatrics, surgery, cardiology, nephrology

2 × H (Germany), 1 × H (UK)

Sample of staff nurses working in various units in Hs, who were members of ANA

Members of the Department of Anaesthesia at the University of Cape Town

1 × H medical and surgical units

1 × ICU, 1 × surgical ward

3 × surgical units, 2 × medical units, 1 × palliative care facility

van Gijssel-Wiersma et al. [

1 × internal medicine unit

Sample of staff nurses working in various critical care units in Hs, who were members of the AACN

Anaesthetists on South African Society of Anaesthesiologists database

1 × medical/surgical ICU

33 × 12-h nursing shifts

1 × paediatric medical/surgical ICU

26 × 12-h nursing shifts

McBride-Henry and Foureur [

Nurses from various clinical units

National Yang-Ming University

Various clinical units

1 × H: 1 × haematology ward

6 months per hospital

Two paediatric wards (general, oncology)

All inpatient areas included

158 active nurses from the Georgia Board of Nursing

School of Nursing and Midwifery, CQ University Australia

4 × teaching H, 2 × private H, 1 × government H

22 × public sector H. All anaesthetising doctors included

Rodriguez-Gonzalez et al. [

2 × gastroenterology units

64 operating theatres

Method of MAE collection

Data collection method for MAE causes

Data collector(s) ± reviewer(s)

2 × pharmacist observers

2 × pharmacist observers

Semi-structured interviews

Semi-structured interviews

Ward staff involved with errors

Incident reports and chart review. Questionable cases discussed with additional investigator for consensus

Interviewing staff responsible/witnesses—physicians, nurses, pharmacists. Utilised structured data collection form

Peer case investigator

DO, informal and formal interviews

DO, informal and formal interviews

Incident report, chart review and independent review

Nurse investigator, ward staff

Nurse peer case investigator

Hartley and Dhillon [

2 × pharmacist observers

2 × pharmacist observers

2 × pharmacist observers

2 × pharmacist observers

Fasting and Gisvold [

Anaesthesiologists and nurse anaesthetists

Prospective procedure record dataset

Prospective procedure record dataset

Self-report by anaesthesiologist

Self-report by anaesthesiologist

Semi-structured interviews

Semi-structured interviews and coding

Pharmacist interviewer

Pharmacist interviewer

The survey questionnaire asked respondents who had reported a wrong drug error to choose one or more factors contributing to the incident from a pre-prepared list

Anaesthesiologists self-report via survey

Anaesthesiologists self-report via survey

Study form after each anaesthetic administration

Study form after each anaesthetic administration—asked for contributory factors for error

Self-report via monitoring form

Self-report via monitoring form

Nurses and physicians

DO + information conversations with ward staff

Pharmacist observer. Data coded by both authors

40 question per day error log book

40 question per day error log book with narrative error descriptions

Self-report by nurses

Self-report by nurses

Confidential self-report questionnaire survey

Questionnaire survey—section asking what factors contributed to the incident

Self-report survey questionnaire

Self-report survey questionnaire

Semi-structured interview

Semi-structured interview

Nurse researcher interviewer

Nurse researcher interviewer

DO and informal conversations with staff

Pharmacist observer. Data coded by both authors

MEQ—contains five sections asking the nurse to identify what they thought the cause of their error(s) was

Self-reported by nurse subjects

Citation

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