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Literature review of medication administration problems in paediatrics by parent/caregiver and the role of health literacy

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ABSTRACT

Objective To identify studies that highlighted medication administration problems experienced by parents and children, which also looked at health literacy aspect using a validated tool to assess for literacy.

Study design Ten electronic databases were systematically searched and supplemented by hand searching through reference lists using the following search terms: (1) paediatric, (2) medication error including dosing error, medication administration error, medication safety and medication optimisation and (3) health literacy.

Results Of the (1230) records screened, 14 studies were eligible for inclusion. Three analytical themes emerged from the synthesis. The review highlighted that frequencies and magnitudes of dosing errors vary by the measurement tools used, the dose prescribed and by the administration instruction provided. Parent's sociodemographic, such as health literacy and language, is a key factor to be considered when designing an intervention aimed at averting medication administration errors at home. The review summarised some potential strategies that could help in reducing medication administration errors among children at home. Among these recommendations is to show the prescribed dose to the parents or young people along with the verbal instructions, as well as to match the prescribed dose with the measuring tool dispensed, to provide an explicit dose intervals and pictographic dosing instructions.

Conclusion The findings suggest that in order to optimise medication use by parents, further work is needed to address the nature of these issues at home. Counselling, medication administration instructions and measurement tools are some of the areas in addition to the sociodemographic characteristics of parents and young people that need to be considered when designing any future potential intervention aimed at reducing medication errors among children and young people at home.

What is known about the subject?

- Medication administration errors occur frequently among children.
- Parent's health literacy could be associated with medication administration problems in children.
- Studies examining parent administrator paediatric medicine accuracy were mainly from one particular research group in the USA with participant parents using non-standardised measuring tools.

What this study adds?

- The nature of medication administration error's happening at home are not well documented across each age group.
- The need to explore parents and patients perspective in regards to medication administration challenges happening at home.

INTRODUCTION

When it comes to medication administration for children at home, a significant burden of responsibility relies on the parents or on the patients themselves.[1] It has been documented that medication administration errors among children is well known to occur.[2] Previous studies recognised that more than 40% of parents and caregivers make dosing errors in an outpatient setting.[3 4] The inability to administer medication correctly may result in adverse drug events and poor patient clinical outcomes.[5] Causes of medication administration problems at home are multifactorial and potentially depend on various factors.[2] So, in order to improve medication administration by parents and patients, an initial assessment of the current problems and factors that may contribute to this issue must be identified first.

Previous studies have recognised potential factors that can contribute to clinician-led medication administration errors in children, but there have been no studies recording both the types and risk factors that can contribute towards caregiver's medication administration problems as well as young people.[6 7] According to the European Health Literacy Survey, conducted across eight different countries, the prevalence of low health literacy levels varies from 29% to 62%.[8 9]

Owing to this, high prevalence of low health literacy levels and its potential association with medication administration issues among children. This review aimed at identifying studies that highlighted medication administration problems experienced by parents and children, which also looked at health literacy aspect using a validated tool to assess for literacy. In this systematic review, the common medication administration problems occurring at home as well as the potential causalities and risk factors other than health literacy that further could contribute to medication administration errors have been highlighted.

Methods

This review was conducted in accordance with the Cochrane Handbook for Systematic Reviews, and followed Preferred Reporting Items for Systematic Reviews andMeta-Analyses (PRISMA) reporting guidelines.[10 11] The review protocol is registered on PROSPERO (ID: CRD42018091590).

Patient and public involvement

There was no patient and public involved in the design, or conduct, or reporting, or dissemination of this review.

Eligibility criteria

Studies were eligible for inclusion if they were related to medication administration errors among children and adolescent between the ages of 0–18 years old as per the WHO definition of population age group. This includes studies reporting medication-related problems outside the clinical setting; where the parent or the child is responsible for administering or taking the medication. Studies must have assessed the health literacy levels of the participants using a validated health literacy assessment tool. Any study that looked only at education levels of the participants without assessing the literacy levels was excluded. There were no restrictions on the date of publication, only English language articles studies where included.

Search strategy

The search strategy was designed initially by the research team and verified by an information specialist using the Population, Intervention, Comparison and Outcomes model. The reviewer (DTD) systematically searched PubMed, Scopus, Web of Science, Cochrane Library, OpenGrey, NHS Digital Department of Health Office for National Statistics, BBC News, Bielefeld Academic Search Engine, E-thesis Online Service and Conference proceedings through Web of Science for studies from database inception to September 2020.

