

This is an Open Access document downloaded from ORCA, Cardiff University's institutional repository:<https://orca.cardiff.ac.uk/id/eprint/131188/>

This is the author's version of a work that was submitted to / accepted for publication.

Citation for final published version:

Young, Simon, Deslandes, Paul, Cooper, Jennifer, Williams, Huw, Kenkre, Joyce and Carson-Stevens, Andrew 2020. A mixed methods analysis of lithium-related patient safety incidents in primary care. *Therapeutic Advances in Drug Safety* 11 , pp. 1-8. 10.1177/2042098620922748

Publishers page: <http://dx.doi.org/10.1177/2042098620922748>

Please note:

Changes made as a result of publishing processes such as copy-editing, formatting and page numbers may not be reflected in this version. For the definitive version of this publication, please refer to the published source. You are advised to consult the publisher's version if you wish to cite this paper.

This version is being made available in accordance with publisher policies. See <http://orca.cf.ac.uk/policies.html> for usage policies. Copyright and moral rights for publications made available in ORCA are retained by the copyright holders.



A mixed methods analysis of lithium-related patient safety incidents in primary care

ABSTRACT

Background: Lithium is a drug with a narrow therapeutic range and has been associated with a number of serious adverse effects. The present study aimed to characterise primary care lithium-related patient safety incidents submitted to the National Reporting and Learning System (NRLS) database with respect to incident origin, type, contributory factors and outcome. The intention was to identify ways to minimise risk to future patients by examining incidents with a range of harm outcomes.

Methods: A mixed methods study of patient safety incident reports related to lithium was conducted. Data from healthcare organisations in England and Wales were extracted from the NRLS database. An exploratory descriptive analysis was undertaken to characterise the most frequent incident types, the associated chain of events and other contributory factors.

Results: 174 reports containing the term 'Lithium' were identified. Of these, 41 were excluded and from the remaining 133 reports, 138 incidents were identified and coded. Community pharmacies reported 100 incidents (96 dispensing related, 2 administration, 2 other), GP practices filed 22 reports, and 16 reports originated from other sources. A total of 99 dispensing-related incidents were recorded, 39 resulted from the wrong medication dispensed, 31 the wrong strength, 8 the wrong quantity and 21 other. 128 contributory factors were identified overall; for dispensing incidents, the most common related to medication storage/packaging (n=41), and "mistakes" (n=22) whilst no information regarding contributory factors was provided in 41 reports.

Conclusions: Despite the established link between medication packaging and the risk of dispensing errors, our study highlighted storage and packaging as the most commonly cited contributory factors to dispensing errors. The absence of certain relevant data limited the ability to fully characterise a number of reports. This highlighted the need to include clear and complete information when submitting reports. This, in turn, may help to better inform the further development of interventions designed to reduce incident numbers and improve patient safety.

Lay title and summary:

A characterisation of lithium-related patient safety incidents in primary care

Lithium is an effective treatment for certain mental illnesses, but has a number of harmful side effects. Safety incidents related to medicines in the UK are reported to the National Reporting and Learning System database (NRLS), and concerns relating to lithium have previously been highlighted. This study aimed to characterise lithium incidents reported to the NRLS that occurred in a primary care setting. Reports relating to lithium, and submitted between 2002 and 2013 were reviewed, and the information coded. 174 reports containing the term 'Lithium' were identified. Of these, 41 were excluded and from the remaining 133 reports, 138 incidents were identified and coded with respect to incident origin, type, contributory factors and outcome. 100 incidents were reported by Community pharmacies (96 of which related to medicine dispensing), GP practices filed 22 reports, and 16 reports originated from other sources. Of the dispensing-related incidents, 39 resulted from the wrong medication dispensed, 31 the wrong strength, 8 the wrong quantity and 21 other. 128 contributory factors were identified overall; for dispensing incidents, the most common related to medication storage/packaging (n=41), and "mistakes" (n=22) whilst no information regarding contributory factors was provided in 41 reports. Despite the established link between medication packaging and the risk of dispensing errors, our study highlighted storage and packaging as the most commonly cited contributory factors to dispensing errors. The absence of certain relevant data limited the ability to fully characterise a number of reports. This highlighted the need to include clear and complete information when submitting reports. This, in turn, may help to better inform the further development of interventions designed to reduce incident numbers and improve patient safety.

