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1. International Journal of Pharmacy Practice -*Incidence, type and caused af dispensing errors; a review of literature {22 pages)*
2. International Journal of Pharmacy Practice- *Unprevented or prevented dispensing incidents: which outcome to use in dispensing error research? {1page)*
3. Health and Social Care in the Community – *Invited Review- Workload in community pharmacies in the UK and its impact on patient safety and pharmacists' well-being: a review of the evidence {15 pages)*

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Review Article

Incidence, type and causes of dispensing errors: a review of the literature

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Abstract

Objectives To identify, review and evaluate the published literature on the incidence, type and causes of dispensing errors in community and hospital pharmacy.

Method Electronic databases were searched from 1966 to Februm·y 2008. This was supplemented by hand-searching the bibliographies of retrieved mticles. Analysis of the findings explored the research methods, operational definitions, incidence, type and causes of dispensing errors.

Key findings Sixty papers were identified investigating dispensing errors in the UK, US, Australia, Spain and Brazil. In general, the incidence of dispensing errors varied deperiding on the study setting, dispensing system, research method and operational definitions. The most common dispensing errors identified by community and hospital pharmacies were dispensing the wrong drug, strength, form or quantity, or labelling medication with the incorrect directions. Factors subjectively reported as contributing to dispensing errors were look-alike, sound-alike drugs, low staffing and computer software. High workload, intenuptions, distractions and inadequate lighting were objectively shown to increase the occurrence of dispensing errors.

Conclusions Comparison of the reviewed studies was confounded by differences in study setting, research method and operational definitions for dispensing errors, error rate and classification of error· types. The World Health Organization is currently developing global patient safety taxonomy. Such a standardized taxonomy for dispensing errors would facilitate consistent data collection and assist the development of error-reduction strategies.

Keywords causes; dispensing errors; hospital; risk management; safety

Introduction

Dispensing medication is the core function of pharmaceutical care and approximately 900 million medicines are dispensed each year by co munity and hos ital phannades across England ru1d WalcsY[1] Dispensing is a complex process (Figure 1)[1, l unequivocally under the supervision of the phannacist.[I,ZJ Traditionally, dispensing has involved pharmacy staff manually selecting medication from shelves, transferring the correct number of medication dose units to a container and/or labelling the assembled productP[1] However, in recent years the use of automated dispensing systems has been widely advocated to improve efficiency, maximize storage capacity and minimize dispensing errors.l[4,51] Consequently, automated dispensing systems are becoming increasingly commonplace in hospital and community phannacies across the world.l4-8J Table 1 smmnarizes the different types of automated dispensing systems.

Errors can arise at any stage during the dispensing process. It is estimated that each year 134 341 dispensing errors occur in community pharmacies in England and WalesJil The majority (85%) of these errors are detected by pharmacists before the medication is supplied to the patient.liJ However, some errors are undetected and. may cause serious patient harm and occasionally death.l[9–121] Thus it is imperative that pharmacists review data on dispensing errors so that risk-reduction strategies are developed to safeguard the quality and safety of patient care.[Ill

In recent years there has been a growing body of research on·dispensing errors. However, a comprehensive review of the literature has not previously been undertaken. This paper reports the findings of a literature review that focuses on dispensing errors in community and

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Receipt of prescription	Validation of patient information		Log of prescription	LegalltE:ichnical check
Product labelling	Medication assembly	Stock selection	Label generation	Clinical check
Completion of registers	Self-checking/ endorsing	Final accuracy check	Issue of medication	Counselling

Figure 1 Dispensing process in community and hospital phannacics[l[21]. In the European community and outpatient hospital phatmacies patients are supplied manufacturers' original packs of medication without a dispensing label detailing directions for use,

Table 1 Summary of automated dispensing systems

Type of automated dispensing system	Description
Repackaging systems	In these systems, medication is removed from the manufacturer's original packs then repackaged into unit dose packs or blister cards, Some repackaging systems can produce patienl compliance packs containing each dose of medication to be administered at a particular time of day. These unil dose systems are widely used in US and European phatmacies, whereas the compliance pack systems are used by specialist unils in the UK, e.g. psychiatric hospitals.
Wiud-based automated dispensers	These systems do not petform any of the charactelistic stages of the dispensing process (L1bel generation, stock selection, medication assembly or product labelling) and would be more accurately described as electronic storage devices, The system consists of an electronic drug cabinet and/or trolley comprising computer-controlled drawers. Medication is stored in patient- or product-specific drawers within the cabinet. When a patient's details are entered into the system's computer, the appropriate drawer opens, enabling administration of the medication, These systems are widely used in US hospitals.
Pharmacy-based original-pack dispensers	Medication is stored and retlieved from the system based on recognition of the European Article Number (EAN) barcode by the interlinked automated system, stock database and phmmacy labelling computer software. Medication is stored on specially designed shelves within the automated dispensing system. During label-geneJ·ation, the pharmacy labelling software sends a signal to the automated dispensing system software, initiating stock selection. The requested product is selecte'd by picking devices in the automated system and transferred to the delivery station by conveyor belt or chute.· Some automated systems have labelling devices which affix. the corresponding dispensing label to the medication prior to transfe1Ting the product to the delivery station. These systems are widely used in US hospitals.

hospital pharmacy. This review of internationally published literature aims to summarize: research methods employed to investigate dispensing errors in community and hospital phB.rmacy, operational definitions for dispensing errors, . classification of error types and incidence, repmted incidence of dispensing errors in community and hospital pharmacy, repmted types of errors in community and hospital pharmacy, and reported causes of dispensing errors;

Method

Literature search

A comprehensive search of electronic bibliographic databases was undettaken: Medline (1966-2008), Embase (1980-2008), CINAHL (1982-2008), Pharm-line (1982-2008), International Phannaceutical Abstracts (1970-2008), Ovid (1966-2008), Sciencedirect (1997-2008) and Web of Science (1966-2008). The search included all publication types but excluded veterinary citations. Search tenns used as both keywords and free-text searches included the following: dispensing, dispens*, errors, incident, inciden*, near-miss, near-miss*, medication, medicines, med*, prescription, prescri*, drug, pharmacy, phann*. Where possible, the search tetms were matched to those included in the database's thesaurus. In addition, the bibliographies of retrieved mticles were searched by hand.

Inclusion/exclusion criteria

Publications were included in this review if they fulfilled the inclusion criteria (Table 2) and any relevant information was extracted from papers the scope of which exceeded pharmacy dispensing en·ors. In some instances, the same research study was published twice as both a conference abstract and research paper. However, only the full research paper was included in this review. Unpublished research on dispensing errors was excluded from the review due to difficulty in accessing the literature.

Data abstraction

The literature search was conducted by two reviewers (KLJ and RMcA) who independently examined the identified titles and abstracts to determine whether the research paper should be retdeved, The inclusion criteria were applied and the quality of retiieved papers was detetmined by KLJ using the framework established by Allan and Barker.l[131] Data from the included papers were abstracted by KLJ using the following data fields: reference, study brief, pharmacy setting, dispensing system,

Table 2 Inclusion/exclusion criteria

Inclusion criteria

International, primary quantitative and/or qualitative research (including research published in a language other than English) investigating the
- o incidence
- o type
- o causes of medication dispensing errors

Dispensing errors: errors arising during the process of dispensing medication
- o detected before medication has left the pharmacy
- o detected after medicatiOn has left the pharmacy

Research undertaken in community pharmacy
- o Pharmacy type
  - Independent
  - Chain/multiple
  - Supetmarket
  - Mass merchant
  - Mail-service
- o Prescription type
  - Individually dispensed items for patients
  - Original prescriptions
  - Repeat prescriptions
- o Dispensing system
  - Manual dispensing (unit dose, original pack or compliance pack)
  - Automated dispensing systems (unit dose, original pack or compliance pack)

Research undertaken in hospital phmmacies
- o Hospital type
  - State
  - Private
  - Health-systems
  - Veterans Affair
- o Phrmacy type
  - Centralized
  - Decentralized/sateJiite
  - Outpatient
  - Ambulatory care
- o Disp.ensing system
  - Manual dispensing (unit dose, original pack or compliance pack)
  - Automated dispensing systems (unit dose, original pack or compliance pack)
- o Presctiption type
  - Inpatient
  - Discharge
  - Outpatient
  - Accident and emergency
  - Individually dispensed ward stock requiring a dispensing label

Exclusion criter,ia

Extemporaneous and aseptic dispensing enors

Ward stock-dish·ibution etTon; where supplied medication is not labelled

Errors associated with ward-based automated dispensers/electronic storage devices

research method, definitions, incidence (numerator and denominator), error types and causes/contributory factors. Application of inclusion, quality criteria and data abstraction was verified by CW and any differences resolved.

Definitions

To facilitate the review of the identified research papers the following approach, based on the National Patient Safety Agency (NPSA) patient safety taxonomy,D[1] has been adopted for the dispensing error terminology. *Dispensing error(s)* refers to all errors occurring during the process of dispensing medication as included in the identified research papers, which are detected within the pharmacy (prevented dispensing incidents) and after the medication has left the phmmacy (unprevented dispensing incidents). *Prevented dispensing incident(s)* are all errors occurring during the process of dispensing medication as included by the identified research papers that are detected within the pharmacy before the medication has been issued to the patient. This term replaces internal error, dispensing incident and filling error. *Unprevented dispensing incldent(s)* are all errors occurring during the process of dispensing medication as included by the identified research papers that are detected after the medication has been issued to the patient and left the pharmacy. This term replaces external error and incident.

Results

Overview of identified research papers

The literature search identified 60 research papers which fulfilled the inclusion· criteria (Figure 2). Forty-one research papers focused on dispensing enors in inpatient and/or outpatient hospital pharmacies and 19 papers investigated dispensing errors in community pharmacy (retail, independent, chain-store, mail-service and supennarket pharmacies). The majority of dispensing-error research was conducted in the US (48%, n = 29) and UK (40%, n = 24). However, research papers have investigated hospital dispensing errors in Australia (n = 3), Spain (n = 1) and Brazil (n = I); and community phmmacy dispensing errors in Australia (n = I) and Denmark (n = 1).

Research methods

Various research methods were used to investigate dispensing errors, including self-completed standardized incident forms, observation, postal surveys, simulation, interviews, case-note review and focus groups.[13,14–721] In some research papers mixed methods were used to determine the incidence and causes of dispensing errorsY5,30.43,65J Table 3[3,14-35,37-62,64-71J summarizes the research methods employed by the identified research papers.

This review has identified that the majority (88%, n = 21) of UIC research papers employed incident report forms to investigate dispensing errors. Jn contrast, observation was most frequently (66%, n = 19) employed by US reseru·chers. In a compm·ativc study of observation and incident reporl, observation detected more dispensing errors (16 errors among 3337 prescription mders) .than incident reports (0 errors among 3337 prescriptions).{JOJ However, this study was small scale, involving data collection at a single mail-service pharmacy over 5 days and little is known about the accessibility of incident forms to the phannacy clicnts.[130] Thus the sh1dy findings may not be generalizable to other community and hospital pharmacy settings.

Operational definitions

Dispensing errors

This review identified a myriad of terms (n = 8) and definitions (n = 21) used to describe dispensing errors with tenninology

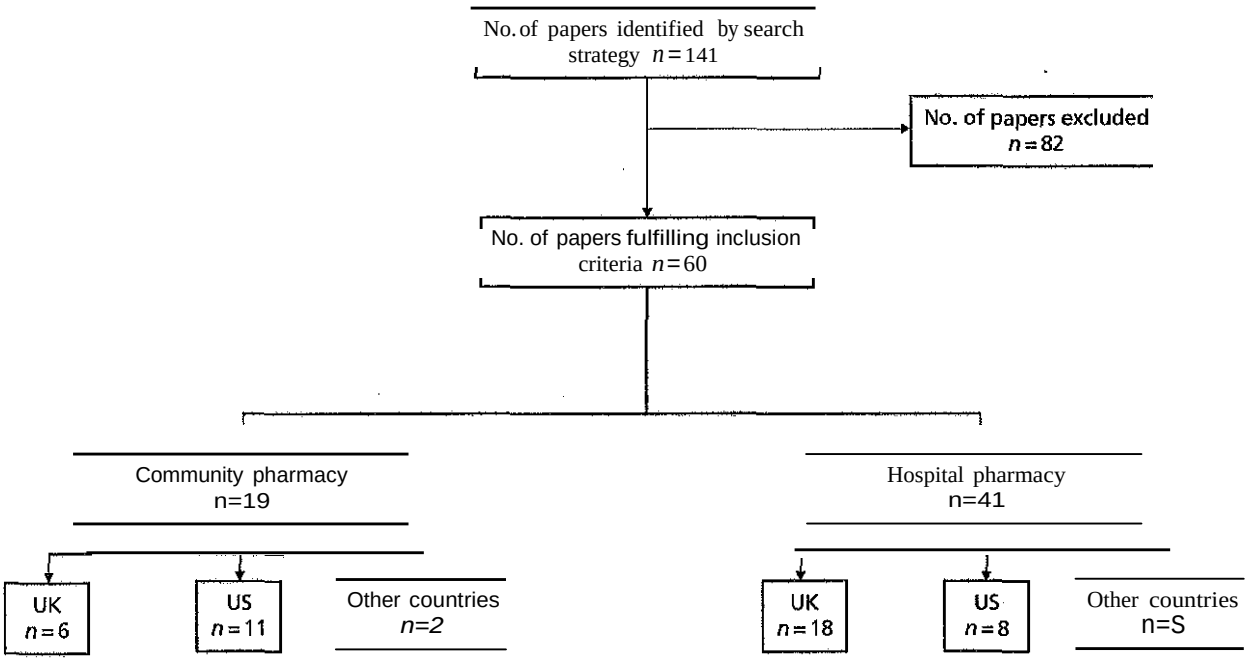

Figure 2 Summary of the literature search.

being used interchangeably (Table 4).f3·15,17,19,2I,25,27-33,37-4l, 43,44,46-4[8].50,S9,[61,65,66,71,72]1 Nineteen different definitions for the term dispensing error were identified. These nineteen definitions were all embracing, ellcornpassing descriptions of the action involved in the error (e.g. 'a discrepancy between the prescriber's written interpretable written order and the filled prescription...•[251]) and/or type of dispensing errors (e.g. '... wrong drug or dose strength; incorrectly labelled directions or drug. dispensed to wrong patient'[31]1). The remaining three definitions related to error detection. D spensing errors detected after the medication had been issued and left the phatmacy were described as dispensing errors, external errors, incidents and/or unprevented dispensing incidents. In contra'lt, dispensing errors detected within the pha1macy before issue of medication to patients were termed near-miss, internal errors, dispensing incidents and/or prevented dispensing incidents. A filling ermr was also used to describe a dispensing error detected by pharmacists during accuracy checking/ verification of dispensed medicines. The multiplicity and interchanging of terminology and definitions for dispensing errors confounds the comparison of identified research papers.

Franklin and O'Grady[1[91] were the only researchers to describe the development of a definition for a dispensbg error. In their study, they employed the Delphi, technique to explore an expert panel's (*n*20) views of a proposed definition for a dispensing error.l[431] Based on the responses of 16 experts to two rounds of Delphi surveys, consensus was achieved and a dispensing error was defined as the following. 'Any unintended deviation from an interpretable written prescription or medication order. Both content and labelling errors are included. Any unintentional deviation from professional or regulatory references or guidelines affecting dispensing procedures.•[19]1

Classification of error types

Various categories were employed by the identified research papers (66%, *n*39) to classify the different types of dispensinij errors occutring in community (Table 5i[15,17,19,21,24,2,5?7_3] 1 and hos ital pharmacy (Table 6).[3,33-37,39,41-44,47-50,52,54,56-Ul, 63,64,70,7]The most common error categodes identified in the research papers were dispensing the wrong drug (100%, *n* = 39), strength (95%, *n*37), dosage fmm (77%, *n*30) and quantity (69%, *n* = 27), and labelling drugs with the wrong directions (77%, *n* = 30). Errors arising during the screening of prescriptions for legal validity and clinical safety,[49,50,54]1 completing controlled drug documentation[43,50,54,61]1 and reconstituting and preparing extemporaneous medicines[63,651] were included in a few research papers despite being typically subject to separate risk-management procedures.[391]

Dispensing error rate

Fmty-five reviewed papers repmted the dispensing error rate in community and/or hospital pharmacy (Tables 7 and S).I14,15,t7,19,2J,24-28,30,32J, [3,33-"35,38,39,43-47,49-57,59-721 However, only 18% (*n* = 8) of these pape1clem·ly defined the calculation of dispensing-error rateP[5,28,30,5,2,56,59,61,62]1 In the remaining 37 papers, the dispensing-error rate calculation (numerator and denominator) was elucidated from the data presented in the papers.