Search terms summarised in online supplemental material, table S1 included a comprehensive list of synonyms and multiple Boolean operators relating to: (1) paediatric (2) medication error including dosing error, medication administration error, medication safety and medication optimisation and (3) health literacy. DTD further performed reference tracking of all included studies to identify any potential studies to be included in the review.

Study selection

Two reviewers (DTD, ZBS) independently evaluated each study for eligibility to reduce bias using the inclusion criteria above. The titles and/or abstracts of all identified studies were reviewed independently, and full manuscripts that appeared to potentially relevant.

Data extraction process and synthesis

Two reviewers (DTD and ZBS) independently extracted data using a standardised predefined spreadsheet. Inconsistencies in extracted data were resolved through consensus discussion by a third reviewer (CH), if necessary. Results were synthesised and summarised according to analytical themes. Thematic analysis was opted by the research team as it is known for its flexibility and ability of identifying patterns of meaningful information within the data.[12]

Quality appraisal

The quality of the included papers was independently assessed by two reviewers (DTD, ZBS) using Critical Appraisal Skills Programme checklists.[13 14] Discrepancies were resolved through discussion and consensus.

RESULTS

A total of 672 citations were retrieved from the database and other searches. After screening titles and abstracts, 38 publications were obtained in full text and assessed for suitability. Of which, 14 met the inclusion criteria and were included in the analysis (see figure 1 for PRISMA flow chart).[15–28] See online supplemental material, table S2 for reasons of exclusion.

The details of the 14 studies are presented in (tables 1 and 2).[15–28] The majority of the included studies were published in the last 12 years. All of the studies (n=14) took place in the USA.

Overall, 11 studies recruited parents or caregivers of children aged between 30 days to less than 9 years old, 2 studies had recruited parents with no age limitations of the child and 1 study recruited only women of childbearing age. The majority of the studies (n=13) did report the ethnic composition of their recruited sample and they were vastly Hispanic or black African American parents or caregivers. One study had only exclusively recruited women from a white ethnic background.[22]

Quality appraisal

The results from the quality appraisal are shown in online supplemental material, tables S3 and S4. All identified studies were included in the final synthesis with a greater emphasis on the higher quality studies.

Synthesis of results

The data from the 14 studies were analysed and three analytical themes emerged from the analysis and a

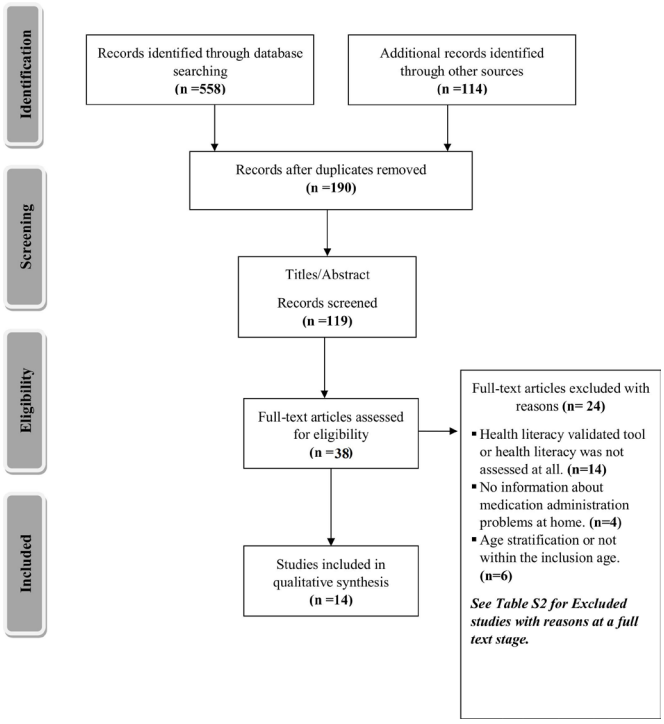

Figure 1 Flow diagram for the study selection based on Preferred Reporting Items for Systematic Reviews andMeta-Analyses flow diagram.

summary of the review results are demonstrated in figure 2.

Types and causes of medication administration errors among children led by parents or child outside a clinical setting

Eight of the included studies indicated that paediatric dosing errors are among the most common medication errors made by parents.[15 18–21 23 24 26] Among these studies, two randomised trials identified that overdosing errors are more common among parents.[23 24] While another cross-sectional study looking at parents with child on a short course prescribed medication reported that the majority of the parents measured below the prescribed dose.[15] A study by Morrison *et al*[20] reported that parents who made underdosing errors made more dosage errors and frequency errors compared with those who made an overdosing error.