INTRODUCTION

Lithium has been shown to be an effective treatment for the management of bipolar affective disorder¹ and as an augmentation strategy in unipolar depression.² However, the clinical use of lithium is complicated by its narrow therapeutic range and adverse effects, such as those affecting the thyroid and parathyroid glands and the kidney, all of which require regular monitoring.³ Adverse patient outcomes associated with lithium in the United Kingdom were highlighted by the National Patient Safety Agency (NPSA) in 2009, with its publication "Safer lithium therapy".⁴ This report identified a number of fatalities and other serious adverse events that had occurred as a result of lithium therapy using the National Reporting and Learning System (NRLS) database. This database records reports of patient safety incidents resulting

from healthcare interventions made in the UK (available at: <https://report.nrls.nhs.uk/nrlsreporting/>). Following a review of incident reports involving severe harm associated with lithium, the NPSA introduced clear guidelines to help healthcare professionals to address these problems. The document suggested measures that were required to be implemented by healthcare providers by December 2010, including requirements for pharmacists prior to dispensing lithium and greater patient engagement through the Lithium Therapy Record Book.⁵

Whilst serious patient safety incidents have been a significant driver for improving patient safety,⁶ it has also been noted that incidents resulting in non-serious harm should not be overlooked.⁷ Incidents that result in mild harm or no harm have the potential to contribute to more serious harm if they are overlooked or measures not put in place to address them. The Heinrich ratio estimated that in an industry setting for every 300 no injury incidents, there would be one major injury⁸. In addition to assessing the effectiveness of reporting systems, these no injury incidents provide a focus for driving system change.⁷ Despite this, there is some evidence to suggest that severity of harm was a factor in determining pharmacist led error reporting in a hospital setting.⁹ As noted above, severe harms associated with lithium have been the subject of a previous report. However, the nature of lithium related incidents occurring in primary care settings, with varying degrees of harm, has been less widely reported.

The present study aimed to characterise all primary care lithium-related patient safety incidents submitted to the National Reporting and Learning System (NRLS) database. The intention being to identify ways to minimise risk to future patients by examining incidents with a range of harm outcomes.

METHODS

We carried out a cross-sectional, mixed methods study of patients who were the subject of a patient safety incident report related to the medication, lithium. This combined a detailed data coding process and iterative generation of data summaries using descriptive statistical and thematic analysis methods as described by Carson-Stevens et al.¹⁰

Data source

The primary data for the study were extracted from an archive of the NRLS database of patient safety incident reports from healthcare organisations in England and Wales. A patient safety incident is defined as: “any unintended or unexpected incident that could have harmed or did harm a patient during healthcare delivery”.¹¹ Reporting began in 2003 on a voluntary basis but, since 2010, it has been mandatory to report any incident that resulted in severe patient harm or death. Each report contains structured information about location, patient demographics, and the reporter’s perception of severity of harm, complemented by unstructured free-text descriptions of the incident, potential contributory factors, and planned actions to prevent reoccurrence. The database was described in more detail in a study of patient safety-related hospital deaths in England.¹²

Study population

The study included incidents occurring from 2003 (when the database launched) to 30th September 2013, which was the full cross-section of data available at the outset of our study. In this time, a total of 272,884 incident reports were submitted by primary care services to the central database of patient safety incidents. The free text fields of the database were searched for terms related to lithium including all common brand names. (see Appendix 1 for full list). Of the incidents identified, a number were excluded either because the report was a duplicate, contained insufficient detail, or because, on detailed scrutiny, the incident was found not to have occurred in primary care or did not directly involve lithium.