Overall a range of different numerators and denominators were employed by the reviewed papers to determine the dispensing ermr rate (Tables 7 and 8). The numerator was defined as the number of prescriptions or error report.,;;; containing one or more diffet•ent etmr types (18%, *n* = 8), the total number of each mutually exclusive error type (16%, *n* = 7), number of doses with errors (5%, *n* = 2) and number of errors discovered by auditors/undetected by phrumacy staff (5%, *n* = 2). However, in

Table 3 Description, strengths and limitations of dispensing-error research methods employed by identified research papers

Research method	Description of method	Reference for identified papers employing research method						Strengths	Limitations
		Community pharmacy			Hospital pharmacy				
		UK	US	Other countries	UK	US	Other countries		
Incident forms	Details of errors reported by staff on standardized forms.	[14-18]	[30]	[32]	[3,33-35, 37-39, 41-48,72]	[64-66]	[67-70]	Used to investigate incidence, type and causes of errors. Anonymity can eliminate fear of disciplinary action_.	Identity of person completing fonn is ambiguous. Under-reporting due to fear of disciplinary action or lack of awareness of error. Underestimates incidence of error.
Observation	Researcher observes dispensing process or performs independent accuracy check of dispensed medicines. Any errors detected are recorded.	[19]	[24-28,30]			[49--57, 59,61, 65,66]	[71]	Used to investigate incidence, types and causes of errors. Highly sensitive. Does not rely on awareness or willingness of staff to report.	Presence of observer may influence staff performance (Hawthorne effect). Observer may fail to detect error. OVerestimates incidence of unprevented dispensing incidents (errors detected after medication has left the pharmacy).
Covert patients	Covert patient$ present legally valid prescription for dispensing at phannacy. Medicines dispensed to covert patient checked for accuracy by researcher.		[21]					Used to investigate incidence and typs of errors. Accurate estimate of incidence of errors. Does not rely on awareness or will oness of staff to report.	Expensive. Time-consuming. Selection of drugs prescribed on covert patients' prescriptions may influence generalizability of study :fmdings.
Case-note review	Trained reviewers screen patients' case notes to identify errors.					[58,63]		Used to investigates incidence and types of errors. Large amount of information on error.	Relies on documentation of error in patients• case notes. Time-consuming. Expensive. Dependent on reviewers' experience and ability to conduct adequate rev-iew.
Simulation	Dispensed medicines with artificially introduced errors checked by study participants and any errors detected on a form. Researchers double-checked the dispensed products and data-collection form to determine the accuracy of the study partici-pants at detecting dispensing errors.					[60,62]		Used in research and training to evaluate accuracy of pharmacy and nursing staff at detecting errors.	Artificial errors may not be representative of range of dispensing errors encountered in real-life practice. Working and environmental conditions imposed on study participants may not be consistent with real-life worldng conditions.
Surveys	Postal surveys sent to pharmacy staff to elucidate opinions on causes of dispensing errors.		[20,22, 23, 29]	[31]				Used to identify factors contributing to errors. Effectively collects data from large sample of pharmacy staff in short-time.	Low response rates. No follow-up of non-respondents. Responses highly subjective.
Interviews	Semi-structured interviews with pharmacy staff involved in error 24--48 hoJITS after error occurred.				[40,43]			Used to explore causes and circumstances surrounding error.	Relies on recall. Highly subjective. Staff may not fully divulge details of error.
Focus groups	Group discussions with phannacy staff.	[15]						Used to explore causes of errors and risk reduction strategies.	Does not address individual errors or trends.

Table 4 Definitions describing dispcnRing errors

Term	Definition	Identified research papers	
		Community phannacy	Hospital phannacy
Dispensing error	An error detected and repmted after the medication has left the phannacy.	[15,17]	[3,37,41]
	Any unintended deviation from an interpretable written prescription or medication order. Both content and labelling enors are included. Any unintentional deviation from professional or regulatory references or guidelines affecting dispensing procedures.	[19]	
	Any deviation from the physician's written prescription.	[21]	
	A discrepancy between the prescriber's interpretable written order and the filled prescription including written modifications made by the pharmacist pursuant to qontact with the prescriber or in compliance with phann'acy policy.	125]	
	En·ors that occur when distributing or selling prescription to patient's or patient's agents.	[27]	
	Discrepancy, between the prescriber's written order and the filled prescription.	[28]	
	Any inconsistencies or deviations from the prescription order such as dispensing the incorrect drug, dose, dosage fmm, wrong quantity; inappropriate, incorrect or inadequate labelling; confusing or inadequate directions for medication use; incorrect or inappropriate preparation, packaging or storage of medication prior to opening.	[29]	
	A deviation from the prescriber's orders, as received by fax or electronically and made by staff in the pharmacy, prior to releasing (dispatching) the dispensed prescription to the canier for delivery to a specific cost centre.	[30]	
	Errors in the dispensing process (e.g. wrong drug or dose strength; incorrectly labelled directions or drug dispensed to wrong patient) that are not detected and conected prior to the patient leaving the pharmacy, and which may lead to sub-optimal outcomes of treatment for the patient.	[31]	
	An enor in connection with dispensing the prescriptions at the community pharmacy. These will have reached the patients. Prescribed medicines were included.	[32]	
	Any variation from a perfect presentation including such minor en·ors as typographical mistakes.	[33]	
	An etror arising during the dispensing process, ignoring en·ors involving the pharmacist's clinical check. First, an error is dispensing the wrong medication; tlmt is the wrong drug, wrong form, the wrong strength or wrong dose, Second, a dispensing et1'or involves incomplete or improper labelling. Other dispensing en·ors do occur.		[39]
	A deviation from an interpretable written prescription or medication order, including written modifications made by a phannacist following contact with the prescriber or in compliance with pharmacy policy. Any deviation from professional or regulatory references, or guidelines affecting dispensing procedures.		[43,46]
	Categolized by the origins of the error; these included pharmacist's error in labelling (labelling en·or), pharmacist's en·or in filling medication bottles (content enors) or phmmacist's errors in completing the pre;;cription form (administrative error).		[50]
	One or more deviations from a physician's written medication order.		[59]
	Any event involving one or more deviations from an interpretable physician order, including written modifications made by the pharmacist pursuant to contact with the prescriber or in compliance with pharmacy policy.		[61]
	Any discrepancy between dispensed medications and physician orders or replenishment reports. Any deviation from standard pharmacy policies. Error		[65]
	caught by a pharmacist observer after verification by the pharmacist. Discrepancy		[66]
	between the written instmction found on the prescription order fom1 and the accomplishment of this instructon by the pharmacy when the drug was dispensed to the wards or hospital services.		[71]
Near-miss	Any error that was detected up to and including the point at which the medication was handed over to the patient or patient's Iepresentative.	[17]	
Extemal errors	Errors detected and reported after issue of medication.		[33,38]
h1temal errors	Errors detected within pharmacy before the dispensed item is issued.		[33,38,40]
Dispensing incidents	An enor which is detected prior to the item leaving the pharmacy and after the person dispensing the item has completed their part of the process.		[3]
Incidents	Enors detected outside the phat111acy department.		[34]
Unpreventec\ dispensing incidents	Unprevented patient safety incident detected after the medication has left the pharmacy, which could have or did lead to patient harm.		[44,47,72]
Prevented dispensing incidents	Enors identified before the medication has left the phannacy department.		[48,72]
Filling error	Error caught by a pharmacist during the verification step.		[66]

Table 5 Classification of dispensing error types in community pharmacy research

	Reference	[15]	[17]	[19]	[21]	[24]	[25]	[27]	[28]	[29]	[30]	[31]	[32]
	Counh)'	UK	UK	UK	US	US	US	US	US	US	US	Australia	Denmark
	Unprevented (D)/prevented (P) dispensing incident	U&P	U&P	U	U	U&P	U	U	U	U	U&P	U	U
Dtug/content error	Wrong drug dispensed	X	X	X	X	X	X	X	X	X	X	X	X
	Wrong strength dispensed	X	X	X	X	X	X	X	X	X	X	X	X
	Wrong form dispensed	X	X	X	X	X	X	X	X	X	X		X
	Wrong quantity dispensed	X	X	X	X	X	X	X		X			X
	Expired/deteriorated drug			X		X	X	X	X				
	Failure to supply drug	X	X	X		X	X						
Labelling error	Wrong drug name on label		X	X	X	X	X				X		
	Wrong strength on label		X	X	X	X	X				X		
	Wrong dosage form on label		X	X							X		
	Wrong directions/warnings on label	X	X	X	X	X	X	X	X	X	X	X	X
	Wrong patient name on label	X	X	X	X	X	X						
	Wrong quantity on label		X	X		X	X				X		
	Wrong ward/cost centre/prescriber				X	X	X						
	Completely wrong label on bottle	X	X										X
Issue error	Issued to wrong patient							X				X	X
	Incorrectly bagged	X											
Other errors			X	X	X	X	X		X	X			X

X denotes inclusion in reviewed research paper. Error types categorized as 'other' include wrong name on bag, wrong patient address on bag, extra item in bag, incorrect date on label, inconect pharmacy address on label, incorrect pharmacy name on label, incorrect prescription number on label, incorrect manufacturer, incorrect expiry date on label, drug dispensed in blister at wrong time, incorrect/inappropriate packaging/storage and incorrect delivery of medicines.

the majority (39%) of papers it was unclear whether the numerator referred to the number of etTor reports or the total number of mutually exclusive errors. The denominators were mostcmmnonly defined as the number of items dispensed (37%, *n* 17), prescriptions (25%, *n* 11) and doses (9%, *n* 4). Other denominators employed by research papers were number of observations (2%, *n* = 1), artificial errors (2%, *n* = 1), clinic orders (2%, *n* 1), medication lines (2%, *n* 1) and unintentional therapeutic exposures (2%, *n* = 1).

Dispensing errors in community pharmacy

Incidence in the UK

Four reviewed papers investigated the incidence of dispensing errors in UK community phannacies.r[14 15 17 9] All four of these papers repmted the incidence of unprevented dispensing incidents but only two papersrt[5,171] reported the incidence of prevented dispensing incidents. The incidences of prevented and unprevented dispensing incidents arc summm·ized in Table 7. Prevented dispensing incidents occurred at a rate of0.22--0.48%. In contrast, the rate of lmprevented dispensing incidents varied considerably from 0.04 to 3.32%. This wide variation in the rate of unprevented dispensing incidents can be attributed to differences in operational definitions (error definition, classification of error types and ermr rate) and research methods employed by the different papers (Tables 3-5 and 7). An observational study, conducted by Franklin and O'Grady,I[19] reported a considerably higher unprcvented dispensing incident rate (3.32%) than the other studies employing incident forms (0.04-0.99%)P[4,15,171] However, the data-collection procedure employed by Franklin and O'Gradyi[191] was inconsistent. In this study, previously dispensed items awattmg collection were double-checked by the observer at 11 pharmacies over 2 working days separated by a week. This was supplemented by real-time observation of the dispensing process (number of items observed ranged from 0 to 98) at seven pharmacies to ensure sufficient data were collectedY[91] This real-time observation may have influenced the behaviour of pharmacy staff. In addition, the paper does not specify whether any strategies were implemented to prevent the observer from double-checking items included in the previous data-collection period. Consequently, the validity, reliability and reproducibility of study findings are compromised.

Incidence in the US

Seven reviewed papers investigated the incidence of dispensing ermrs in US community phannacies.[21, 4- 2 28 30] Each of these papers reported the incidence of unprevented dispensing incidents but only one paperf[241] investigated the incidence of prevented dispensing incidents. The incidences of prevented and unprevented dispensing incidents are summarized in Table 7. The rate of prevented dispensing incidents was 1.28% but the rate of unprevented dispensing incidents ranged from 0.08 to 24%. Similar to research in UK community pharmacies, differences in operational definitions may have contributed to the wide-ranging rate of unprevented dispensing incidents.

A highly automated mail-service pham1acy was associated with the lowest rate of unprevented dispensing incidents (0.08%).l[26] Flynn and Barker[28] demonstrated that automation reduced the incidence of unprevented dispensing incidents at two community phatmacies (site 1: pre-automation = 2.7%,

Table 6 Classification of dispensing error types in hospital pharmacy research

	Reference	[>]	[33]	[34]	[35]	[37]	[39]	[41]	[42]	[43]	[44]	[47]	[48]	[49]	[50]	[52]	[54]	[56]	[57]	[58]	[59]	[60]	[61]	[63]	[64]	[65]	[70]	[71]
	Country	UK	UK	UK	UK	UK	UK	UK	UK	UK	UK	UK	UK	UK	US	US	US	US	US	US	US	US	US	US	US	US	Spain	Brazil
	Unprevented (U)/ prevented (P) incidents	U&P	U&P	p	p	u	u	u	p	U&P	u	u	p	u	u	u	u	u	u	u	u	u	u	u	u	U&P	u	u
Drug/content error	Wrong drug dispensed	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Wrong strength dispensed	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X		X	X	X	X
	Wrong dosage form dis-peosed	X	X	X			X		X	X	X	X	X		X	X	X	X			X	X	X			X	X	X
	Wrong quantity dispensed		X	X	X	X	X	X	X	X	X	X	X	X					X		X	X	X			X		X
	Expired/deteriorated drug	X					X		X	X	X	X	X	X					X							X		
	Failure to supply prescribed drug								X		X	X	X	X			X	X		X						X	X	X
Labelling error	Wrong drug name on label	X		X						X	X	X	X		X	X	X				X		X	X				
	Wrong strength on label	X		X						X	X	X	X		X	X	X				X		X					
	Wrong dosage form on label	X		X						X	X	X	X		X	X	X							X				
	Wrong directions/warnings on label	X		X	X	X	X	X	X	X	X	X	X		X	X	X			X	X		X	X				
	Wrong patient name on label	X		X			X			X	X	X	X		X	X	X				X		X		X			
	Wrong quantity on label			X						X	X	X	X		X	X	X				X		X					
	Wrong ward/cost centre/ prescriber	X		X							X	X	X		X	X					X		X		X			
	Completely wrong label on bottle	X									X	X	X															
Issue error	Issued to wrong patient										X	X		X													X	
	Incorrect bag label										X	X																
	Incorrectly bagged										X	X					X											
Other error		X	X	X			X		X	X	X	X	X	X	X		X	X			X		X	X		X		X

X denotes inclusion in reviewed research paper. Errors categorized as 'other' include typographical error, container error, incorrect date on label, pharmacy address missing/incorrect, documentation errors, absent{mcorrect controlled drug documentation, wrong/missing expiry date on label, issued to wrong ward, failure to relabel patient's own drug, oral syringe marked incorrectly, wrong calculation, extra medicine dispensed, drug continued past automatic stop, absent/incorrect prescription number, absent patient name, absent drug strength, absent drug quantity, directions changed inappropriately, neglect to clarify order, absent directions, no controlled drug stamp, no child-resistant closure, no phannacist initials, absent refill instructions, wrong dosage form in directions, patient name missing, charge code/lot number missing, patient address not recorded for controlled drug, request for non-child-resistant closure nosigned, drug supplied not ordered, wrong manufacturer/distributor, incorrect liquid dilution, incorrect capsule preparation, overdosage/underdosage, wrong signature, wrong order entry, reconstitution error, medicine prescribed without administration schedule, quantity, concentration and/or form dispensed.

Table 7 Incidence of dispensing errors in community pharmacy

Reference	[14]	[15]	[17]	[19]	[21]	[24]	[25]	[26]	[27]	[28]	[30]	[32]
Country	UK	UK	UK	UK	US	US	US	US	US	US	US	Denmark
ReSearch method	Incident form	Incident form	Incident form	Observation	Covert patients	Observation	Observation	Observation	Observation	Observation	Observation & incident forms	Incident forms
Setting	4 Pharmacies in Scotland	4 Pharmacies in England	35 UK phannacies	11 Phannacies in England	100 Pharmacies	Unclear	50 Pharmacies	1 Mail-service phannacy	18 Phannacies	2 Pharmacies	1 Mail-service pharmacy	40 Phannacies
Dispensing system	Manual[a]	Manual[2]	Manual[2]	Manual[a]	Manual[a]	Manual[2]	Manual[a]	Repackaging automated dispensing system	Manual[2]	Repackaging automated dispensing system	Manual[a]	Manual[a]
Unprevented (U)/ prevented (P) dispensing incidents	U	U&P	U&P	U	U	U&P	U	U	U	U	U	U
Definition for numerator	Unspecified	Total no. of mutually exclusive error type	Total no. of errors	Unspecified	No. of prescriptions containing one or more error type	Unspecified	Total no. of errors	Total no. of errors	Total no. of errors	No. of prescriptions containing one or more error type	No. of prescriptions containing one or more error type	Total no. of errors
Numerator	50	U 39 P 247	U 50 P 280	U 95	U 28	U 11 P 74	77	16	5	Site 1: pre-automation = 92, post-automation =58 Site 2: pre-automation =58, post-automation = 57	16	203
Definition for denominator	No. of prescriptions	No. of items dispensed	No. of items dispensed	No. of items dispensed	No. of prescriptions	No. of prescriptions	No. of prescriptions	No. of prescriptions	No. of observations	No. of prescriptions	No. of prescriptions	No. of prescriptions
Denominator	5004	51 357	!25 359	2859	100	5784	4481	21 252	950	Site 1: pre-automation = 3427, post-automation= 3241 Site 2: pre-automation = 3424, post-automation = 3028	3337	1 466 043
Incidence(%)	0.99%	U= 0.08% P = 0.48%	U= 0.04% P = 0.22%	3.32%	24%	U = 1.57% P = 1.28%	1.71%	0.08%	0.5%	Site 1: pre-automation = 2.7%, post-automation= 1.8% Site 2: pre-automation = 1.7%, post-automation = 1.9%	0.48%	0.01%

[a]Inadequate description of dispensing process or no reference to automated dispensing system in research paper, therefore the dispensing system was assumed to be manual.