From the included studies, it was noticed that the magnitude and frequency of dosing errors by parents were influenced by two factors: measurement tool used by parents and the dose volume (amount) . In one study, parents stated that non-standardised kitchen spoon was their primary dosing tool.[17] Two studies reported that errors were more common with measuring cups than with syringes, in particularly with small dose volumes (amounts).[21 24] In a cross-sectional study conducted in the USA, the majority 66% of the parents considered oral syringes are the best tool for dosing accuracy, while 23.5% believed that cups were the best; however, few 10.1% believed that dosing spoon, measuring spoon, kitchen teaspoon and droppers were the best.[27] Another study reported that larger dosing errors (>40% deviation of the recommended dose) were made by parents using cups with printed marking and etched markings; this was thought to be due to confusion about teaspoon versus tablespoon instructions, assumptions that the cup is the unit of measure and the full cup is the dose.[16] Labels and units of the prescribed medication were contributing factors to dosing errors.[24] Parents made significant dosing errors when the units found on the medication bottle label were not similar to the units used on the dosing tool.[24] Parents who used teaspoon/tablespoon units were likely to use a non-standardised dosing instrument and make errors in measuring the prescribed and intended dose.[19] The final potential factor was the type of instructions provided. For liquid medication, less errors were seen among parents who were provided with text-plus-pictogram instructions 43.9% compared with text-only instructions 59.0% and this group were also less likely to make overdosing errors.[26] Parents who received standard medication counselling were 47.8% more likely to make dosing errors when compared with parents who received pictogram instruction (5.4%).[25]

Factors related to patients or caregivers and medication errors

Health literacy

Health literacy of caregivers in the studies were assessed; six conducted further analyses of its influence on dose accuracy and other cofactors related to medication errors. Yin *et al*[17] reported that caregivers with inadequate or marginal health literacy were more likely to use a non-standardised dosing instrument and further lacked knowledge on weight-based dosing for over the countermedication when compared with caregivers with adequate health literacy. Another study by Yin *et al*[16] found a significant association between health literacy and dosing errors using cups and dosing spoons. In adjusted analysis conducted by Williams *et al*,[27] they found that there was a strong association between health literacy levels and measurement tool preference in particular cups, parents with limited literacy reported that dosing cups were the tool of choice most of the time (aOR=2.4). The use of a teaspoon/tablespoon was associated with errors in the intended dose for those with low health literacy but not for those with adequate health literacy.[19] Harris *et al*[21] identified that parents with limited health literacy and limited English proficiency (LEP) made the most dosing errors. Similarly, Samuels-Kalow *et al*[18] revealed that parents with inadequate and marginal health literacy committed dosing errors, but the sample size of this group was small compared with the adequate health literacy group.

Language

Association between health literacy and lack of knowledge of weight-based dosing varied by English speaking caregiver's. For English speaking caregivers, 88.6% of inadequate or marginal health literacy caregivers were unaware of weight-based dosing in comparison to 54.1%

Table 1 Characteristics of the observational included studies in the review (listed by health literacy test)

Study information		Participants characteristics			Findings		
First author (year)	Setting	Methods	Aim	Age of the recruited sample	Sample size	Health literacy test used	Outcomes and gaps
Morrison *et al* (2017)[20]	Outpatient clinic and emergency department	Interviews and applied assessment	To examine the association between parent health literacy and pain medication knowledge and applied skills in parents of children with sickle cell disease.	Parents of children 1–12 years old.	100	Newest vital sign (NVS)	Parents with low health literacy made more under dose frequency errors on the pain treatment skills. Health literacy was not associated with errors on the applied treatment skills. Parents recalled underdosing of medication (both dose and frequency). On the applied pain treatment skills, parents made both underdoing and overdosing errors.
Torres *et al* (2018)[28]	Paediatric outpatient clinics	Cross-sectional analysis	Sought to examine the interrelationships between parents' preferences and perceptions regarding unites of measurement, parents millilitre dosing experiences, and parent health literacy.	Parents or legal guardian of children≤8 years old.	493	NVS	Parents preferred the millilitre dosing to be easy; few 11.5% prefers teaspoon units. Parents will low health literacy levels had a higher odd of having a teaspoon preference and greater odds of perceiving difficulty with the millilitre only dosing.
Williams *et al* (2019)[27]	Outpatient clinics	Cross-sectional analysis	To assess parent decision-making regarding dosing tools, a known contributor to medication dosing errors, by evaluating parent dosing tool use, beliefs, and access, and the role of health literacy, with a focus on dosing cups, which are associated with an increased risk of multifold overdose.	Parents or legal guardians of children aged ≤8 years old.	473	NVS	Health literacy is one of the factors that could be associated with the dosing tool choice. Parents with limited health literacy reported that dosing cups were the tool used most of the time.
Yin *et al* (2010)[16]	Paediatric clinic	Observational	To assess parents' liquid medication administration errors by dosing instrument type and to examine the degree to which parents' health literacy influences dosing accuracy.	Parents of children with no specific age limitation.	302 (287 mothers, 8 fathers, 7 legal guardians)	NVS	Health literacy was significantly related to doing errors with the cups as well as the dosing spoon, while non-significant trend was seen for the dropper and the oral syringes with the bottle adaptor.