Data coding

Two clinical researchers familiar with the treatment of mental illness were trained in root cause analysis and the role of human factors in healthcare. This team reviewed the free text component of each incident report and coded the information in relation to: the type of safety incident that directly affected patient care (e.g. prescribing error) and the chain of events leading up to the safety incident (e.g. communication error between staff); the contributory factors (e.g. staff knowledge); and reported patient harm outcomes with harm severity classified according to World Health Organisation (WHO) International Classification for Patient Safety definitions.¹⁴ Each report was coded independently by both researchers and any discordance was discussed to ensure correct interpretation of codes and their definitions. Difficult cases were discussed and a third investigator, arbitrated where necessary. The process has previously been described in more detail.¹⁰

Data analyses

We undertook exploratory descriptive analysis to assess all relevant incident types, the associated chain of events and other contributory factors. Vignettes were discussed as a team to identify salient themes amongst reports with similar characteristics (incident type, contributing factor, outcomes), which could be considered as targets for the prevention of future incidents.

Ethical approval

Aneurin Bevan University Health Board (AB HB) Research Risk Review Committee judged the study as using anonymised data for service improvement purposes and approved it on this basis (ABHB R&D Ref number: SA/410/13).

RESULTS

From the available dataset of 272,884 incident reports, 174 incident reports containing the term 'lithium' were identified. Of these, 41 were excluded, (22 unrelated to lithium, 17 had insufficient information to allow coding, and two duplicate reports), and from the remaining 133 reports, 138 incidents were identified and coded (some reports included more than one identifiable incident). It was noted that the number of incidents reported per year increased over time, from four in 2002 to 24 in 2013 (see Figure 1).

Figure 1.

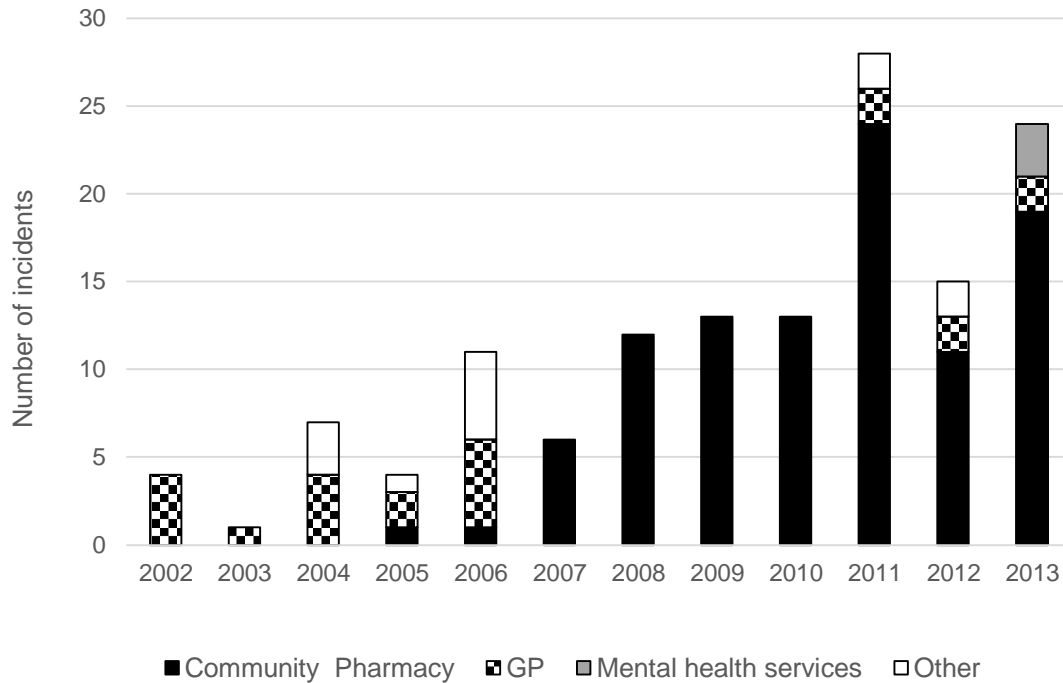


Figure 1: Number of primary care incidents relating to lithium, originating from different healthcare professional groups

Incident origin

Incidents were grouped into those originating from community pharmacy, General Practitioners (GPs), mental health services and other (including nurses and other hospital staff). Of the total, community pharmacies reported 100 (72%) incidents (96 were dispensing related, two relating to administration and two classified as other), GP practices filed 22 (16%) reports, 13 (9%) reports originated from other sources, and three (2%) from mental health services. The number of incidents according to reporter type and year are shown in Figure 1.