Table 8 Incidence of dispensing errors in hospital pharmacy

Reference	[3}	[33]	[34]	[35]	[38]	[39]	[43]	[44]	[45]	[46]	[47]	[72]
Count:ty	UK	UK	UK	UK	UK	UK	UK	UK	UK	UK	UK	UK
R=rroh method	Forms	Forms	F •	F=	Fonru	Fonru	Forms	Forms	Forms	Observation	Forms	Fonru
Setting	l9NHS hospitals (teaching, district general, psychiatric)	5 NHS hospitals (teaching, district general, psychiatric)	1 NHS district general hospital	I NHS hospital	1 Acute NHS Trust	I NHS teaching hospital	I NHS teaching hospital	1 NHS teaching hospital	1 NHS teaching hospital	2 NHS hospitals	20 NHS hospitals (teaching, district general, psychiatric)	5 NHS hospitals
Dispensing system	Manuala	Manuala	Manuala	Manuala	Manuala	Manuala	Manuala	Manual and pharmacy-based original pack automated dispensing system	Pharmacy-based original pack automated dispensing system	Manual and pharmacy based original pack automated dispensing system	Manual dispensing (n = 17), pharmacy-based original pack dispensing system (n = 3)	Manual dispensing (n = 3), pharmacy-based original pack dispensing system (n = 2)
UniJ!t:vented (U)/prevented (P) dispensing incidents	u	u	p	p	U&P	u	U&P	u	p	p	u	U&P
Definition foe nwnerator	Total no. of ocro"	Total no. of ıııııııı	Total no. of ocrorn	Total no. of=	Total no. of errors	Total no. of errors	Total no. of errors	Total no. of errors reported containing one or more error types	Total no. of errors reported containing one or more error types	Total no. of errors	Total no. of errors reported containing one or more error types	Total no. of errors reported containing one or more error types
Numerator	181	21	180	352	Pre-intervention; U=52, P=35l, post-intervention: t) = 16, p = 359	Unspecified	u = 32 p = 130	Pre-automation = 42, post-automation = 32	89	Site I; pre-automation = 245, post-automation = 93 Site 2: pre-automation I = 118, pre-automation 2 = 99, post-automation = 46	915	u = 35 P=291
Definition for denominator	No. of items dispensed	No. of items dispensed	No. of items dispensed	No. of items dispensed	No. of items dispensed	No. of items dispensed	No. of items dispensed	No. of items dispensed	No. of items dispensed	No. of items dispensed	No. of items dispensed	No. of items dispensed
Denominator	I 002 095	Unknown	38 846	37 828	Pre-intervention: 332 501, post-intervention: 165 212	Unspecified	U = I94 584 p = 4849	Pre-automation= 391 467, post-automation = 429 911	3930	Site I: pre-automation = 9161, post-automation= 9289 Site 2: pre-automation I = 8250, pre-automation 2 = 8033, post-automation = 7894	5 564 969	22I 670
Incidence	0.02%	0.02%	0.4%	0.94%	Pre-intervention: u = 0.02%, P = 0.11%; post-interVention: u = 0.009%, p = 022%	0.02%	U=0.02% p = 2.7%	Pre-automation = 0.01% Pre-automation = 0.008%	2.26%	Site 1: pre-automation= 2.7%, post-automation = 1% Site 2: pre-automation 1 = 1.4%, pre-automation 2 = 1%, post-automation= 0.6%	0.02%	u = 0.02% p = 0.13%

Table 8 *(Continued)*

Reference	[49]	[50]	[51]	[52]	[53]	[54]	[55]	[56]	[57]	[59]	[60]
Country	US	US	US	US	US	US	US	US	US	US	US
Research method	Observation	Observation	Observation	Observation	Observation	Observation	Observation	Observation	Observation	Observation	Simulation
Setting	Satellite ph=nacy serving medical wards in teaching hospital	I Outpatient hospital pharmacy	Ambulatory care pharmacy	Outpatient pharmacy in general Army hospital	3 Minnesota hospitals	1 Teaching hospital	I Teaching hospital	3 Large hospitals	1 Teaching hospital	1 Hospital pharmacy	1 Teaching hospital
Dispensing system	Manuala	Manuala	Manuala	Marlllala	Manuala	Manuala	Manuala	Manuala	Manual and repackaging system	Manuala	Manual'
Unprevented (U)/ prevented (P) dispensing incidents	u	u	u	u	u	u	u	u	u	u	u
Definition for numerator	Total no. of errors	Total no. of errors	Unspecified	No. of prescriptions containing one or more error type	Unspecified	No. of pre-scriptions containing one or more error type	Total no. of errors	Total no. of errors	Total no. of errors	No. of pre-scriptions containing one or more error type	No. of artificial errors unde-tected
Numerator	Pharmacist = 45 Technician = 21	1165	Unspecified	369	Unspecified	1229	PharmaCist = 34 Technician = 10	Pharmacist = 107 Technician = 50	Manual= 34 Automated = 25	164	Pharmacists = I00 Nurses= 145
Definition for denominator	No. of doses	No. of pre-scriptions	Unspecified	No. of prescriptions	Unspecified	No. of pre-scriptions	No. of doses	No. of doses	No. of doses	No. of pre-scriptions	No. of artificial errors
Denominator	Pharmacist = 2420 Technician = 2403	9394	Unspecified	10 888	Unspecified	9846	Pharmacist= 3116 Technician = 7571	Pharmacist= 49 718 Technician= 55 470	Manual= 4029 Automated= 3813	5072	812
Incidence (%)	Pharmacist = 1.86% Technician = 0.87%	12.4%	Pharmacist = 5.17% Technician = 4.17%	3.39%	0.06%	12.5%	Pharmacist= 1.09% Technician = 0.13%	Pharmacist= 0.215% Technician = 0.09%	Manual= 0.84% Automated = 0.65%	3.23%	Pharmacists = 12% Nurses= 18%

(Continued)

Table 8 *(Continued)*

Reference	[61]	[62]	[63]	[65]	[66]	[67]	[68]	[69]	[70]	[71]
Country	US	US	US	US	US	Australia	Australia	Australia	Spain	Brazil
Research method	Observation	Simulation	Case-note review	Observation	Observation	Observation	Observation	Observation	Observation	Observation
Setting	1 Hospital	2 Tertiary care hospitals	Regional poisons control centre	1 Tertiary hospital -	Teaching hospital	1 Hospital	1 Hospital	1 Hospital	1 University hospital	1 Public hospital
Dispensing systems	Manuala	Manuala	No details	Manuala	Repackaging >y>I=	No details	No details	No details	Manuala	No details
Unprevented (U)/ prevented (P) dispensing incidents	u	u	u	U&P	u	u	u	u	u	u
Definition for nwnerator	No. of prescriptions containing one or more error type	No. of errors discovered by auditors	Total no. of errors	No. of doses with errors	Total no. of errors	Total no. of o=rn	Total no. of errors	Total no. of e=rn	Total no. of errors	No. of drugs with one or more =rn
Numerator	164	Pharmacists = 172 Technicians = 178	40	u''' 1059 p = 4016	Unspecified	Unspecified	Study period 1 := 1 Study period 2 = 2 Study period 3 = 3	0	20	345
Definition for denominator	No. of prescriptions	No. of doses	Unintentional therapeutic exposures	No. of doses	Clinic orders	No. of items dispensed	No. of items dispensed	No. of items dispensed	No. of medication lines	No. of prescriptions
Denominator	5072	Pharmacists = 35 829 Technicians:= 161 740	6450	140 755	Unspecified	Unspecified	Study period 1 = 84 Study period 2 = 520 Study period 3 = 360	24 174	2827	422
Incidence (%)	3.32%	Pharmacists = 0.48% Technicians = 0.11%	0.62%	u := 2.9% p = 0.75%	Pre-automation = 0% Post-automation = 1.2%	0.08%	Study period I = 0.4% Study period 2 = 0.4% Study period 3 = 0.8%	0	0.7%	81.8%

ainadequate description of dispensing process or no reference to automate.d dispensing system in research paper, therefore the dispensing system was assumed to be manual.

post-automation = 1.8%, P = 0.014; site 2: pre-automation= 1.7%, post-automation= 1.9%, P = 0.57). Therefore, the type of dispensing system employed by the community pharmacy may also have influenced the incidence of unprevented dispensing incidents.

The highest rate of unprevented dispensing incidents (24%) was determined using covert patients.[211] In this study, three covert patients presented a prescription for a single item (warfarin, carbamazepine or theophylline) at 100 randomly selected phannacies.[Ztl This paper may provide the most accurate measurement of the incidence of Unprevented dispensing incidents in US community pharmacies as the findings are not influenced by under-repmting or the Hawthorne effect. However, only a limited range of drugs at high risk of dispensing errors[73] were included in the study, and thus the findings may not be comparable with other studies.

Postal surveys of phannacists have also been used to estimate the extent of dispensing errors in US community pharrnacies.[20,22,23,29] Ukens[20] repmted that all retail pharmacists who responded to the survey (n = 359) were aware of making a dispensing error in the previous 3 years. In a further survey, 53% (n = 109) of retail pharmacists repmted maldng a dispensing error in the previous 60 days (mean = 2.5 errors in. previous 60 days).[221] In contrast, Bond and Raehl[231] reported that 34% (n = 793) of phmmacists surveyed perceived that at least one patient per week was at risk of a dispensing etror. However, there is no significant difference in the number of dispensing errors made per month by mass-merchant/supermarket pharmacists (2.7 en·ors), chain pharmacists (2.4 errors) and independent pharmacists (3.4 en·ors).[291]

Incidence in Australia

A postal survey of Tasmanian pharmacists revealed that 71% (n = 134) of respondents were aware of making an unprevented dispensing incident within the previous 6 months.[311] The median number of unprevented dispensing incidents made by the pharmacist was three (range 1-50). The majority of respondents (n = 171, 82%) perceived that tl1e risk of unprevented dispensing incidentwas increasing but only 47% (fz = 96) indicated that actual unprevented dispensing incidents were becoming more common.[311] However, the survey findings are highly subjective and may not truly reflect the incidence of unprevented dispensing incidents in practice.

Incidence in Denmark

The overall rate of unprevented dispensing incidents in 40 Danish pharmacies was 0.01% (Table 7).[321]

Error types in the UK

Five reviewed papers investigated the types of dispensing en·or in UK community pharmacies.[14,15,17–19] All five papers reported the types of unprevented dispensing incidents but two papers[15,17] also Tecorded the types of prevented dispensing incidents. The most common types of unprevented dispensing incidents repmted were supply of the wrong drug, strength and form, and printing the wrong directions on the label (Figure 3).[14,15 – 1 .17 19 The most common prevented dispensing incidents reported were suPtpof the wrong drug, strength, form and quantity (Table 9). [15· ?]

Error types in the US

Five reviewed papers investigated the types of dispensing error in US community pharmacies employing manual dispensing systems.[21,24,25,28,301] Flynn and colleagues[24] investigated the types of both unprevented and prevented dispensing incidents but combined the data to provide the main types of dispensing errors. These dispensing errors were predominant\/; labelling (58.24%) and drug/content errors (41.76%)[2 1 Four papers reported the types of unprevented dispensing incidents.[21,25,28,301] Unprevented dispensing incidents most commonly involved supply of the wrong strength, dosage form of medication and labelling medicines with the wrong directions (Figure 4).[21,25,28,30] Flynn and colleagues[281] compared the types of unprevented dispensing incidents reported at two pharmacies pre- and post-automation. In this study, automation reduced errors involving supply of the wrong dose (site 1: pre-automation= 8%, post-automation = 5%; site 2: pre-automation = 9%, post-automation = 5%) and wrong directions (site 1: pre-automation = 69%, post-automation = 64%; site 2: pre-automation= 74%, post-automation= 67%) (Figure 4).

Postal surveys of community pharmacists have also examined phannacists' views on the most common types of dispensing errors.[20,221] These surveys have identified that pharmacists perceive that supply of the wrong dosage (47%, n = 49) and wrong drug (36%, n = 38) are the most common dispensing errors in US community pharmacies.[20,22]

Error types in other countries

Reviewed papers detailing research undertaken in Australian[311 and Danish[321] community phm·macies did not identify the types of dispensing errors.

Dispensing errors in hospital pharmacy

Incidence in the UK

Fomteen reviewed papers investigated .the incidence of dispensing errors in UK hospital phannacies.[3,33–36,38,39,42-47,72] Six of these papers investigated unprevented dispensing incidents,[3,33,36,39,44,47] five papers investigated prevented dispensing incidents[34,35,42,45,46] and three papers investigated both mtprevented and prevented dispensing incidents.f3S.4J,?21 The incidence of unprevented dispensing incidents ranged from 0.008 to 0.02% (Table 8). In contrast, prevented dispensing incidents occm-red more frequentiy at a rate of 0.11-2.7% (Table 8). The wide range of error rates reported for unprevented and prevented dispensing incidents may be attributed to differences in research methods, operational definitions and dispensing systems (Tables 3, 4, 6 and 8).

Five papers involved hospitals with an automated dispensing system.[44–47,721] However, two ofthese papers weie multi-site studies and little information was piovided on the incidence of dispensing errors at the participating hospitals employing automated dispensing systems.[47,721] Adcdoye[145] repmted that an automated dispensing system was associated with a prevented dispensing incident rate of 2.26%. However, a

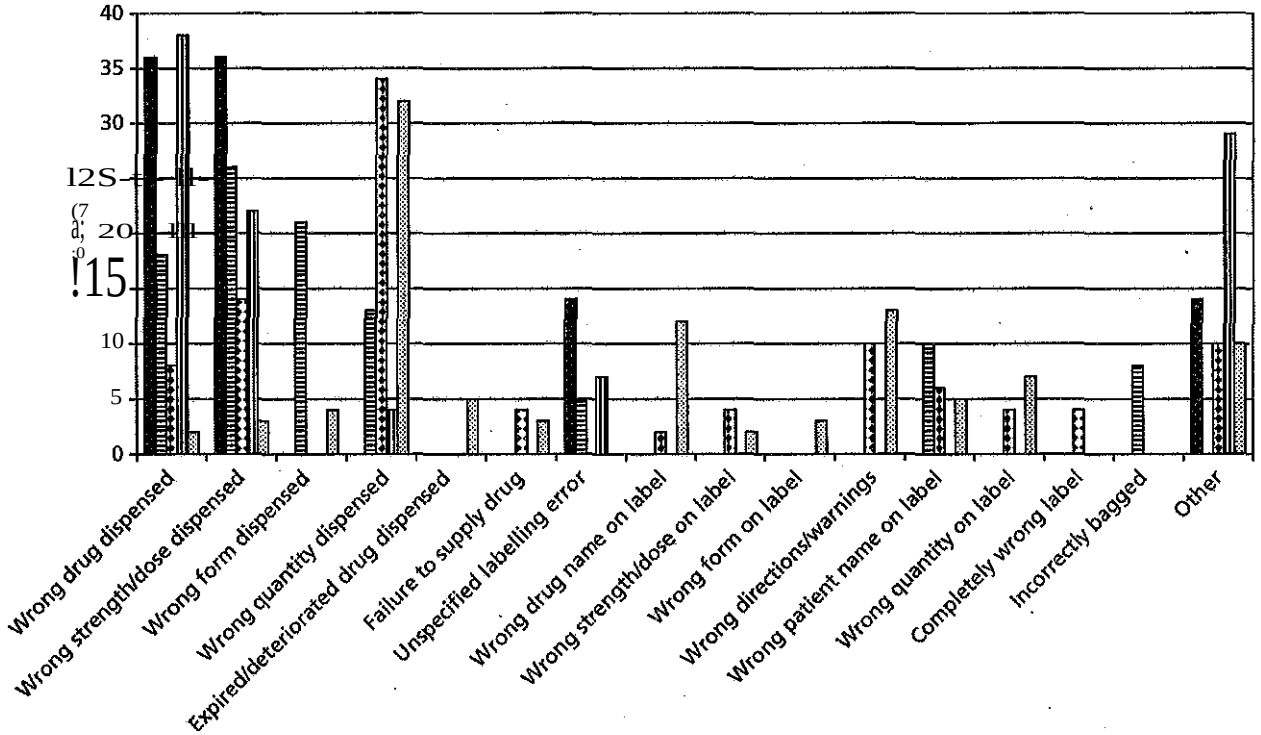

Figure 3 Most common types of unprevenlcd dispensing incidents reported by UK community phannacies With manual dispensing systems. Where (II) Kayne[141] (*n* = 50); (e) Chua[lSJ (*n* "" 39); Ashcroft[I?] (n = 50); (10) Mmpby[181] (*n* = 434); $]) Fl'anklinl[19]1 (*n* = 95).