Continued

Table 1 Continued

Study information		Participants characteristics			Findings		
First author (year)	Setting	Methods	Aim	Age of the recruited sample	Sample size	Health literacy test used	Outcomes and gaps
Samuels-Kalow *et al* (2013)[18]	Tertiary	Prospective observational	To examine language-based disparities in discharge communication and parental understanding of discharge instructions.	Parents of children 2 to 24 months.	145	Short Test of Functional Health Literacy (S-TOFHLA)	Parents had acetaminophen dosing errors. There is significant association between language and dosing errors. Parents with marginal or inadequate health literacy had dosing errors compared with adequate health literacy.
Yin *et al* (2014)[15]	Paediatric emergency department	Interviews and observations	To examine the degree to which recommended provider-counselling strategies, including advanced communication techniques and dosing instruments provision, are associated with reductions in parents liquid medication dosing errors.	Parents of children aged <8 years old.	287	S-TOFHLA	Majority of the patents made underdoing errors as well as few made overdosing errors. Recipient of at least one advanced counselling were less likely to make a dosing error compared with those who did not report received advanced counselling. Parent who received dosing instrument from the emergency department made fewer errors. For adequate health literacy levels was significantly associated with fewer errors when they have received advanced counselling in combination with instrument provision but not the low literacy.
Yin *et al* (2014)[19]	Emergency department	Interviews and observations	To examine the association between unit used and parent medication errors and whether non-standard instruments mediate the relationship.	Parents of children aged <9 years old.	400	S-TOFHLA	Parents made different kind of error in measurement. One in six parents used kitchen spoon rather than a standard instrument. Parents did not used the unit listed on the prescription or label.

Continued

Table 1 Continued

Study information		Participants characteristics			Findings		
First author (year)	Setting	Methods	Aim	Age of the recruited sample	Sample size	Health literacy test used	Outcomes and gaps
Yin *et al* (2007)[17]	Paediatric emergency department.	Interviews	To assess whether low caregiver health literacy was related to risk factors for liquid medication dosing errors, including reported use of non-standardised dosing tools and lack of knowledge about weight-based dosing.	Parents and caregivers of children aged between 30 days to 8 years old.	292	Test of Functional Health Literacy in Adults	Low health literacy, particularly reading comprehension, was associated with reported use of non-standardised dosing instruments and lack of knowledge regarding weight-based dosing. In addition, this has been found previously to be associated with decreased dosing accuracy.

of caregivers with adequate health literacy.[17] In contrast, Yin *et al*[26] found that there was no significant relation between dosing error and LEP. However, there were some differences in teaspoon-associated errors in measurement by language.[19]

Comprehension and recall of instructions in relation to parent sociodemographic status

Yin *et al*[25] reported that parents from a low sociodemographic status who were prescribed a daily dose and who received a simple language, pictogram instructions sheets, were less likely to make errors in knowledge of dose frequency and dose accuracy compared with the control group who received standard medication counselling (0% vs 15.1%). Participants among the interventional group were less likely to report incorrect medication preparation related to shaking the medication before administration for both daily doses (10.9% vs 28.3%, p=0.04) and as needed medication (21.5% vs 43.0%).[25] Participants in the interventional group were less likely to use a non-standardised measurement tool compared with the parents in the standard group (daily dose: 93.5% vs 71.7%; as needed: 93.7% vs 74.7%).[25] Torres *et al*,[28] a cross-sectional study that analysed data from a randomised control study, looked at parents preference and perceptions in regards to units of measurements. It was found that over 80% of the parents perceived a change to millilitre only instructions would be easy in comparison to 14% found it some how hard and 4.1% very hard.