Incident type

The 138 incidents were categorized as being related to either prescribing, dispensing, administration, lithium monitoring, communication or other (such as record keeping and decision making); see Table 1 for details. A total of 99 dispensing-related incidents were recorded representing 72% of incidents overall. Of the dispensing incidents, 39 resulted from the wrong medication being dispensed (34 of which involved Priadel® and Plaquenil®), 31 the wrong strength, 8 the wrong quantity and 21 classified as other (see Table 2 for details). The

remaining 39 (28%) incidents related to monitoring (n=13), prescribing (n=8), communication (n=7), other (n=6) and administration (n=5).

Table 1: Incident type, grouped according to reporting healthcare professional

Incident type	Incident report origin				Total n=138 (%)
	Community pharmacy n=100 (%)	General Practice n=22 (%)	Mental Health n=3 (%)	Other n=13 (%)	
Dispensing	96 (96%)	2 (9%)	1 (33%)	0 (0%)	99 (72%)
Prescribing	0 (0%)	3 (14%)	1 (33%)	4 (31%)	8 (6%)
Administration	2 (2%)	1 (4%)	0 (0%)	2 (15%)	5 (4%)
Monitoring	0 (0%)	8 (36%)	0 (0%)	5 (38%)	13 (9%)
Communication	0 (0%)	5 (23%)	0 (0%)	2 (15%)	7 (5%)
Other	2 (2%)	3 (14%)	1 (33%)	0 (0%)	6 (4%)

Table 2: Details of dispensing incident types.

Dispensing Incident type	Number n=99 (%)
Wrong medicine	39 (39)
Wrong strength	31 (31)
Wrong quantity	8 (8)
Wrong patient	4 (4)
Wrong dose timing	4 (4)
Wrong formulation	4 (4)
Wrong label	3 (3)
Wrong dose	3 (3)
Contraindicated medication dispensed	1 (1)
Discontinued medication dispensed	1 (1)
Out of date medication dispensed	1 (1)

Contributory factors

A total of 128 contributory factors were identified for 82 of the incidents reported, whilst no information was available for 56 incidents. Overall, the most common contributory factor was medication storage or packaging in relation to dispensing incidents (n=41), followed by a cognitive error (such as a mistake or inattention), which occurred in the context of most error types. 97 contributory factors were identified for 58/99 of the dispensing incidents (some incidents had more than one identified contributory factor), whilst no information was available for 41/99, as the relevant section of the NRLS data collection form was left blank. The most

commonly cited contributory factor for dispensing incidents was medication storage or packaging (n=41), where the similarity of the packaging between two medicines with similar names (Priadel® and Plaquenil®) was commonly noted. Other factors were cognitive errors (n=23), working conditions (n=18) (where being busy and being interrupted were commonly noted), process not followed (n=8), continuity of care (n=3), lack of protocol (n=2) and other (n=2).

Outcome and harm

No outcome (as the relevant section of the NRLS data collection form was left blank) or an unclear outcome with insufficient detail to allow coding was reported for 84 (61%) incidents. 74 outcomes were reported for the remaining 54 coded incidents (more than one outcome was possible for each incident). The most frequently reported outcomes were requirement for repeated visit to a health care provider (n=24; 32%), hospital admission (n=10; 14%), unplanned change in dosing (n=9; 13%), treating of the patient with insufficient information (n=6; 8%) and need for repeated tests (n=5; 7%).

Patient harms resulting from the incidents were reported for only 63/138 incidents. Where harm was reported, it was classified as no harm (n=8), no harm due to mitigating action (n=32), mild (n=10), moderate (n=9) and severe (n=4; 2 reports with 4 incidents). The severe harms all required hospital admission (three of the four resulted from medication overdose) and all occurred prior to 2011.