Table 9 Most common prevented dispensing incidents occurring ilt UK community pharmacies

	Chua *et al.*[lSJ		Ashcroft *et al.*[171]	
	n	%	*n*	%
Wrong drug dispensed	48	19.4	98	35
Wrong strength dispensed	56	22.7	35	12.5
Wrong form dispensed	39	15.8	0	0
Wrong quantity di pensed	45	18.2	38	13,6
Failure to supply drug	0	0	3	LI
Labelling error	43	17.4	0	0
Wrong drug name on label	0	0	13	4.6
Wrong strength on label	0	0	23	8.2
Wrong directions/warnings on label	3	1.2	25	8.9
Wrong quantity on label	0	0	4	1.4
Wrong patient name on label	13	5.3	26	9.3
Completely wrong label	0	0	3	1.1
Other errors	0	0	12	4.3
Total	247	100	280	100

comprehensive study conducted pre- and post-automation at two London hospitals revealed that automation significantly reduced the incidence of prevented dispensing incidents (site 1: pre-automation= 2.7%, post-automation= 1%; site 2: pre-automation= 1.2%, post-automation= 0.6%).[461 This su,g-ports previous research by Fitzpatrick and colleagues[·21 which reported that automation reduced the incidence of prevented dispensing incidents by 16%. However, not all medication is suitable for dispensing from an automated dispensing system and it is unclear whether items dispensed manually in the post-automation period were included in the study.[S,42.46] James and colleagues[44] reported that automation reduced the incidence of unprevented dispensing incidents from O.ot% (pre-automation) to 0.008% (post-automation). Excluding manually dispensed items, the incidence of unprevented dispensing incidents had been reduced by 67%.[441 Slee and

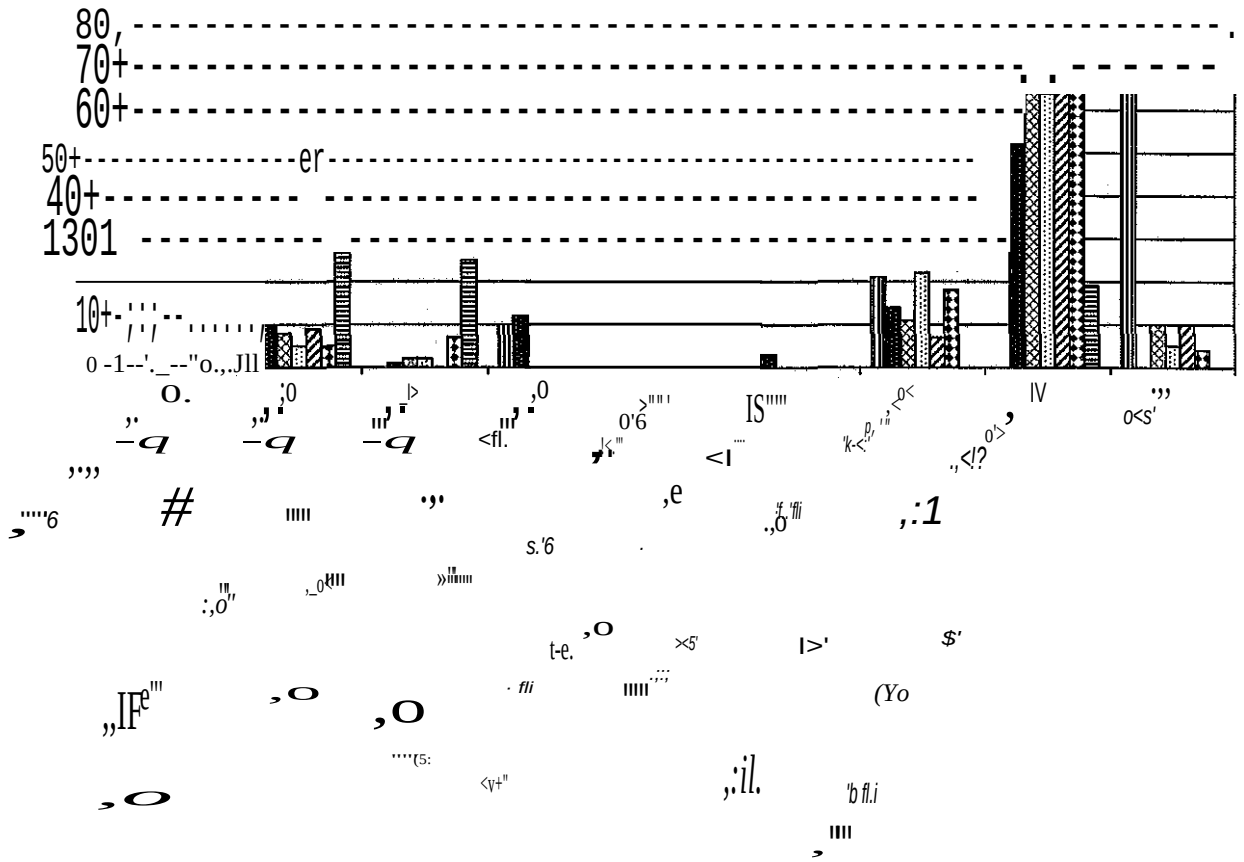

Figure 4 Most common types ofunprevented dispensing incidents reported by US community pharmacies with manua]l[21 25,28 30]l and automatedl[28]1 dispensing systems. Where (Ul) Allanl[211] (n := 100); (ED) Flynn[251] (n = 77); (m) FlynnE[28]1 site 1: pre-automation (n = 92); (IJ) Flynnl[28]l site 1: post-automation (n =58); (fa) Flynnl[28]! site 2: pre-automation (n =58); (Cll) F1ynd[28]1 site 2: post-automation (n =57); (13) VaradarajanPOJ (n = 16).

colleaguesl[361] also reported that automation reduced the rate of dispensing error by 40% but the op€rational definitions and research methods used in the study were not clearly defined.

Incidence in the US

Sixteen reviewed papers investigated the incidence of dispensing errors in US hospital pharmacies,L[49–57,59–63,65,66]l All of these papers reported the incidence of unprevented dispensing incidents but one paperr[651] also reported the incidence of prevented dispensing incidents. The incidence ofunprevented dispensing incidents ranged from 0.06 to 18% (Table 8). Prevented dispensing incidents occurred at a rate of 0.75% (Table 8).

In a study comparing the accmacy of phmmacists and nurses at checking dispensed items, nurses were found to have a significantly higher rate of unprevented dispensing incidents (nurses18%, phannacists12%; $P < 0.05$) (Table 8)t [60]1 In contrast, pharmacists were reported to have a higher unprevented dispensing incident rate than technicians.[49·51·55·56·621 However, these study findings may not be generalizable as the mtificial errors and conditions imposed on pharmacists, nurses and technicians may not be consistent with real life.

Two papers reported the incidence of unp_revented dispensing incidents pre- and post-automation at two US hospitals.[57·661 Klein and colleagues[571 reporte_d that an automated dispensing system reduced the incidence of unprevcnted dispensing incidents from 0.84 to *0.65%.* In contrast, Oswald 0.12%. However, it is unclear whether these research papers included manually dispensed items in the post-automation analysis of unprcvcnted dispensing incidents.[S?·66]1

Incidence in Australia

Three reviewed papers investigated the incidence of unprevented dispensing incidents in hospital phannacies.[67-()9]1 The repm1ed rate of unprevented dispensing incidents ranged from 0 to 1.6% (Table 8). However, the research methods and operational definitions utilized in these studies were ambiguous.

Incidence in Brazil

The single research paper investigating unprevented dispensing incidents in a Brazilian hospital identified that 82% (*n* = 345) of dispensed prescriptions contained at least one unprevented dispensing incident.[?lJ

Incidence in Spain

The rate of prevented dispensing incidents in a Spanish hospital was 0.7% (Table 8).1[70]1

Error types in the UK

Fourteen papers investigated the types of dispensing elTOr occmring in UK hospitalsP·[33–35,37,39,41–47,72]J Five papers investigated unprevented dispensing incidents,£[37,39,41,44,47]1 five papers explored prevented dispensing incident1Jl [34,35,42,45,46]1 and four papers researched both unprevented and prevented dispensing incidents[[3,33,43,72]1 The most common types of

and Caldwell[661 reported that automation increased the incidence of unprevented dispensing incidents from 0 to unprevented dispensing incidents in hospitals with both manual and automated dispensing systems were supplying the wrong

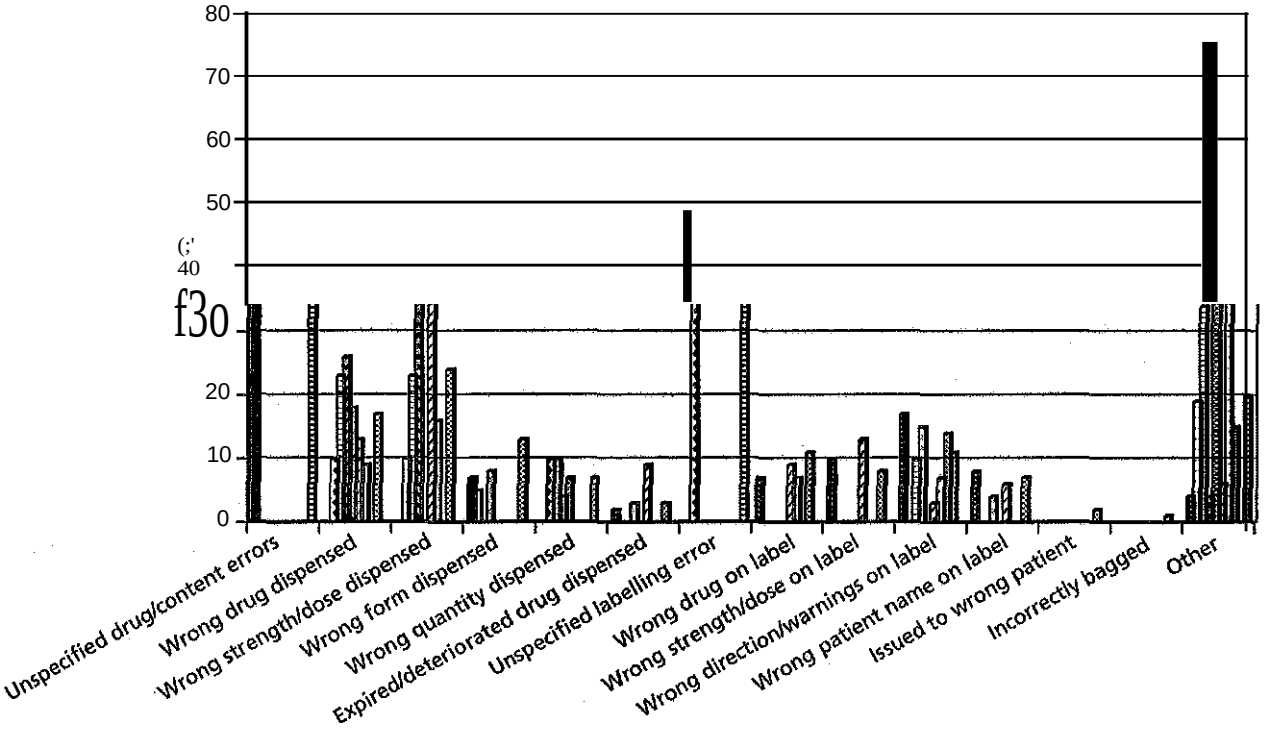

Figure 5 Most common types of unprevented dispensing incidents reported by UK hospital phannacies with manuaJ[33 33 37. 39 41.43.44.47.72] and automatcd[44.47.721] dispensing systems, Where **(B)** Spencer(JJ (*n* = 178); (EI) James[721] (11 = 35); (tl) Roberts[J?J (n = 7158); (1!!) James[441] post-automation (n = 14); (111) Robetts[411] (n = 2068); (21) Beso[431] (*n* = 32); (IJ) James[441] pre-automation (*n* = 42); **(Ill)** Bowerf 331 (n = 21); **(II)** James[471] (*n* ''' 1005); (ID) BarkcrL[391] (*n* = 208).

drug and strength (Figure 5).[3,33.:n,39.41,43.44.4?,?2J] In contrast, labelling medicines with the wrong directions, dispensing the wrong drug and strength were the most common prevented dispensing incidents in hospitals with manual and automated dispensing systems (Figure 6).[3,3,3-35.4.46.721]

Five papers investigated the impact of automation on the types of dispensing errors.[42.44--471] Three papers analysed prevented dispensing incidentsr[42. .4 J] and two papers examined unprevented dispensing incidents.[44.471] Adedoyel[451] repmted that the most common prevented dispensing incidents associated with an automated dispensing system were labelling errors (76%, *n*81) and drug/content errors (18%, *n*20). However, comparison of prevented dispensing incident types pre- and post-automation at two London hospitals revealed that automation significantly reduced drug/content errors (site 1: pre-automation= 1.1%, post-automation= 0.4%; site 2: pre-automation = 0.7%, post-automation = 0.2%) but had no marked effect on labelling errors (site 1, pre-automation: 1.5%, post-automation: 0.6%; site 2, pre-automation: 0.6%, post-automation: 0.4%).[461] This is consistent with another reviewed research paper which reported that automation decreased drug/content errors such as wrong drug (-22%), wrong sll'ength (*-46%*), wrong fotm (*-4%)* and quantity (-14%) but increased labelling errors with the wrong directions (+35%).[421] Similarly, analysis of unprevented dispensing incidents revealed that automation was frequently associated with labelling errors (37%, *n* = 10), combined drug and labelling errors (33%, *n* = 9) and drug/content errors (30%, *n* = 8).[471] However, James and colleagues[441] identified that automation significantly increased combined drug and labelling errors (pre-automation: 19%, *n* = 8; post-automation: 79%, *n* = 11). Thus, labelling errors are commonly associated with automated dispensing systems and can result in supply of the wrong drug.

Error types in the US

Nine papers investigated the tyges of di ensing errors occurring in US hospitals.[49 50 54 57 58 60 --6 1] All nine papers reported the types of unprevented dispensing incidents but one paper[651] also reported the types of prevented dispensing incidents, The most common unprevented dispensing incidents associated with both manual and automated dispensing systems were supply of the wrong drug, dosage form, strength and quantity, and rioting the wrong directions on the label (Figure 7).[49,50 52 54 7 58 63 651] TI1e most common prevented dispensing incidents were supply of the wrong quantity (62%, *n*2471), drug (II%, *n*451), strength (10%, *n*419) and dosage form (8%, *n*330).[6 SJ]

Error types in Australia

Reviewed papers detailing research undertaken in Australian hospitals did not identify the types of dispensing errors.[67 –691]

Error types in Brazil

The most common types of unprevented dispensing incidents reported by a Brazilian hospital were failing to supply a drug (57%, *n*412), dispensing the wrong strength (13%, *n*91),

