The effects of mental workload on community pharmacists' ability to detect dispensing errors

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Executive Summary

1. Introduction

1.1 Background

The workload of UK community pharmacists is continually rising, with the number of prescriptions written and dispensed increasing annually, and in recent years pharmacists have taken on new and expanded roles (National Health Service Information Centre & Prescribing Support Unit, 2010). This has led to growing concerns that increases in community pharmacists' workload are linked to the occurrence of dispensing errors (DEs) (Hassell, Seston, Schafheutle, Wagner, & Eden, 2011). A review of the incidence and causes of DEs found that workload was the most frequently cited contributor to DEs in hospital and community pharmacies, as perceived by pharmacists working in these sectors (James et al., 2009). However, there is as yet no firm evidence to link DEs occurring in community pharmacies with the workload pressures experienced by community pharmacists (Grasha, 2001; RPS & PPRT, 2009). It has been proposed that this is because the measures of pharmacy workload used in the past have mainly been limited to the physical amount of work pharmacists are required to do (e.g. dispensing volume). This has overlooked the subjective experience of workload and the impact the work pharmacists are carrying out has on their cognitive processes (Grasha, 2001a). This subjective experience of workload is commonly described as our mental workload (MWL) (Hockey, 2002). Measures of MWL index the demand work makes of an employee's physical and mental resources (ISO, 1991). Research has shown that when MW is very high *or* very low individuals become more susceptible to making errors (Hancock & Caird, 1993).

There are up to 14 discrete stages in the dispensing process. Research conducted by Ashcroft, Quinlan, & Blenkinsopp (2005) highlighted that DEs were most likely to occur at the stage when the required medicine is selected off the shelf in the dispensary. This research also found that DEs that were detected before the medicine was given to the patient were most likely to be picked up through the final accuracy check (a double check of the dispensed and labelled medicine against the prescription carried out by a pharmacist or accuracy checking technician). The current research quantified the amount of MWL that community pharmacists' experienced when carrying out a final accuracy check and measured the relationship between MWL and community pharmacists' ability to detect DEs.

The current research is both timely and important because of the likelihood that the community pharmacy workload will continue to rise annually, as further burdens are placed on the resources of the National Health Service. If workload is related to dispensing errors then this is likely to present a growing patient safety issue.

1.2 Aims and objectives

The aims of this study were to 1) investigate the role of perceived mental workload (MWL) on community pharmacists' performance (measured in terms of correctly detected dispensing errors) of a final accuracy check of dispensed medicines, and 2) investigate community pharmacists' perceived levels of MWL during routine pharmacy tasks and how they manage their work if and when they feel mentally under or overloaded. The objectives of this study were to 1) measure the relationship between perceived MWL and dispensing errors (DEs), 2) measure the differing impact of task (secondary task load) and environment characteristics (distractions and interruptions) on performance of accuracy checking tasks and reported levels of MWL, 3) evaluate the contribution of individual difference factors (e.g. age, sex, amount of experience, personality traits, mood states) on perceived MWL and performance of an accuracy checking task, and, 4) explore in depth, community pharmacists' individual experiences and perceptions of MWL.

2. Methods

A mixed method approach was used to provide a comprehensive overview of the relationship between MWL and community pharmacists' ability to detect DEs through the final accuracy check. Three studies were conducted, the first and second formed the quantitative phase of the research and the third was the qualitative phase. Participants progressed sequentially through each study, and at each stage was asked to opt-in and provide consent. The numbers of participants who took part in each stage are described below in Table 1.

Table 1: The number of community pharmacists participating in each stage of the study

Study 1 Accuracy checking experiments	Experiment 1		Experiment 2	
	Low WM	High WM	No Distraction	Distraction
	N=26	N=26	N=26	N=26
Study 2 MWL diary study	N = 40			
Study 3 Qualitative follow-up	N=15 (N.B. 1 participant in this study did not return take part in study 2)			

2.1 Study 1: Accuracy checking experiments

Participants

A representative sample (N=104) of community pharmacists currently practising in the UK were strategically recruited[1] to take part in study 1. Table 1 above details the number of participants who participated in each phase.