DISCUSSION

This study investigated incidents relating to the use of lithium in primary care in England and Wales, reported to the NRLS database between 2003 and 2013. A total of 174 reports were identified and from these, 133 reports detailing 138 incidents were reviewed and coded. The frequency of reporting increased over time, with the largest number of incidents reported in 2011. This was broadly in line with the increased level of reporting seen in the NRLS database¹³. The majority of the primary care reports submitted to the NRLS database and reviewed in this study related to errors made in the dispensing of lithium. Reports came largely from community pharmacy and incorrect medicine or incorrect strength dispensed were the most common incidents.

Although the majority of incidents were associated with the dispensing process, this perhaps reflected the number of lithium reports submitted by community pharmacies compared with other professional groups. Community pharmacists reported 100 (72%) of the coded incidents, starting with a single report in 2005, followed by a significant increase in reporting from 2007 onwards. The timing of this initial reporting, and the subsequent increase in reporting coincided with a change to the terms of the NHS Community Pharmacy Contractual Framework in 2005, which required all pharmacy contractors to report incidents to the NRLS.¹⁵ It has been suggested that the effectiveness of a reporting system can be based upon the ratio of severe to less severe harm reporting.⁷ Using the assumption that where no harm was reported a severe event had not occurred, the ratio of severe to less severe harms (1:99) reported by community pharmacies might be considered somewhat encouraging. However, briefing document 034/14 issued by the Pharmaceutical Services Negotiating Committee (PSNC) in 2014,¹⁵ indicated that the level of reporting to the NRLS by community pharmacies was low, and put measures in place to address this. Given the estimated 1–3% incidence of dispensing incidents in community pharmacies¹⁶ and number of prescription items for lithium dispensed in Wales in 2012 alone (approximately 75,500 items data from the Comparative Analysis System for Prescribing Audit; NHS Wales Shared Services Partnership), these concerns over under-reporting appear well substantiated despite it being a contractual requirement.

Whilst the number of reports submitted by community pharmacies in relation to the number of items dispensed was relatively low, it was significantly greater than that observed for other healthcare professionals. This may in part reflect the contractual obligation for community pharmacies to report using the NRLS database. It has been documented that all stages of the medication management process from prescribing to administration are associated with a risk of error.¹⁷ However, only 38 reports of lithium related incidents originated from other healthcare professionals. Furthermore, only 39 were associated with aspects of the medicines management process other than dispensing (see figure 2). A number of factors have been identified as barriers to the reporting of medication errors,^{18,19,20} which may have contributed to the limited quantity of reporting observed in our study. These include a lack of feedback to the reporter following incident submission, time constraints in completing reports, the complexity of navigating reporting systems and fear of blame. The low level of reporting and the focus on a single medicine were limitations of the study, and impact on the generalisability of the findings. Overall, the level of detail contained within the reports could have been improved. In a significant number of cases, there was insufficient detail to allow coding of the

incident or of contributory factors, and in some cases no details were provided for key aspects such as resulting outcomes and harms. This lack of information prevented full coding of these incidents and a similar lack of data quality has been reported elsewhere.²¹ Without a full description of the incident, it becomes more difficult to attempt to develop strategies such as driver diagrams and harness learning to facilitate change.^{22,23}

Despite the established link between medication packaging and the risk of dispensing^{24,25} and other errors,²⁶ our study highlighted medicine storage or packaging as the most commonly cited contributory factor. The WHO “Medicines without harm” initiative identifies look-alike sound-alike medicine names, and labelling and packaging as frequent sources of error and harm that can be addressed.²⁶ It was notable that the lithium brand Priadel[®] and the medicine Plaquenil[®], both of which were manufactured by Sanofi Aventis and have similar names and packaging were the most frequently confused medicines. Strategies to address confusion of look-alike sound-alike names include the use of “Tall-Man” lettering on medicine labels.²⁷ Tall-man lettering utilises capitalisation for parts of the text of the medicine name, to highlight differences between similar names. Evidence to support this approach remains somewhat mixed, with little definitive evidence of a beneficial effect.²⁸ A limitation in the evaluation of this strategy is the limited number of published studies; particularly those conducted in real-world settings (see Larmené-Beld et al, 2018 for review).²⁷ Nevertheless, adoption of lists of medicines recommended for Tall Man lettering^{29,30} may represent a possible driver for reducing similar dispensing errors. Medication storage and packaging is likely to be an ongoing source of error in the dispensing process involving manual selection of medicines. Whilst automation has been shown to reduce some of the errors associated with dispensing,³² other aspects of the medicines management process from prescribing to administration will undoubtedly continue to be subject to human error.