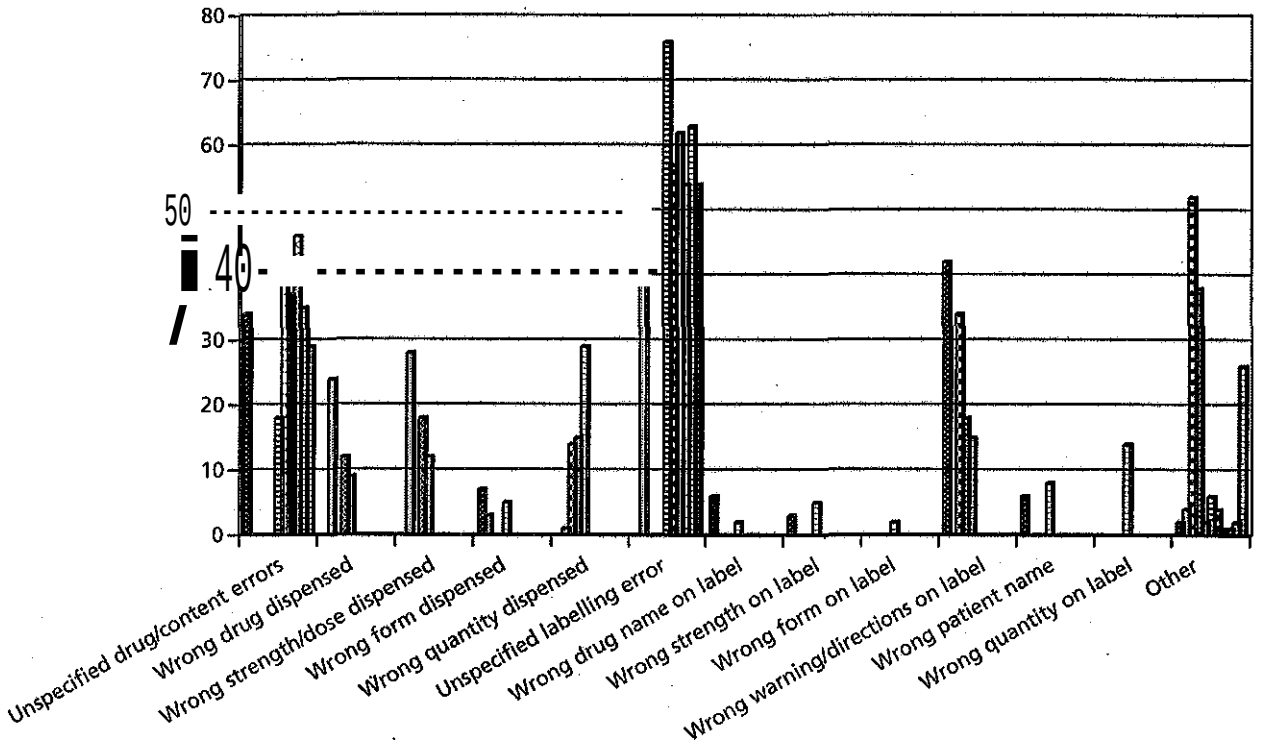

Figure 6 Mot common typeS of prevented dispensing incidents rep01ted by UK hospital phannacies with manual[3,JJ-JS,[43]A[6,72]] and automated[[45,46,72]] dispensing systems, Where **(JI)** SpenceP[1] (*n* = 1500); (I:1) Adedoyef[45]1 (*n* = 108); **(01)** Franklinf[461] site 1: pre-automation (*n* = 245); (21) Franklinr[461] site 2: pre-automation (*n* = 217); (CI) Franklin[4[61] site 2: post-automation (*n* =51); (IS) Bowerr[331] (*n* = 98); (III) Wu[1351] (n = 352); (I;I) Besol[43]1 (*n* = 130); **(tiD** Banningl[34]1 (n = 180); **(11)** Jamesl[721] (*n* = 291); (ID) Franklinf[46]1 site 1: post-automation (n = 93).

excessive dose (9%, *n* = 67), dispensing the wrong drug (3%, *n* = 25) and other errors (18%, *n* = 124).l7[1]l

Error types in Spain

The most common unprevcntcd dispensing incidents reported by a Spanish hospital were dmg omission (30%, *n* = 6), wrong patient (30%, *n* = 6), wrong dmg (15%, *n* = 3), wrong dosage form (15%, *n* = 3) and wrong close (10%, *n* = 2).l7°l

Causes of dispensing errors

TWeilty-thl'ee reviewed papers investigated the factors contributing to pharmacy disfcnsing errorsY&-[18,20,22,23,29-31,33,35,37,40.43,47,48,50,52,54,58,59,7] l Factors most commonly cited in the reviewed papers as contributing to dispensing errors were workload (n = 13), similar dmg names (n = 12), similar drug packaging (n = 9), staffing levels (n = 9), interruptions (n = 6) and puor handwriting (n = 6) (Table 10). However, research has shown that the number of prescdptions dispensed per hour (r'- = 0.285, $P < 0.001$), phmmacist job clissatisfaction (r'- = -0.422, $P < 0.001$) and pharmacy dispensary design are perceived by pharmacists to significantly increase the risk of dispensing errors,[[23,291]

Reason's human error theory was employed in three reviewed papers to understand the aetiology of prevented dispensing incidents in UK hospital pharmacies.l [40,43,48]1 Analysis of stafi interviewsf[40,43]1 and self-completed critical incident report formsl[48]1 revealed that prevented dispensing incidents were caused by a complex interweaving of active failures (slips, lapses and mistakes), latent conditions and error" producing conditions. Slips were identified as selecting the wrong drug or strength of medication, lapses involved forgetting to remove inappropriate cautionary labels during label generation, and mistakes involved assumptions that products were interchangeable, doses were the same as pmviously recorded in patient medication record and dis,gensing in accordance with labels rather than prescriptions.l40, [3,4BJ] *A* repmted violation involved the dis ensing of medication without reference to the prescription.l[41] Various error-producing conditions repmted as contributing to the dispensing incidents were _shift-patterns, lack of knowledge, hunger, illness, complex prescriptions and agitated patients. Latent conditions identified were lack of guidance on dealing with interruptions, poor labelling or packaging of medicines and unclear presentation of drug selection lists on computer software used to generate labels.f[40,43,4S] However, these studies involved the retmspective repmting of the causes of prevented dispensing incidents 24-48 h after the incident occurred. Consequently, the findings are highly subjective and may be biased by failme to divulge or recall details of incident.

Few studies have objectively measured the impact of contributory factors on dispensing errors in community and/or hospital pharmacy. Guernsey and colleaguesl[501] objectively measured the impact of dispensary workload on unprevented dispensing incidents in a US hospital outpatient pharmacy. They concluded that a linear relationship existed between the number of prescriptions dispensed and potentially serious

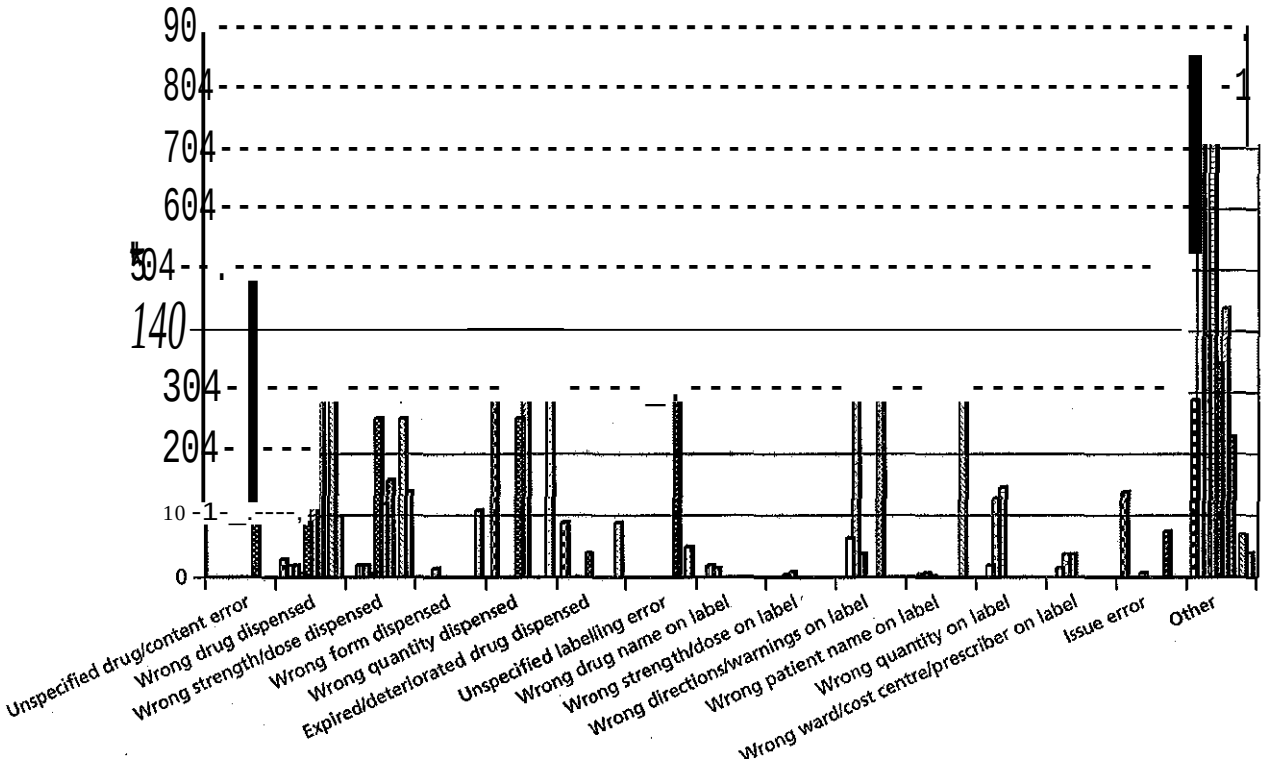

Figure 7 Most common types of unprevented dispensing incidents reported by US hospital pharmacies with manuatl[9,50,52,54,57,58,63–65] and automatedl[571] dispensing systems. Where (K;t) Becker[491] (n = 66); **(ltl)** Guernsey[SOJ (n = 1165); Buchanan[521] (n = 369); (C'il) Kistnerr[541] (n := 1371); **(Bl)** Klein£[571] pre-automation (*n* = 34); $,3) Klcin[571] post-automation (*n* = 25); (Ilil) Leape[SSJ (*n* = 38); (811) Seifertl[631] (n := 40); am Rolland[641] (*n* = 82); (1,81) Cina{GS] (n ''' 1059).

unprevented dispensing incidents (1 = 0.78, $P < 0.001$). In contrast, Kistner and co1lcaguesl[541] found. there was no correlation between the number of prescriptions dispensed per hour and the total number of unprevented dispensing incidents in a US hospital outpatient pharmacy. In both studies,[50,54] workload was measured according to the number of prescriptions dispensed per hour but this could be considereq a surrogate marker as it does not account for the number of staff in the dispensary at any given time. In addition, it is unclear in these studies whether the term prescription refers to a single prescribed item or single medication order with multiple prescribed items. The use of the term prescription to represent a single medication order with multiple prescribed items would lead to an inaccurate measurement of workload.

Buchanan and colleagues[521] investigated the impact that lighting had on the incidence of unprevented dispensing incidents in a high-volume US outpatient military pharmacy. In this study, the illumination level in the pharmacy was set at three different levels (45, 102 and 146 foot candles) and the unprevented dispensing incident rate was determined by observers double-checking dispensed items. The study found that overall the level of illumination had a significant effect on the incidence of unprevented dispensing incidents (F = 9.25, $P < 0.01$). There was little difference between the impact an illumination level of 45 and 102 foot candles on the unprevented dispensing incident rate of 3.8 and 3.9% respectively. However, an illumination level of 146 foot candles was associated with a significantly lower incidence of unprevented dispensing incidents (2.6%, F = 10.48, $P < 0.05$), The authors acknowledge that the observer's accuracy at detecting·unprevented dispensing incidents may also have been influenced by the lighting, so therefore it is possible the observer may have failed to detect some errors.[521] It is unclear from the paper whether the dispensary staff, prescription items dispensed and workload were the same during the different lighting periods. Consequently, it is uncertain whether the observed differences in error rate are due to the lighting or other working conditions, for example different staff, prescription items and workload.

Flynn and colleagues[59,611] investigated the impact of ambient sounds and interruptions on unprevented dispensing incidents in US hospital phannacies. Pharmacy staff involved in dispensing were videotaped .over a 23-day period and a study investigator petformed final accuracy checks on the dispensed medication. Details of unprevented dispensing incidents recorded by the investigators were compared with information on ambient noise, interruptions and distractions obtained by reviewing the videotapesf[59,611] **It** was found that unpredictable audible stimuli, controllable audible stimuli and noise were statistically associated with a lower incidence of unprevented dispensing incidents.[59] In contrast, intern1ptions and distractions per half hour were both significantly associated with unprevented dispensing incidents (interruptions, F = 8.22,

Table 10 Factors cited in research papers as contributing to dispensing errors

Contributory factor	Number of papers cited
Workload	13
Similar drug names	12
Similar packaging	9
Staffing levels	9
Poor handwriting	6
Interruptions/distractions	6
Design of dispensary	5
Staff inexperience	5
Atnbiguous directions	3
Failure to check	3
Lack of procedures	3
Job dissatisfaction	3
Poor communication	3
Computer software	3
Noise	3
Proximity of drugs on shelves	2
No breaks	2
Failure to follow: standard Operating procedures	2
Hunger	2
Fatigue	2
Stress	2
Lack of training	2
Lack of concentration	2
Lighting	2
Lone worker	2
Complex prescription	2
Lack of knowledge	2

Factors cited once were misread prescription, medicine-stored in wrong place, typing, incorrect drug selected on computer screen, usc of previous drug/dose on patient medication record, swapping of labels, tablet counting error, confusing label, staff inflexibility, lack of space, inadequate support/supervision, delivery problems, pre-typed prescriptions, large number of dmgs prescribed, parenteral chugs, lack of time for counselling, lack of privacy, assistants, non-professional activities, original-repeat, regulatory requirements, generic drugs, technical resources, staff skill mix, shift patterns, pressure to dispense quickly and lack of responsibility.

*P*0.004; disn·actions, *P*6.28,PO.oJ2).r [611] These studies had a number of limitations; notably, data on ambient sounds, interruptions and distractions were missed when videotapes were changed.[59,611] In addition, the authors acknowledge that the observers' accuracy at detecting unprevented dispensing incidents was not verified.[59,611] Consequently, these studies' may underestimate the occurrence of sounds, interruptions, distractions and unprevented dispensing incidents but provide the only objective measurement of these factors on unprevented dispensing incident rate.

Discussion

Dispensing medication is inherently risky and this review reveals that dispensing e11·ors are inevitable -occurrences in community and hospital pharmacies across the world. This review identified 60 papers investigatii1g the incidence, type and/or causes of dispensing errors in community and hospital pharmacy. The overall incidence of dispensing errors varied greatly depending on the type of dispensing enor (unprevented or prevented dispensing incident), research method and the dispensing error rate definition (Tables 7 and 8). In general, prevented dispensing incidents occurred more frequently than unprevented dispensing incidents. The most common types of unprevented and prevented dispensing incidents were supply of the wrong drug, strength, form and quantity, and labelling medication with the incorrect directions. Factors subjectively rep01ted by pharmacy staff as contributing to dispensing errors were workload, staffing, look-alike sound-alike drugs, interchanging formulations and computer selection errors resulting from unclear presentation of drug-selection lists on computer software. Studies einploying objective measurements demonstrated that high workload, intenuptions, distractions and inadequate lighting increased the incidence of unprevented dispensing incidents. However, comparison of study findings was difficult due to differences in study setting, operational definitions and research method.

This is the most comprehensive review of the literature on dispensing errors. This extensive literature review has attempted to identify publications on dispensing errors which fulfil the inclusion criteria and are available' via a selection of electronic bibliographic databases. However, it is inevitable that individual community and hospital phannacies will have undertaken their own audits or investigation of dispensing errors to meet the needs of clinical governD.nce. These small-scale studies may not have been published in peer-reviewed journals cited in the searched bibliographic databases. Consequently, the review findings may be subject to publication bias.

This review examined published dispensing error research undertaken across the world. The majority of reviewed papers originated from the UK and US but some Australian, Spanish and Brazilian studies were identified. Cousinsl[741] has reported that dispensing systems vary greatly across the world. In US hospitals, inpatients are often supplied unit doses of medication labelled witl1 the physician's directions, whereas in European countries patients· are supplied a manufacturer's original pack of medication without a dispensing label.[741] In general few of the reviewed papers adequately described the dispensing systems at participating pharmacies. Consequently, comparison of the reviewed papers was problematic as the study may not be generalizable to other countries or pharmacy settings.

This review identified a multitude of terms and definitions used to define a dispensing error and classify error types. To date, Franklin and O'Grady[19] have developed the most comprehensive m1d -valid definition for a dispensing error. However, this definitiOn is not exhaustive. The definition restricts dispensing errors to those 'unintended deviations from an interpretable prescription•.U[91] Nevertheless, research employing Reason's human error theory has shown that dispensing errors arise due to intended actions (mistakes and violations) and unintended actions (slips- and Iapses).l[40,43,48,75] Therefore, application of this definition would result in exclusion of dispensing errors stemming from violationS. In addition, the definition specifies that 'both content and labelling errors are included'[191] but does not

acknowledge errors in the issue of medication to patients. Issue errors have the potential to be serious if a patient inadvertently takes another's medication and are included in other research papers and the Royal Pharmaceutical Society of Great Britain's dispensing error audit criteria.[17.4.4.7 .4 9 76] Simihir to other. research papers,[125.43,4.6,61.65] 'deviations from...guidclines affecting dispensing procedures'[191] or standard operating procedures (SOPs) were included as dispensing errors. This may be problematic in multi-site studies, where the SOPs may vary. Therefore, data collected on errors may not be consistent across- sites unless explicit information is provided on the content of the SOPs. Furthermore, the definition does not distinguish between errors detected within and outside the pharmacy.

To facilitate data collection, a standardized definition for a dispensing error, distinguishing between unprevented and prevented dispensing incidents, and classification system for error types would be desirable. In 2004, the UK NPSA dev loped a standardized system for classifying patient safety information according to incident types and harmY [1] However, the UK NPSA patient safety taxonomy for unprevented and prevented patient safety incidents was only adopted by four of the reviewed UK papers undertaken after 2004.[44.47.48.72] The World Health Organization is currently developing global patient safety taxonomyP[7.781] Therefore! it is anticipated that the World Health Organization taxonomy will facilitate consistent data collection, sharing of patient safety information and the development of global solutions.