[1] Based on published statistics (Seston & Hassell, 2011) of the distribution of community pharmacists by age, sex, years of experience, type of community pharmacy they worked for (e.g. independent vs. national chain), working hours (full-time vs. part-time) and ethnicity

Procedure

Two experiments were carried out which involved participants carrying out a final accuracy check of two sets of 25 (real) medicines against (realistic) prescriptions for DEs, under a time limit of 25 minutes. Randomly positioned in these 50 items were 5 deliberate DEs (either labelling or product errors). Participants were randomly allocated to one condition in either experiment 1 or 2 (so participants only took part in 1 experiment).

In experiment 1, half the participants were asked to remember a string of six, two-digit numbers, and the other half were asked to remember just one, two-digit number, whilst carrying out their accuracy checks on the dispensed items. The intention of the number memory task was to add load to participants' short-term memory processes, and possibly their levels of MWL (depending on how challenging they found the accuracy checking task). It was hypothesised (1) that those with the harder memory task would report higher levels of MWL and (2) that these participants would also miss more DEs.

In experiment 2, half the participants were distracted and interrupted (a total of six times per set of 25 dispensed items) whilst they were carrying out the accuracy checking task (they were not required to carry out any number memory). The other half of the participants were not distracted and interrupted and only had to carry out the accuracy checking task. It was hypothesised (1) that participants who were interrupted and distracted would report higher levels of MWL and (2) that these participants would also miss more DEs.

Data collected

a. Detection of dispensing errors (described in terms of signal detection values - hits, false alarms, response criterion and perceptual sensitivity (Green & Swets, 1988))
b. Participants rated their levels of MWL as measured by the National Aeronautics and Space Administration Task Load Index (Hart & Staveland, 1988) after the first and second set of dispensed items.
c. Participants rated their levels of other mood states, motivation, intruding thoughts and thinking style, before and after they checked each set of dispensed items (3 administrations in total) on the Dundee Stress State Scale (Matthews et al., 2002).
d. Participants completed a personality trait questionnaire the day before the study.

2.2 Study 2: Mental workload diary study

This was a diary study of community pharmacists' MWL during a day in their "real-life" practice conducted to measure whether MWL ratings made during study one were comparable to those made during "real-life" practice.

Participants

Forty community pharmacists who participated in study 1 completed a MWL diary (and of these 40 participants, 14 also participated in study 3).

Data collected

a. Participants rated their levels of MWL on the National Aeronautics and Space Administration Task Load Index (Hart & Staveland, 1988) up to seven times during a shift at work, but a minimum of twice (once at a busy time in their pharmacy, and once at a quiet time).
b. Participants reported demographic details about themselves (e.g. years of experience) and their pharmacy (e.g. dispensing volume)

2.3 Study 3: Qualitative follow-up study

This was an interpretative phenomenological analysis (IPA; Smith, Flowers, & Larkin, 2009) study of MWL and DEs. This involved semi-structured interviews with community pharmacists' about their experiences of MWL and DEs.

Participants

Forty-two participants from study 1 expressed an interest in being interviewed, of these 15 were selected for interview (based on their MWL scores in study 1, their role in the pharmacy, and the community pharmacy setting they worked in).

3. Key findings

3.1 Community pharmacists' accuracy at detecting dispensing errors

Across the two experiments in study 1 only 35% of community pharmacists detected all five of the deliberate DEs. The DEs missed were mostly labelling errors, although these included incorrect directions on how to take the medicine. We propose that labelling errors may be harder to detect as labels are more uniform than packaging and carry less sensory information (e.g. the wrong medicine may not feel the correct weight), making any errors less obvious. Community pharmacists' accuracy at detecting errors also significantly declined between the first and second set of dispensed items, this was linked to a significant shift towards a more conservative response criterion[2], which suggests that participants spent less time searching for evidence of a DE.