Conclusion

Despite lithium being a drug with a narrow therapeutic range that has been associated with serious harm, the number and quality of the primary care reports submitted to the NRLS database and reviewed in this study was limited. Although community pharmacy made a significant contribution to lithium-related incident reporting, the absence of certain relevant data limited the ability to fully characterise a number of reports. This highlighted a need for better understanding amongst reporters to include clear and complete information (e.g. contributory factors such as packaging and work environment) when submitting reports. This,

in turn, may help to better inform the further development of interventions designed to reduce incident numbers and improve patient safety.

Funding

This work was part-funded by a project funded by the National Institute for Health Services and Delivery Research Program (project number 12/64/118), <http://www.nihr.ac.uk>. The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Conflict of interest statement

The authors declare that there are no conflicts of interest.

References

1. Balance investigators. Lithium plus valproate combination therapy versus monotherapy for relapse prevention in bipolar I disorder (BALANCE): a randomised open-label trial. *Lancet* 2010; 375: 385–395.
2. Bauer M, Adli M, Ricken R et al. Role of lithium augmentation in the management of major depressive disorder. *CNS Drugs* 2014; 28: 331–342.
3. McKnight RF, Adida M, Budge K et al. Lithium toxicity profile: a systematic review and meta-analysis. *Lancet* 2012; 379: 721–728.
4. National Patient Safety Agency. Safer lithium therapy. (Patient safety alert PSA005.) 2009.
<http://webarchive.nationalarchives.gov.uk/20171030124420/http://www.nrls.npsa.nhs.uk/resources/?entryid45=65426&p=9>
(2009, accessed 2 September 2019)
5. National Patient Safety Agency. Lithium Therapy Record Book. 2009.
<https://www.sps.nhs.uk/wp-content/uploads/2018/02/2009-NRLS-0921-Lithium-record-et-2009.12.01-v1.pdf>
(2009 accessed 2 September 2019)
6. Woods K. The prevention of intrathecal medication errors. A report to the chief medical officer. 2001.
<https://webarchive.nationalarchives.gov.uk/20040209163605/http://www.doh.gov.uk:80/imeprevent/>
(2001, accessed 2 September 2019)
7. Department of Health. An organization with a memory. Report of an expert group on learning from adverse events in the NHS chaired by the Chief Medical Officer. London. The Stationery Office. 2000

https://webarchive.nationalarchives.gov.uk/20130105105027/http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_4065083

(2000, accessed 2 September 2019)

8. Heinrich HW. *Industrial Accident Prevention: A Scientific Approach*, New York, NY: McGraw Hill Book Company, 1931.
9. Williams S, Phipps DL, Ashcroft DM. Understanding the attitudes of hospital pharmacists to reporting medication incidents: A qualitative study. *Res Soc Admin Pharm* 2013; 9: 80–89
10. Carson-Stevens A, Hibbert P, Avery A, et al. A cross-sectional mixed methods study protocol to generate learning from patient safety incidents reported from general practice. *BMJ Open* 2015; 5: e009079.
11. National Reporting and Learning System
<https://improvement.nhs.uk/resources/report-patient-safety-incident/>
(accessed 2 September 2019)
12. Donaldson LJ, Panesar SS, Darzi A. Patient-safety-related hospital deaths in England: thematic analysis of incidents reported to a national database, 2010–2012. *PLoS Med* 2014; 11(6): e1001667.
13. NHS Improvement. National quarterly data on patient safety incident reports: September 2016.
Available at:
<https://improvement.nhs.uk/resources/national-quarterly-data-patient-safety-incident-reports-september-2016/>
(Accessed 9th March 2020)
14. WHO. 2009 The conceptual framework for the international classification for patient safety:
https://www.who.int/patientsafety/taxonomy/icps_full_report.pdf
(accessed 2 September 2019)
15. PSNC Briefing 034/14: Reporting patient safety incidents to the NRLS
<https://psnc.org.uk/wp-content/uploads/2014/12/PSNC-Briefing-034.14-Reporting-patient-safety-incidents-to-the-NRLS.pdf>
(accessed 2 September 2019)
16. Franklin BD, O’Grady K. Dispensing errors in community pharmacy: frequency, clinical significance and potential impact of authentication at the point of dispensing. *Int J Pharm Pract* 2007; 15: 273–281.
17. Cousins D, Gerrett D, Warner B. A review of medication incidents reported to the National Reporting and Learning System in England and Wales over 6 years (2005-2010). *Br J Clin Pharmacol* 2012; 74(4): 597–604.