There was great variation in the dispensing-error rate definitions employed by the reviewed papers. Consequently! it was difficult to compare and estimate the overall incidence of dispensing etrors (unprevented and/or prevented dispensing incidents) in community and hospital pharmacy. Allan and Barkerl[131] recommend that enor rates should be calculated as 'the number of actual errors (incorrect in one or more ways) divided by the total opportunities for error. This figure is then multiplied by 100 to arrive at a percentage'. Dispensing error researchers could adopt this standard definition for calculating dispensing error rates. However, the 'total opportunities for error' needs to be explicitly defined to ensure accurate calculation of dispensing error rates and aiding the comparison of studies.

Numerous research methods were employed by the reviewed research papers to evaluate the incidence, type and causes of dispensing errors (Table 3). Self-completed incident forms and observation were the most common methods employed to investigate the incidence and type of dispensing errors in community and hospital pharmacy, In a study comparing the efficiency of observation and incident reports at detecting dispensing errors, observation was found to detect significantly more dispensing errors than incident reports.[301] However, observation has a number of limitations, notably the influence of the observer on the behaviour of the pharmacy staff (Hawthorne effect). Barkerl7[9] suggests that the subjects of an observational study will revert to normal behaviour within 1-3 h. In contrast, Savage[SOJ suggests that habituation may take longer to develop. Therefore, the Hawthorne effect must be taken into consideration when employing observation to investigate dispensing errors. In addition, observational studies may overestimate the incidence of unprevented dispensing incidents as errors detected by the observer are logged and rectified before patient counselling. Thus, errors which may have been detected dudng patient counselling before issue to the patient (prevented dispensing incidents) would be classified as unprevented dispensing incidents in an observational study. Furthermore, the reviewed observational studies failed to validate the accuracy of the observer at detecting dispensing errors. The expense and time taken to conduct an observational study limit its use as a routine quality-assurance or risk-management procedure. In contrast, incident forms are low in cost and can be used routinely to monitor dispensing errors within community and hospital phannacy. Also, the use of anonymous incident forms and the establishment of a non-punitive culture could improve reporting.[3]

The majority of reviewed papers investigating the causes of dispensing errors relied on the subjective reporting of perceived contributory factors by pharmacy staff in interviews and on incident forms. Consequently, the validity of contributory factors is questionable. High workload, interruptions, distractions and inadequate lighting have been objectively shown to increase the incidence of dispensing errors in hospital phannacy.[SO,s4.59.611] However, two studies employed a surrogate marker (number of prescriptions dispensed per hour) to measure workload.[50.541] Further work is needed to objectively measure the impact of other proposed contributory factors, for example staffing levels, on dispensing errors.

Conclusions

Dispensing errors arc a major concern for the· pharmacy profession. To date extensive research has been undertaken to investigate the incidence, type and causes of dispensing errors. This review has revealed that dispensing errors occurred in community and hospital pharmacy and most commonly involved supply of the wrong drug, strength and form of medication. High workload, interruptions and inadequate lighting were both subjectively and objectively reported as conb·ibuting to dispensing errors. However, comparison ofthe reviewed papers was confounded by differences in study setting, research method and operational definitions f{)]' dispensing errors, error rate and classification of error types. A standardized, global taxonomy for dispensing errors and types is essential to facilitate consistent data collection. Future studies evaluating dispensing errors should clearly describe the phannacy dispensing system, research methods and operational definitions. This will facilitate comparison of research studies, and assist the global sharing of information and the development of errorMreduction strategies, thereby enhancing the quality and safety of patient care.

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Conflict of interest

The Author(s) declare(s) that they have no conflicts of interest to disclose.

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Unprevented or prevented dispensing incidents: which outcome to use in dispensing error research?

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Author information

Abstract

OBJECTIVES:

To compare the rate, error type, causes and clinical significance of unprevented and prevented dispensing incidents reported by Welsh National Health Service (NHS) hospital pharmacies.

METHODS:

Details of all unprevented and prevented dispensing incidents occurring over 3 months (September-December 2005) at five district general hospitals across Wales were reported and analysed using a validated method. Rates of unprevented and prevented dispensing incidents were compared using Mann-Whitney U test. Reported error types, contributory factors and clinical significance of unprevented and prevented incidents were compared using Fisher's exact test.

KEY FINDINGS:

Thirty-five unprevented and 291 prevented dispensing incidents were reported amongst 221,670 items. The rate of unprevented (16/100,000 items) and prevented dispensing incidents (131/100,000 items; $P = 0.04$) was significantly different. There was a significant difference in the proportions of prevented and unprevented dispensing incidents involving the wrong directions/warnings on the label (prevented, $n = 100$, 29%; unprevented, $n = 4$, 10%; $P = 0.02$) and the wrong drug details on the label (prevented, $n = 15$, 4%; unprevented, $n = 6$, 14%; $P = 0.01$). There was a significant difference in the proportions of prevented and unprevented dispensing incidents involving supply of the wrong strength (prevented, $n = 46$, 14%; unprevented, $n = 2$, 5%; $P = 0.02$) and issue of expired medicines (prevented, $n = 3$, 1%; unprevented, $n = 5$, 12%; $P = 0.002$).

CONCLUSION:

The use of prevented dispensing incidents as a surrogate marker for unprevented incidents is questionable. There were significant differences between unprevented and prevented dispensing incidents in terms of rate and error types. This is consistent with the medication error iceberg. Care must be exercised when extrapolating prevented dispensing incident data on error types to unprevented dispensing incidents.

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Invited Review

Workload in community pharmacies in the UK and its impact on patient safety and pharmacists' well-being: a review of the evidence

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What is known about this topic

- Anecdotal evidence suggests that community pharmacist's workload is increasing.
- It is suggested their heavy workload causes ham1 to patients.
- Heavy workload is also thought to be affecting pharmacist's well-being.

What this paper adds

- Community pharmacist's workload has increased since the introduction of their new contract.
- What constitutes too much work is ill-defined.
- Evidence indicates that pharmacists are feeling stressed due to the volume of work.
- No robust evidence is available to confirm heavy workload is directly hamung patients.
- Clarity about how much work is too much, and studies examining associations between workload and other work place factors, such as the availability of support staff, are recommended.

Abstract

New contractual frameworks for community pharmacy are believed to have increased workload for pharmacists; too much work has been implicated in hlgh profile cases of dispensing errors leading to patient harm, and concerns about pharmacists' well-being. A review was undertaken to ascertain whether commu nity pharmacists' workload has increased and whether links between workload and patient safety and pharmacists' well-being have been established. We searched Scopus; EMBASE; MEDLINE; PubMed; CINAHL; PsychlNFO; ASSIA; E-pic, and Interna tional Pharmaceutical Abstracts for research published between 1989 and 2010 containing data on UK community pharmacy workload, and on its consequences when workload was found to be a determinant of either patient or pharmacist outcomes. Researchers assessed retrieved material against inclusion and exclusion criteria and synthesised findings using a data extraction form. Fifteen studies were retrieved that met the inclusion criteria. A number of methodological weaknesses were identified: studies categorised work tasks and workload differently making comparisons over time or between studies difficult; most studies were small scale or conducted in specific localities, or lacked sufficient methodological information to rule out bias; studies that control for possible confou nders are rare. The reviewed resea rch suggests that community pharmacists still spend the majority of their time involved in activities associated with the dispensing of prescriptions. There is some evid ence that comm unity phar macists' workload has increased since the introduction of the new contracts in England and Wales, especially around the core activity of dispensing prescriptions and medicines use reviews. There is also some evidence to suggest a link between heavy workload and aspects of pharmacists' well-being but there is no robust evidence indicating threats to patient safety caused by their having too much work to do. More high quality resea rch is required to examine what constitutes too much work, the impact of high workload , and associations with other work place factors.

Keywords: community pharmacy, GB, patient safety, pharmacist, well-being, workload

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Introduction

While primary care providers include general practitioners, nurses, therapists, pharmacists, optometrists, dentists, and midwives, pharmacists are arguably one of the least visible of these professions as far as their contribution to patient care is concerned. This is largely because their consumerist image as a profession that sells and dispenses medicines largely dominates (Varnish 1998). However, following a period of re-professionalisation in pharmacy over the last 30 years (Birenbaum 1982, The Nuffield Foundation, 1986, Edmunds & Calnan 2001), and the large scale reform to U1e National Health Service (NHS) in ti1e last decade (Department of Health, 2000) the number of services provided by pharmacists has gradually expanded (Department of Health, 2003).

The reform culminated in new national contractual frameworks for community pharmacy in Great Brit:lin (GB). They differ somewhat between linglmd and Wales, and Scotland, where they were introduced on 1 April 2005 and 1 April2006 respectively. However, they are ostensibly aimed at reimbursing pharmacists for their professional clinical roles rather than for their technical supply role. So while dispensing remains a core activity, (an 'essential' or 'core' service under the new contracts), other nationally contracted, as well as locally co)nmissioned services, (see Tables la,b), are key to pharmaci'?t's work Roles for pharmacists now include prescribing, (Deparhnent of Healfu, 1999) hnproving medication safety (Department of Healfu, 2001), and public health and consultant pharmacist roles (Department of Health, 2003). Many services provided by them, such as smoking cessation, prescribing advice to general practitioners (GPs), the provision of emergency hormonal contraception, and minor ailments advice, are now well embedded wifuin phannacy and the NHS more generally. Indeed community pharmacies, privately owned as they are, are a nice illustration of government healthcare strategy

Table 1 (a) Services delivered under the three tiers of the new community pha1111acy contractual framework for England and Wales. (b) Services delivered under the new community pharmacy contract in Scotland

(a)		
Tier one: Essential services	Dispensing of medicines Repeat dispensing Waste management (disposal of unwanted medicines) Public health Slgnpostlng service Support for self-care Clinical governance	Offered by all pharmacy contractors
Tier two: Advanced services	Medicines Use Review (MUR) & prescription Intervention service Appliance Use Review (AUR) service Stoma Appliance Customisation (SAC) service	Optional Pharmacists need to meet accreditation requirements
Tier three: Enhanced services	Including: Supervised administration (consumpiion of prescribed medicines) Needle & syringe exchange Stop smoking Care home (support and advice on storage, supply and administration of drugs and appliances) Medicines assessment & Compliance support Medication review (full clinical review) Minor Ailment Service Out-of-hoUIIS (access to medicines) SUpplementary prescribing by pharmacists Emergency hormonal contraception Seasonal influenza vaccination Pallengroup directions Chlamydia screening & treatment NHS Health Check (Vascular risk assessment and management service) [further services can be developed, depending on identified local need]	Optional Pharmacist need to meet accreditation requirements Locally commissioned by PCOs In response to needs of local population

Source: http://www.psnc.org.uk/pages/introduction.html.

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(b)		
Core services	Acute Medication Service (AMS) Minor Ailment Service (MAS) Chronic Medication Service (CMS) Public Health Service (PHS)	Offered by all pharmacy contractors
Additional seiVices	E.g. Oxygen supply Harm reduction seiVices Care home seiVices Out of-hours services Waste collection	Locally commissioned but service specWioation and payment tariff negotiated nationally

Sources: http://www.pharmj.com/pd!lcontract/pL20051119_scottlshcontract01.pdf, http://www.communltypharmacy.scot.nhs.uk/Index.html.

which, under the slogan of promoting 1pore choice for patients, has sought to encourage the movement of private sector healthcare providers into a systen1 where the public provision of health-care predominates.

Government data collected for reimbursement purposes highlights the extent to which pharmacists' workload has grown. In the last 10 years community pharmacy dispensing volume in England and Wales has increased from 511.6 million items in 1998--1999, to 785.4 million in 2007, a 54% increase over the period (Information Centre, 2008a,b). Scotland has experienced a 23% increase in a similar time period (lnforJik'ltion Services Division, 2010). Currently, an average 5931 prescription items in England and Wales are dispensed per pharmacy per month. Since the new contract there is also a clear upward trend in tl1e number of enhanced services being provided in cormnunity pharmacies in England and Wales: from 17 745 in 2005-2006 to 25 229 in 2007-2008 (Information Centre, 2006, 2008a). The most dramatic increase though is in the number of medicines use reviews (MUR,) being conducted: from jtiSt 148 195 in 2005-2006 to 1 021 161 in 2007-2008, a 589% increase in the time period. The number of registered pharmacists grows by approximately 2% eacil year so it would appear that growth in service provision outweighs increases in the supply of pharmacists (Seston & Hassell 2010).

With the expansion of pharmacists' roles has come growing concern that their workload is now too demanding and tl1at workload pressures are affecting pharmacists' well-being, and the quality of care being delivered to patients (Murphy 2006, Koziol2008), in particular that there is a problem with delivering services safely (Anon, 2001a,b, 2003, Gartside 2005, Watson 2008). A recent high profile case in which a locum pharmacist received a suspended sentence for making a dispensing error, after working a 10-hour shift without a break, brought this debate into sharp foCtiS (Anon, 2009). Other anecdot.:1.l evidence suggests that MURs are also a source of discontent: company pressure to reach targets, and MURs supposedly being performed regardless of whether they are clinically appropriate, suggest compromises on quality are being made (Gilpin 2008, Jukes 2008).

It is well established, in healthcare organisations and more widely, that aspects of the working environment, in particular, heavy workload, lack of control over work and poor support from managers (Michie & Williams 2003), can have a detrimental impact on employees' well-being, whim in tmn has been shown to affect organisational performance (Donald *et al.* 2005) and the quality of patient care (Micilie & West 2004). Given that medication and dispensing errors can be so deleterious for patients, and given that questions concerning the quality and safety of patient care, in particular when that care is being delivered by private sector organisations, (Timmins 2005), remain unanswered, it seems timely to examine whether the growing expressions of concern about care provided through community pharmacies are justified.

This paper reviews published research on workload in *tlw* community pharmacy setting in the UK. The main objectives of the review were to ascertain whether workload has increased during the last 20 years, and to examine whether a link between workload and patient safely and pharmacists' well-being has beeo established or not. The focus is to examine whether the volume of work affects adverse events such as dispensing errors, or workforce outcomes such as job satisfaction, and to examine what, if any, relationships have been demonstrated between workload, its impact and organisational setting.

Methodology

This review is a synthesis of the research evidence on pharmacy workload. While it is not a systematic review we have nevertheless adhered to the principles of

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conducting a systematic review, by limiting bias in identification and inclusion of relevant articles and setting out in detail the methods we employed (Pettigrew & Roberts 2006).

Search strategy

Searches of a wide selection of electronic databases (Scopus; Embase; Medline; PubMed; Cinahl; Psychinfo; ASSIA; E-pic [Royal Pharmaceutical Society of Great Brlt.:'lin online search engh1e], and International Pharmaceutical Abstracts) were first undertaken between July and September 2008, and again in September 2010 1D capture material published in 2009. Manual searches of key pharmacy journals (e.g. *Research in Social and Administrative Pltannacy; Intemational Journal of Pharmacy Practice)* were undertaken in January 2011 to ensure retrieval of any relevant material published in 2010. Authors have highlighted the difficulties of defining standard search terms when reviewh1g material on workload (Cannel & Rowan 2001, Pronovost *et al.* 2002). Other researchers conducting similar reviews have subsequently used diverse search terms and strategies to ensure as wide and as complete coverage of relevant material as possible (West *et al.* 2009). We have followed this approach in tmdertaking Ulis review. So in addition to using the search terms below, we also used the Lrelated articles' feature in the electronic databases that provide this. Grey literature (such as professional jomnals, reports from profeSsional organisations) was also searched, bibliographies of retrieved articles were scanned for any relevant material not tmcovered using electronic databases, and manual searcl1es of the contents page of selected pharmacy journals were undertaken. No quality criterion was used to lhnit shtdy selection, thus we did not limit the search by study type, methodology or size.

Keywords and search terms used in electronic databases

Setting terms	Pharmacy, community, retail, UK (I.e. England, Scotland, Wales, Northern Ireland)
Workload terms	Workload, work measurement, work intensification; work conditions, work pattern, work activity, dispensing load, dispensing volume, threshold, staffing level, size, number, pharmacy services, new contract, overload
Workforce terms	Pharmacist, pharmaceutical staff; pharmacy staff
(Workload) outcomes	Errors, mistakes, adverse events, patient safety, (job) satisfaction, well·belng, stress, pressure

A set of inclusion and exclusion criteria was developed for the review (below). Some were kept wide to enstll'e all studies of relevance to the overall subject matter of the review were captured (e.g. study design), others were intentionally more specific (e.g. service setting, country of origin, date, and type of publication), to help contain its scope. For example, studies in non-community pharmacy settings (i.e. phannacies in hospitals or outpatient services) in the UK, and studies from USA and elsewhere were excluded, because these settings are so different from community pharmacies in the UK that they warrant separate reviews. The time period 1989--2010 was chosen to ensure the review would be as up to date as possible and have contemporary relevance given the significant changes in health-care and pharmacy that have occurred in the past two decades. Studies were included if they only measured workload, i.e. without exploring any of the worldoad outcomes identified above, but shtdies that examined the specified outcomes without exploring their relationship to workload were excluded. This focus was important because studies were found that examined certair\ outcomes (e.g. job satisfaction), without measuring workload as a possible antecedent.