[2] A measure of signal detection theory. The response criterion indexes an observer's (human or machine) response bias, for example an observer may show a "liberal" response criterion or in other words be more prone to saying "yes there is a signal" compared to the "standard" or "perfect" observer. By contrast an observer who shows a "conservative" response criterion is more prone to saying "no there is not a signal" and in this sense are seen as requiring more evidence before they report a signal (in the context of this study – a dispensing error) has been made.

3.2 Mental workload and dispensing error detection

Studies 2 and 3 indicated that community pharmacists are experiencing sub-optimal MWL (both mental underload and overload) on a daily basis, and that at these times they felt they were susceptible to making DEs. Pharmacists reported the effective use of strategies to manage times when they experienced mental overload but few strategies were identified to manage mental underload. All participants reported needing to be "in the zone" and have a high level of mental focus in order to be able to detect DEs. This was supported by a finding in study 1 that indicated that participants who reported higher mental demand (one aspect of MWL) detected more DEs than those who reported lower levels of mental demand. Study 1 revealed that overall MWL scores were not related to detection (or failure to detect) DEs. Participants in experiment 1 (study 1) who were given the hard number memory task in addition to the checking tasks did not miss significantly more DEs or report significantly higher levels of MWL, meaning the null hypotheses could not be rejected.

3.3 The impact of distractions and interruptions on error detection

Some initial evidence was found that pharmacists who were distracted and interrupted whilst carrying out their accuracy checks missed significantly more DEs, although this effect was only observed during the second set of 25 items that they checked. Participants who were distracted and interrupted did not report significantly higher levels of MWL.

3.4 Frustrated community pharmacists

Frustration was a theme which ran across the three parts of this mixed-methods study. In study 1, participants in the first experiment who had to remember a string of six, two-digit numbers whilst checking, reported significantly higher levels of task frustration (an aspect of MWL) compared to the participants who only had to remember one, two-digit number. In study 2 task frustration was found to be significantly higher in real-life practice than the levels measured in experiments 1 and 2. Task frustration was also a key theme identified by interview participants and was caused variously by poor lines of communication with prescribers, a feeling that they were never able to get on top of their work or complete all outstanding tasks each day, issues with getting stock from manufacturers and wholesalers and the difficulty in finding time to take a break.

4 Recommendations

4.1 Recommendation 1: Reduce distractions and interruptions in the pharmacy

Our research has shown that distractions and interruptions can lead to significant reductions in patient safety. It should therefore be considered a priority to reduce the interruptions and distractions in areas where medicines are prepared. Evidence already exists of distraction free environments reducing errors in a US pharmacy practice setting meaning those findings could easily be translated to UK community pharmacies (LePorte, Ventresca, & Crumb, 2009).

4.2 Recommendation 2: Consideration of the cognitive processes involved in pharmacy tasks

This study has shown that error detection on a final accuracy check is likely hampered by natural unconscious cognitive processes, namely the setting of response criterion and perceptual sensitivity. The criterion and perceptual sensitivity can be shifted through minimal work interventions (e.g. breaks from repetitive tasks) in order to increase the detection of errors on a final accuracy check. Such interventions should be piloted to identify the intervention which leads to a greater detection of errors without significant increases in false alarms. Other aspects of pharmacy tasks should also be considered in relation to unconscious processes in order that we can ensure that they are designed to work with instead of against our natural cognitive processes.

4.3 Recommendation 3: Support for pharmacists in managing their workload and mental workload

Pharmacists who were interviewed gave several examples of strategies they used to avoid the negative consequences of mental overload, but did not report strategies for mental underload. Pharmacists could share best practice in minimising mental overload and in the future could be trained in strategies to minimise the impact of mental overload and underload. Pharmacists are already planning safety critical work to avoid times of underload and overload. Further research into the factors that cause mental underload in community pharmacies may support the development of task and environment interventions so that pharmacists can maintain an optimal level of mental workload. This need not be a costly process, interventions to improve mental underload can be as simple as encouraging pharmacists not to spend large amounts of time on one type of task when the pharmacy is quiet, so that their attentional focus does not become too narrow (Nachreiner, 1995).

5 References

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