18. Burns N, Alkaisy Z, Sharp E. Doctors attitudes towards medication errors at 2002 and 2015. *Int J Health Care Qual Assur* 2018; 31: 451–463.
19. Mitchell I, Schuster A, Smith K, et al. Patient safety incident reporting: a qualitative study of thoughts and perceptions of experts 15 years after 'To Err is Human'. *BMJ Qual Saf* 2016; 25: 92–99.
20. Ashcroft DM, Morecroft C, Parker D, et al. Likelihood of reporting adverse events in community pharmacy: an experimental study. *Qual Saf Health Care* 2006;15: 48–52.
21. Gong Y. Data Consistency in a Voluntary Medical Incident Reporting System. *J Med Syst* 2011; 35(4): 609–615.
22. Leistikow I, Mulder S, Vesseur J, et al. Learning from incidents in healthcare: the journey, not the arrival, matters. *BMJ Qual Saf* 2017; 26: 252–256.
23. Macrae C. The problem with incident reporting. *BMJ Qual Saf* 2016; 25: 71–75.
24. Garfield S, Franklin BD. Understanding models of error and how they apply in clinical practice. *The Pharmaceutical Journal*, 2016; 296: No 7890, online | DOI: 10.1211/PJ.2016.20201110
25. Beso A, Franklin BD, Barber N. The frequency and potential causes of dispensing errors in a hospital pharmacy. *Pharm World Sci* 2005; 27:182–190.
26. WHO. Medication Without Harm - Global Patient Safety Challenge on Medication Safety. Geneva: World Health Organization, 2017. Licence: CC BY-NC-SA 3.0 IGO. <https://apps.who.int/iris/bitstream/handle/10665/255263/WHO-HIS-SDS-2017.6-eng.pdf;jsessionid=4D366701963A358F9AE611BB36CD50FF?sequence=1> (accessed 2 September 2019)
27. Larmené-Beld KHM, Alting EK, Taxis K. A systematic literature review on strategies to avoid look-alike errors of labels. *Eur J Clin Pharmacol* 2018; 74: 985–993
28. Lambert BL, Schroeder SR, Galanter WL. Does Tall Man lettering prevent drug name confusion errors? Incomplete and conflicting evidence suggest need for definitive study. *BMJ Qual Saf* 2016; 25: 213–217
29. Australian commission on quality and safety in healthcare. National Tall Man lettering list. 2017
<https://www.safetyandquality.gov.au/wp-content/uploads/2018/01/National-Tall-Man-Lettering-List-Nov-2017.pdf>
(accessed 2 September 2019)
31. Institute for Safe Medication Practice. FDA and ISMP lists of look-alike drug names with recommended tall man letters. 2016.
<https://www.ismp.org/sites/default/files/attachments/2017-11/tallmanletters.pdf>
(2016 accessed 2 September 2019)

32. Rodriguez-Gonzalez CG, Herranz-Alonso A, Escudero-Vilaplana V, et al. Robotic dispensing improves patient safety, inventory management, and staff satisfaction in an outpatient hospital pharmacy. *J Eval Clin Pract* 2019; 25: 28–35

Appendix 1, field searched and search terms:

Free text fields searched:

Description of what happened

Actions preventing recurrence

Apparent causes

Search terms related to lithium: Lithium; priadel; camcolit; Li; Li-, Li+; Liskonum; purple book;
purple-book