Inclusion and exclusion criteria applied in selecting papers

Inclusion criteria: *(all* met for each study)	
Setting	Community phannacy
Location	UK
Design/ study type	Any empirical study
Publication type	Peer reviewed journal papers only
Publication date	1989-2010
Focus of study	Studies must address any aspect of workload and/or its impact
Exclusion criteria: *(any* met for excluded studies)	
Setting	Hospital pharmacy; health centre or outpatient pharmacy
Location	If outside UK
Design!study type	Non-empirical work;. methodological papers
Publication type	letters; non-peer reviewed articles/reports; conference. abstracts
Focus of study	Studies which only address the outcomes (without exploring relationships to workload)

Criteria were applied in two stages. First, the title and abstract were examined. If all inclusion criteria were met or if there was insufficient information 1D apply the criteria, the full article was retrieved. The criteria were applied a second time on reading the full article. RelTieved articles and reports were stored in Reference Manager and after duplicates were removed articles

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were sequentially allocated and shared between the authors for data extraction.

A data exh·action table, using a Microsoft Access· database, was designed to ensure that relevant information about each publication was captured and recorded. Each paper was read and the following data extracted:

(1) Country of origin
(2) Methodology (e.g. design, sample, study site/location)
(3) Focus of study
(4) Aspect of workload measured/described
(5) Outcome of workload measured/described
(6) Main findings
(7) Study quality issues (e.g. rigour)

Synthesis and reporting

The review of the papers begins with a brief overview of the methods and study quality. It was not possible to appraise the quality of all the studies systematically because of the heterogeneity of the methods used in the papers and because papers invariably do not report the level of detail necessary to judge quality according to usual criteria. However, quality in relation to study scope, data recording, analysis, use of controls, is appraised. Reflecting the heterogeneity of the material a narrative synthesis of the content of this literature, rather than a meta-analysis of the fmdings, is then provided. This means that fmdings have been compared and contrasted and reported in relation to notable areas of divergence or agreement, and gaps in the evidence base.

Findings

The initial search strategy identified 344 papers once duplicates had been removed (Figure 1). After the inclusion/exclusion criteria had been applied 299 citations were excluded, mostly because they were either not reporting empirical work, or studies reported on were conducted in settings other th..m community pharmacies, or outside the UK. Copies of 45 full papers were obtained for full consideration, after which a further 30 were excluded. Only a few papers were identified through hand searching strategies and all were subsequently excluded, leaving articles or reports from 15 studies that met the inclusion criteria. Key features of each research study are provided in Tables 2a-d, as follows: first, studies that describe or measure specific aspects of pharmacy workload (n = 7); studies that explore the impact of workload on pharmacists' work behaviour (n = 4); those that explore the impact of workload on pharmacists' well-being (n = 5), and finally, those studies that explore the impact of workload on

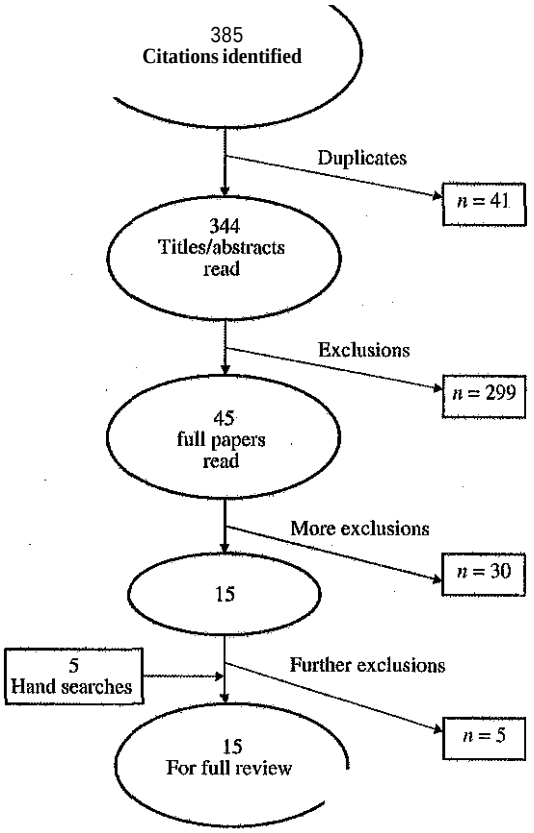

Figure 1 Literature review identification and selection process.

patient outcomes (n = 4). Some studies addressed more than one aspect of workload measurement, its impact, or both, therefore some papers appear in more than one table.

Study quality

Of the 15 studies reviewed, 12 included 'objective' measures of dispensing workload (le. prescription volume), while three solely relied on pharmacists perceptions of their workload (Sha1m & Hassell 2006, Gidman *et al.* 2007, Eden *et al.* 2009). Only four studies could be described as large scale in scope (e.g. n ;, 50) or designed to be nationally representative of pharmacies/pharmacists (Rutter *et al.* 1998, Bell *et al.* 1999, Bond *et al.* 2008, Bradley *et al.* 2008). The majority of the studies employed a cross-sectional design; none used longitudinal designs, and nearly all (10) relied on retrospective self-reporting of data. The studies utilised a range of methodologies. Qualitative interviewing was the 1nain method used in three studies (Shann & Hassell 2006, Gidman *et al.* 2007, Eden *et al.* 2009); a postal questionnaire was tl1e main method employed in one study (McCann *et al.* 2009),

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Table2 (a) Characteristics of studies: volume or type of work. (b} Characteristics of studies: Impact of pharmacy workload on pharmacists' work behaviour. (c) Characteristics of studies: impact of workload on pharmacist's well-being. (d) Characteristics of studies: impact of workload on patient outcomes

Study	Method and subjects	Study aim	Workload measures	Main findings
(a)				
(Savage 1995)	Fixed inteJVal work sampling study; 2529 observations made ov.er 2 weeks, of four pharmacists in two independent pharmacies matched for dispensing volume; in two villages within commuting distance of London	To investigate the effect of skilled dispensary help on pharmacists work activities	Proportion of time spent dispensing; and other activities classified Into 12 categories; controlled for dispensing volume and presence or not of a trained dispenser	28-38% of time spent on dispensing
(Savage 1997)	Fixed interval work sampling; 8652 obseJVations made during 153 hours of 18 pharmacists Working In 15 pharmacies located In Greater London and Home Counties	To describe how pharmacists manage the potentialconflict between their prescription and OTC advisory roles	Time spent advising customers on prescriptions, symptoms, and over the counter products and health; number of prescription + OTC customers per hour	65% of prescriptions were issued by a pharmacist, with some dialogue with the customer. There was an average of 1-2 OTC customers per hour
(Rutter *eta/.* 1998)	Self-reported estimates by each pharmacist at the end of the day on how much time was spent on key activities- 1084 usable replies. Took place over 7 weeks. Between 376 and 392 stores throughout GB belonging to one national multiple chain	To determine baseline Information on how community pharmacists spend their time	Proportion of time spent on dispensing and 15 other tasks, grouped Into NHS woi"k or not. Tasks further grouped into professional tasks, technical or non-professional activities	Overall, NHS activities occupied 68% of pharmacists' time; 37% of time spent on dispensing, ·12'% on prescription monitoring; neither affected by week day but both lower on Saturdays; time spent on OTC activities was 6%
(Rutter *et a!.* 1999)	Work sampling using five trained observers; 2682 observations, on three separate days over a 6-week period; five community pharmacies; location not specified.	To determine the validity of the findings from the 1998 study (above) using a different methodology	Proportion of time spent on dispensing and 15 other tasks. ObseJVed data compared with estimated data from earlier study (above)	Overall, NHS activities occupied 57%'of pharmacists' time; 31% of time spent on dispensing, 9% on prescription monitoring; some differences between observed and estimated data noted
(Bell *eta/.* 1999)	Work sampling using a random bleeper device; pharmacists recorded activity over a 10-day period using a pre designed report form;. 3623 obseJVations made over 300 study days; 30 community pharmacists in Greater Belfast area	To Identify how pharmacists utilise their time	Dispensing volume, and proportion of time spent on 15 activities grouped into professional, semi-professional and non-professional tasks Number and type of staff & dispensing volume- but not In conjunction with each other	49% spent on professional activities, and 22% on non-professional tasks

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Table 2 (a) (Continued)

Study	Method and subjects	Study aim	Workload measures	Main findings
(Bradley *et a/.* 2008)	Mixed methods: secondary data analysis of government data sets; a survey (74% response rate) of 303 primary care organisations In England; 43 stakeholder Interviews	To explore and identify . the key determinants Influencing the uptake of MURs	Number of MURs per pharmacy; pharmacy type; depriv'ation levels In PCT; proportion of patients with long-term conditions	Th!il mean rate of MUR provision per year was 87; ownership category most significant determinant of MUR uptake – rates in multiples (108) were almost twice that of independent pharmacies (56); MUR uptake lower in PCOs with higher deprivation levels and higher % of patients with long term conditions
(Bond *at* a/. 2008)	Mixed methods: postal survey (71% response rate); interviews and focus groups; 1080 community pharmacists from a 10% stratified random sample of PCOs In England and Wales	To determine the effect of the new pharmacy contract on the community pharmacy worldorce, specifically issues related to workload and job satisfaction	Dispensing volume; proportion of time spent on dispensing; number of pharmacies providing MURs; number of services offered; job satisfaction, stress; type of pharmacy	Between 51% and 75% of time spent on dispensing; and between 10% and 25% of time spent counselling patients; 87% of pharmacists provided one or more of the enhanCed services under the new contract
(b)				
(Savage 1995)	Fixed interval work sampling study; 2529 observations made over 2 weeks, of four pharmacists in two independent pharmacies matched for dispensing volume; in two villages within commuting distance of London	To Investigate the effect of skilled dispensary help on pharmacists work activities	Proportion of time spent In direct contact with customers In pharmacy A and pharmacy B, one without (A) and one with (B) a trained dispensing technician; additional activities classified into 12 categories, and dispensing volume	Prescription workload did not correlate with frequency or length of customer contact with prescription or OTC Issues; pharmacy B spent less time on dispensing and more time on the counter or resting than phannacy A, but no difference between A and B in the amount of time spent. in customer contact
(Savage 1997)	Fixed interval work sampling; 8652 observations made during 153 hours of 18 pharmacists working in 15 pharmacies located in Greater London and Home Counties	To describe how pharmacists manage the potential conflict between their prescription and OTC advisory roles	Pharmacist workload, measured as Rx Issues + OTC; time spent advising customers on prescriptions, symptoms, and over the counter products and health	Great variation between pharmacists, regarding the number of patients they gave advice to *even* in the same pharmacy, so advice giving activity Is not explained by workload. When the pharmacy is busy, the counselling of OTC customers took priority of that of Rx customers. OTC and Rx counselling was shorter at the end of the day

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Table 2 (b) (Continued)

Study	Method and subjects	Study aim	Workload measures	Main findings
(Bell *et at.* 1999)	Work sampling using a random bleeper device; pharmacists recorded activity over a 1O day period using a pre designed report form; 3623 observations made over 300 study days; 30 community pharmacists in Greater Belfast area	To identify how pharmacists utilise their time	Dispensing volume, and proportion of time spent on 15 activities grouped into professional, semi professional and non-professional tasks. Number and· type of staff & dispensing volume – but not In conjunction with each other	Pharmacists working alongside other pharmacists sperlt less time on administration and non professional activities and more time assembling and labelling products; pharmacists working In higher dispensing pharmacies spent less time counselling and responding to symptoms
(Hawksworth *et at.* 1999)	SeiHecording of clinical Interventions made during 1 week a month for 1 year; multidisciplinary clinical panel assessed the potential of each Intervention to alter patient outcome; 14 pharmacists; location not specified	To evaluate the professional contact between community pharmacists and GPs during the dispensing process; and to assess clinical pharmacy inte(.Ventions on the potential health gains for patients	Number of prescription items dispensed; number, type and nature of each clinical intervention and time taken; potential for clinical impact on patient, · Including potential for preventing a hospital admission	1503 clinical pharmacy Interventions were made out of 201 000 items (a mean of 0.89% per item dispensed by each pharmacy). Lower dispensing volume pharmacies made more clinical interventions.
(c)				
(Shann & Hassell 2006)	Qualitative telephone interviews with 34 locum pharmacists, randomly selected from around England	To explore the reasons why locums choose self employment over a permanent contract	Perceptions of workload, job satisfaction, and stress; controlled for age, sector of work	Too much work overall, too much paper work, company targets, and management pressure, affected decision to locum
(Gidman *et al.* 2007)	Face to face interviews with 30 female community pharmacists In the North West of England	To explore the effects of increased workload on female community pharmacists	Perceptions of work conditions, job satisfaction, stress Controlled for sector; job type	Pharmacists stressed and dis!llusloned because of high workload and nature of work. Women expressed fears about making mistakes and about threats to patient safety, and poor management support
(Bond *eta/.* 2008)	Mixed methods: postal survey (71% response rate); Interviews and focus groups; 1080 community pharmacists from a 10% stratified random sample of PCOs in England and Wales	To determine the effect of the new pharmacy contract on the community pharmacy workforce, specifically issues related to workload and job satisfaction	Perceptions of workload, job satisfaction, stress controlled for pharmacy type; dispensing volume	58% of pharmacists felt stressed at work; 24'% work longer hours since the introduction of the · new contract; the top three work pressures identified as demands from the new contracts, workload, and paperwork
(Eden *eta/.* 2009)	Telephone Interviews with 15 early career pharmacists; England wide	To explore the reasons why pharmacists leave or Intend to leave their job	Perceptions of work and workload; job satisfaction, stress; controlled for sector; age	Pharmacists change career in part because they are dissatisfied with high workload

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Table 2 (c) (Continued)

Study	Method and subjects	Study aim	Workload measures	Main findings
(McCann *et al.* 2009)	Postal survey (39% response rate) of all registered hospital and community pharmacists In Northern Ireland (n = 766); used adapted (but not revalidated) HPSJ questionnaire	To determine the levels of job satisfaction and stress in the context of changes In practice developments	Perceptions of workload; satisfaction and stress controlled for gender, year of registration, sector of wort(job	57% of community pharmacist were satisfied with their job most of the time; community pharmacist had higher stress scores than hospital pharmacists; Interruptions, excessive workload and Inadequate staffing were the most stressful aspects of their employment
(d)				
(Hawksworth *at al.* 1999)	SeiHecording of clinical interventions made during 1 week a month for 1 year; multidisciplinary clinical panel assessed the potential of each intervention to alter patient outcome; 14 pharmac sts; location not specified	To evaluate the professional contact between community pharmacists and GPs during the dispensing process; and to assess clfnical pharmacy Interventions on the potential health gains for patients	Number, type and nature of each Intervention and time taken; potential for clinical Impact on patient, including potential for preventing a hospital admission. Number of prescription items dispensed	748 of the 503 clinical pharmacy interventions made could have Improved efficacy or prevented harm or a hospital admission, representing an Incidence of 37 per 10,000 items prescribed by the 14 pharmacists
(Chen *et al.* 2005)	Self-recording over 1 month of prescribing problems and their causes, and inteiVentions made; nine community pharmacists in Nottingham	To describe prescribing problems reported by community pharmacists	lnteiVentions made; and number, type and proportion of prescribing problems; dispensing volume	For 32 403 items dispensed 196 (0.6%) prescribing problems were recorded; reporting rate ranged from 0.2-1.9% and they were inversely correlated to dispensing volume
(Ashcroft *et al.* 2005b)	Prospective self-report study, over a 4 week period, in 35 pharmacies. Location not specified but all were part of the same chain.	To determine the Incidence, nature and cause of dispensing errors and near misses in community pharmacies	Incidence of dispensing errors; who made it, type of error, cause of error, and circumstances associated with the error; number of prescription items dispensed	125 395 prescribed Items were dispensed, and 330 incidents recorded; 280 incidents were classified as a 'near miss'; Incidence of error reporting is low overall; 46.5% of the Incidents were associated with the pharmacy being busier than normal, telephone Interruptions, or because there was a different dispenser on duty
(Lynskey *at al.* 2007)	Self-report form to gather data on medication errors and near misses in the dispensing process; data collected for 3 months from 15 community pharmacists; located in Brighton and Hove	To establlsh the nature of medication errors occurring within community pharmacies and identify factors which influence their occurrence	Causes of medication error in the dispensing process; dispensing volume	113 near misses and 32 actual errors were reported, an average rate of 9.7 errors per pharmacy; rates Inversely correlated to dispensing volume; being busier or quieter than normal 'busyness' was cited as a circumstance In 58% of the near misses and 63% of actual errors

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while two studies utilised a mixed method design (Bond *et al.* 2008, Bradley *et al.* 2008). Six studies employed self-recording work sampling methods (Rutter *et al.* 1998; Bell *el al.* 1999, Hawksworth *et al.* 1999, Ashcroft *et al.* 2005b, Chen *et al.* 2005, Lynskey *et al.* 2007), while three studies used non-participant observation work sampling teclmiques (Savage 1995, 1997, Rutter *et al.* 1999). In the observation studies the number of observations recorded by trained observers ranged from 2529 over 2 weeks, to 8652 over 153 hours; no account of the statistical power behind the number of observations reported on, is provided. The tasks and activity categories devised for data recording varied. For example, Bell *et al.* (1999) classified 15 activities into professional, semi-professional, and non-professionals tasks, while Rutter *et al.* (1998) categorised 15 tasks into professional or technical activities. Ten years later, Bond *et al.* (2008) recorded 14 tasks conducted by community pharmacists. They were not categorised into professional or non-professional in their anal}rsis, and the categories used were not directly comparable with those used in earlier studies because of the changes in pharmacists work wrought by the contract.

While it is evident that differences in characterising the activities associated with dispensing (as a process) pose difficulties in consistently measuring the workload associated with it, less problematic is measuring the output of the process, i.e. the number of prescriptions dispensed. As already mentioned, the majority of the studies report prescription volume, but it is variously reported as the number of prescription items dispensed either per mont!\ per hour, per pharmacy, or (rarely) per phannacist. Furtltermore tltere appears to be no agreed definition or shared tmderstanding of what constitutes a low or high prescription workload. In one study for example, average prescription items dispensed per pharmacy were grouped from a low of 2000 per month and less, to a high of 11,000 per month (Bond *et al.* 2008), while another study describes 1500 prescription items per month as high (Belief *al.* 1999).

Data analysis in most of the studies which try to map and characterise workload is generally limited to reporting how much time is spent doing certain activities. Very few stodies control or make adjustments for confounders such as prescription volume, number of staff, skill mix, equipment, or opening hours, and it is the exception rather than the rule that relationships with outcome variables are explored. A paper reporting a study conducted in Northern Ireland (Bell *et al.* 1999) does attempt to control for a number of confmmders, such as number and type of staff, and dispensing volume. Pharmacists who worked alongside other pharmacists or had a greater number of dispensary assistants spent less time on administration activities and ·non-professional tasks, and more time assembling and labelling products. While the authors also fotmd an inverse relationship between dispensing volume and time spent with patients, they did not control for the numbers and types of staff to disentangle this relationship further; busier pharmacies may have more staff.

One study (Bradley *et al.* 2008), in its use of more sophisticated analysis (regression) techniques, was unusual among the 15 sh1dies included in the review. It was able to show that multiples, compared with independents, and pharmacies with higher levels of dispensing volume, were significantly more likely to conduct MUR•, while higher levels of deprivation and proportions of patients with limiting long-tenn illness within the primary care organisation (PCO) were associated with *lower* levels of uptake. However, only 12% of the variance in uptake of MURs was explained by the variables in the model, so it is likely tltat explanatory variables not examined, such as staffing levels, staff training, and other workload activity would add to the explanatory power of the model.

Pharmacy workload and what is measured

While dispensing activity was the focus of the majority (12) of stodies, one (Savage 1997) also measured time spent advising customers, two (Bond *et al.* 2008, Bradley *et al.* 2008) reported on the number of MURs provided, and five recorded other activities (e.g. other services; non-professional tasks). Notwithstanding that studies use different methods of recording and characterising workload, and different levels of activity are reported, it appears to be the case that NHS activities, particularly 'dispensing', do make up the bulk of pharmacists' workload, even after the introduction of the new contract.

The impact of pharmacy workload on pharmacists' work behaviour

Four studies were found that attempted to control for the effect of workload on different aspects of pharmacists' professional behaviour (Table 2b). Controlling for the presence or not of a trained t-echnician, Savage (1995) examined whether pharmacists spent more time with customers if they had a trained dispenser to assist them in the pharmacy. She found that although pharmacists working in a pharmacy that also employed a trained dispensing technician did spend less time on dispensing, this did not translate to spending more time in direct contact with patients. In another study by Savage (1997), looking at the amount of advice-giving provided by pharmacists, little correlation was found between time spent giving advice and dispensing workload. However, the shtdy did suggest that at peak dispenshtg times advice to over the counter (OTC)

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custmners was maintained, whereas time spent speaking to prescription customers was reduced.

Conversely, Bell *et al.* (1999) found that pharmacists in higher dispensing volume pharmacies did spend significantly less time counselling on non-prescription medicines and responding to symptoms and, perhaps surprisingly, that pharmacists working alongside other pharmacists spent more time on tasks categorised as only 'semi-professional'.

Hawksworth *et al.* (1999) investigated whether clinical interventions made by 14 pharmacists on just over 200,000 new and repeat prescription items were related to dispensing volume. They found that fewer clinical interventions were made in the high dispensing volume pharmacies, suggesting there may be an inverse relationship between dispensing load and clinical interventions. This study's design is vulnerable,.however, since other possible confounders, such as number of other staff helping in the dispensing process, and the presence or type of computerised repeat prescribing system, were not controlled for.

The impact of pharmacy workload on pharmacists' well-being

Five papers were found looking at the causes and consequences of pharmacists' workload on aspecl') of pharmacists' well-being (Table 2c). Three qualitative studies with very specific cohorts of pharmacists, (e.g. locums, early career pharmacists, young female commtmity pharmacists), report on either pharmacists' perception') about their workload and whether it has increased, about their job satisfaction, or about work-life balance, and work conditions (Shann & Hassell 2006, Gidman *d al.* 2007, Eden *et al.* 2009). Two studies employing quantitative methods fotmd that workload was related.to job dissatisfaction (McCann *et al.* 2009), or stress (Bond *et al.* 2008).

Conducted just after the new contract was introduced, Shann & Hassell (2006) explored with 34 purposively sampled pharmacists the reasons why they preferred to work as a self-employed locum. The authors found excessive work-reL:1ted stress was a key driver in the locums' decision to leave their job as a permanent employee or owner. Their stress was said to be caused by having too muclt work, by having to meet unreasonable company targets, or because they had to undertake work that took them away from direct contact with patients.

The same issues were raised in another qualitative study looking at tlte working conditions experienced by 30 female community pharmacists (Gidman *et al.* 2007). In this study interviews were conducted with women in a range of different jobs (i.e. owners, employees). Widespread stress, low satisfaction and disillusiomnent with work, caused or exacerbated by high workload in general, high dispensing volumes in particular, working long hours without breaks, falling staff levels, and unresponsive or inexperienced management, was prevalent among these women. The women also perceived that standards were falling and patient safety was being compromised as a direct result of the working conditions they were experiencing.

A target-driven enviromnent and heavy workloads in the community sector were again singled out as problematic in a qualitative study with 15 early career pharmacists, targeted because they had left or were planning to leave the profession (Eden *et al.* 2009). mtensity of work, its mundane nature and the under-utilisation of skills were all identified as causes of dissatisfaction and low morale among this small group of qualified pharmacists.

In their assessment of the impact of the new contract on pharmacists' workload which involved a large-scale survey of pharmacists across England and Wales, Bond *et al.* (2008) found evidence that workioad had placed additional demands on pharmacists' time (fable 2c): 58% of tlte 762 community pharmacists who responded to their survey said they felt stressed at work, 24% reported working longer hours since the introduction of the new contract, and only 10% reported being more satisfied with work than before the introduction of the new contract. The top three pressures they identified were demands from the new contract, workload, and paperwork. This study achieved a very good response rate to the survey (71%).

Levels and causes of job satisfaction and stress were explored in another quantitative study, by McCann *et al.* (2009) (Table 2c). In their survey (39% response rate) of all registered pharmacists in Northern Ireland they found moderately high levels of reported stress overall, witlt community pharmacists reporting a higher mean stress score than tlteir hospital colleagues (94.66 and 89.63 respectively). Over half (57%) of community pha,... macists compared witlt 60% of hospital pharmacists were satisfied with their current job most of tite time. Interruptions, excessive workload and inadequate staffing were tlte top three most stressful aspects of their employment. The study did not report any 'objective' workload measures such as dispensing volume or delivery of other services, although it did control for gender, year of registration and sector of work to assess the independent impact of these factors on self-reported stress.

The impact of pharmacist's workload on patient outcomes

Four empirical studies were fmmd U1at measured some aspect of patient outcomes in the context of community

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pharmacy workload (Table 2d). One was the Hawksworth *et al.* (1999) study of the clinical interventions made by 14 community pharmacists during the dispensing process, mentioned earlier. This study used a multidisciplinary clinical panel to assess the potential the intervention had to alter the outcome of the patient's clinical management and to prevent a drug related hospital admission. Findings revealed that of the 1503 interventions lTh'lde, 748 (representing an incidence of 37 per 10,000 items prescribed), could have improved efficacy, or prevented harm or hospital admission. This study is rare In that It is one of the first to attempt to examine pharmacists' contribution to patient outcomes, but the study design is vnlnerable in that it was only the *potential* for impact that was evaluated, and oU1er potential confounders, such as number of staff helping in the pharmacy, were not reported.

Using dispensing errors as an indicator of patient safety, a prospective study by Ashcroft *et al.* (2005a,b) explored their incidence, nature and causes in community pharmacies in the UK. The authors found that, on average, for every 10,000 items dispensed 26 incidents are detected, of which 22 are near misses and .four are dispensing errors. Pharmacists' own assessment of the circumstances most associated with these included the pharmacy being busier than normaL telephone intermptions, and not havig tl1e usual dispensing staff.

These findings were slightly at odds with results from a study involving 15 pharmacies in one Primary Care Trust looking at causes of medication errors during a 3-month period (Lynskey et *al.* 2007). When examining the 145 errors identified, the authors found being busier *or* quieter than normal was frequently cited as a circumstance surrounding the error, while staffing and distractions accounted for less than 10% of circumstances surrounding tl1e errors. One limitation of this study was that in 30% of near misses and 41% of actual errors no possible cause of the error was recorded.

In a study on pharmacists' role in detecting and reporting prescribing errors Chen *et al.* (2005) found that although t!1ere was a relatively low incidence (0.6%) of reporting prescribing problems there was a 10-fold variation in the reporting rates among the pharmacist participating in this si.udy; the rates between pharmacies were inversely correlated to dispensing volume, although tl1e association was not strong.

Discussion

Our study benefits from its novelty and currency at a tilne when pharmacists' workload and their performance and patient safety issues are subject to extensive discussion and debate. In terms of limitations, otrr study did not weight the retrieved evidence into synthesised recommendations, but we have identified concerns associated with the quality of the evidence. Only evidence reported in peer reviewed publications was included, and the findings may not he generalisable outside tl1e UK. However, many of the findings may still be of international interest and general relevance given that pharmacists and other healthcare practitioners in other countries are experiencing similar workload concerns (Ukens 1998a, Peterson *et al.* 1999, Tissot *et al.* 2003, Svarstad *et al.* 2004, Gaither *et al.* 2007).

With regard to the design and conduct of the studies included in tl1e review, a number of general comments are wortl1 making. Dispensing is described as a multidimensional task (Bell *et al.* 1999); researchers thus make different decisions about what to include or exclude when measuring it, and other workload activities. This means that findings across studies cannot be compared. Thus, increases in the amount of time pharmacists spend on dispensing reported in the studies (28-37% in Savage· 1995, 37% in Rutter *et al.* 1998, 50% in Bond *et al.* 2008) could be due to differences in classifying the tasks witltin the dispensing process, or indeed to differences in study design (non-participant observation versus self-reporting), rather than to genuine increases in workload over time.

Much of the evidence revie ed is derived from small scale qualitative studies, or quantitative studies with low response rates and limited representativeness. For example, the four studies which explored the impact of workload on various patient outcomes, had small samples ranging from 9--35 pharmacies/pharmacists, and all but one were locality based rather than nationwide studies. Many studies do not report sufficient methodological detail to rule out bias. No workload studies were found from Scotland; only two included pharmacies in Wales (Ashcroft *et al.* 2005b, Bond *et al.* 2008), and two were conducted in Northern Ireland (Bell *et al.* 1999, McCann *et al.* 2009). Of the studies conducted in England only one, because of its sampling method and high response rate, is representai.ive of the wider population of pharmacies (Bond *et al.* 2008).

Another major methodological weakness in many of the quan tative studies is that many do not consider, measure, or even acknowledge potential confounders that could be used to explain the findings. For example, data on staffing levels, skill mix, pharmacist-patient ratios, hours worked, and so on, are rarely gathered or considered during data analysis. Often' the studies are descriptive, rarely multifactorial in their design, and do not look for associations, and measuring impact is to a large extent overlooked. Only a very limited set of possible outcomes are the subject of investigation (e.g. detection of dispensing errors, 'counselling' rates),.with others (e.g. prevention of drug related hospital admissions)

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more difficult to examine. Certain workforce or workplace factors that have been found elsewhere to impact on patient or pharmacist outcomes have not been investigated at all in the UK community pharmacy setting (e.g. use of computers/technology, pharmacists' training and experience), (Barber *et al.* 1993, Westerlund *et al.* 1999, Me Namara *et al.*2007), so fuh1re sh1dies would need to address these shortcomings.

Regarding the substantive findings on workload, in particular the amount and its impact, what can we glean? First, the majority of studies on workload are more concerned with classifying and measuring the type of work undertaken in community pharmacies than with trying to assess its quality or effectiveness. It is perhaps significant that there have been no attempts by researchers to assess how much work is too much and when work therefore becomes unsafe. Even among key commentators in the profession, it is clear no shared agreement about this exists. For example, some consider workload too heavy when a pharmacist is dispensing more than 500 prescriptions in a 9-hour *day* (Watson 2008). It has been argued that patient care is being jeopardised because the average community pharmacy in Wales is dispensing 4,500 prescriptions *per month* or more (Gartside 2001). A prescription load of 150 was the threshold identified by pham1acists in Australia as to what could be safely dispensed in a 9-hour day (Peterson *et al.* 1999). Some state pharmacy boards in the USA have pioneered a regulation holding employers equally liable for medication errors when a pharmacy's *daily* prescription load exceeds 150 (Ukens 1998b, 2001). As key stakeholders here are calling for the profession to look at establishing similar guidelines about workload, perhaps it is now time to address this issue using research to underpin ti1eir development.

A point worth making here is that government data on prescription voltune and services and nearly all of the quantitative empirical studies reviewed here report the average prescription workload in a *pharmacy;* as such they are uninformative about individual *pharmacists'* workload. Variation in the distribution of community pharmacists nationally !ills been noted (Wagner *et al.* 2008); variation in their workload is likely to be similarly large, and very dependent on their role in the pharmacy, their hours of work, Ute type, size, location, and opening hours of the pharmacy, and the number of whole time equivalent pham1acy technicians, other support staff or second pharmacists that work in the store (Hassell *et al.* 2002). Empirical work is therefore required that examine these factors together.

TI1e four studies whicll explored the link between workload and different indicators of patient safety (e.g. clinical interventions; medication errors) do not provide convincing evidence that increasing workload leads to more errors or fewer interventions; only moderate associations are reported between prescription volume and error rates for example, or no associations are reported or examined.

The material on worldoad and impact on pharmacists themselves is perhaps more convincing, if only because findings, irrespective of study methodology, consistently point to the detrimental affect heavy workload is having on pharmacists' well-being, lending some weight to their reliability. The findings from the three qualitative studies are however, not generalisable to the broader population of pharmacists because they examined the experienoes of fairly specific cohorts of practitioners, so more researcll will need to be undertsken to assess how widespread the perceptions of these small groups of pharmacists are. Furthermore while perceptions are clearly important, they will probably need to be borne out by more 'objective' data linking ti1e perceptions of individuals to some more quantifiable measure of actual workload.

Conclusions

This review shows that despite the introduction of the new pharmacy contracts in England and Wales community pharmacists still appear to spend the majority of their time involved in activities associated with the dispensing of prescriptions. Research conducted prior to the new contract did not provide convincing evidence timt a high dispensing volume necessarily prevented pharmacists providing other services. However, government data show that dispensing volnme has increased and the number of pharmacies providing services under ti1e new contract has grown, lending some weight to the emerging research evidence and stakeholder opinion that pharmacist's workload has increased. Qualitative evidence consistently suggests a link between heavy workload and aspects of pharmacists' well- being, but there is no robust evidence h1dicating threats to patient safety caused by their having too much work to do. The number of registered pharmacists has not grown to keep pace with the increase in pharmacy services, and nor is there any evidence to suggest pharmacists are working longer hours, so it may well be the case that some tasks once c.:uried out by pharmacists are now the province of other pharmacy-employed staff, or that pharmacists are more productive. More high quality research is required, to explore what constitutes too much work, to examine the impact of high workload, and to unpack associations with other work place factors, sucll as ti1e availability and utilisation of other staff and technology, and hours worked.

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