Interventions aimed at reducing medication administration errors occurring among children outside a clinical setting

Parent's sociodemographic factors

Four studies suggested that parental sociodemographic risk factors should be considered when designing an intervention aimed at averting medication administration errors.[16 17 21 26] Among these factors were parents' health literacy as well as language. Kalow *et al* suggested that efforts to streamline interpreter services must be continued as well, to having a more formalised approach in place to elucidate the patient's preferred language for communication.[18]

Counselling and training

Three studies suggested that provisional dose counselling (showing the patient how to prepare the dose) in combination with verbal counselling could be associated with less dosing errors.[15 17 23] A study by Yin *et al*[15] indicated that errors occur across different counselling approaches, and they have recommended developing new strategies to ensure that parents understand medication instructions as well as the need for further research to identify the best counselling strategies and how to incorporate these within clinical practice. Yin *et al*[24] suggested the need for intensive teaching, training and coaching programmes that can accommodate for different parental health literacy levels.

Table 2 Characteristics of the randomised controlled experiment included in the review (listed alphabetically according to first author)

Study information		Participants characteristics			Findings		
First author (year)	**Setting**	**Methods**	**Aim**	**Age of the recruited sample**	**Sample Size**	**Health literacy test used**	**Outcomes and gaps**
Wallace *et al* (2012)[22]	Outpatient clinic	Randomised controlled trial	To address the gap by addressing whether instructions wording that implicit versus explicit dosage intervals was associated with participant's ability to describe and correctly measure a dose of a commonly prescribed liquid paediatric prescription medication.	Women of childbearing age.	193	Estimated using three established items: ▶ How often do you have problems learning about your medical condition because of difficulty understanding written information? ▶ How often do you have someone help you read hospital martials? ▶ How confident are you filling out medical forms by yourself?	One third of the participants (32.1%) were able to describe and measure the dose accurately. Participants with inadequate health literacy skills were one third as likely to measure a dose of the medication correctly.
Yin *et al* (2016)[24]	Paediatric clinic	Randomised controlled experiment	Hypothesised that unit concordance would be associated with fewer errors and that parents would measure most accurately with syringes we also sought to examine differences in impact by parents health literacy and language because low health literacy and limited English proficiency (LEP) are factors known to place children at risk for errors.	Parents of children aged ≤8 years old.	2099 parents	Newest vital sign (NVS)	Nearly all parents (99.3%) measured ≥1 dose that was not the exact amount. Overdoing (68.0%) was the majority of the errors. Dose amount of 2.5 and 7.5 mL was associated with more errors when compared with 5 mL(2.5 vs 5 mL adjusted OR (aOR)=4.2; 95% CI,3.8 to 4.6; 7.5 vs 5 mL (aOR)=1.4;95% CI, 1.2 to 1.5).

Continued

Table 2 Continued

Study information		Participants characteristics			Findings		
First author (year)	**Setting**	**Methods**	**Aim**	**Age of the recruited sample**	**Sample Size**	**Health literacy test used**	**Outcomes and gaps**
Harris *et al* (2017)[21]	Outpatient	Randomised controlled experiment	To examine the association between health literacy and limited English proficiency and liquid medication dosing errors in Hispanic parents	Hispanic parents of children<8 years old.	1126 parents	NVS	70% of the recruited parents had LEP, 82.7% had limited literacy. Of parents who had LEP 88.8% had limited and 11.2% adequate health literacy. 83.1% of parents made a dosing error at least one out of the nine dosing trials. Parents with limited health literacy and with LEP made the most dosing error and errors varied by dose amount and tool type.
Yin *et al* (2011)[26]	Outpatient paediatric clinic	Randomised controlled trail	To sought whether a pictographic dosing diagram included as part of written instructions can decrease parent errors in dosing infant acetaminophen as well as whether pictogram benefit varies by parent health literacy level.	Parents or caregiver of a child with no specific age limitation.	299 parents were assessed	NVS	Both groups were associated with poor dosing with the tendency for the parents who have received text plus pictogram significantly less likely to make dosing error (0.6%) compared with parents who received text only instructions (5.6%). Parents with low literacy who received the text plus pictogram instructions were significantly less likely to make errors in dosing compared with who received text only instructions(50.4% vs 66.4%; p=0.02).
Yin *et al* (2017)[23]	Paediatric outpatient clinic	Randomised controlled experiment	To examine the degree to which errors could be reduced with pictographic diagrams, millilitre-only units, and provision of tools more closely matched to prescribed volumes	Parents of children aged ≤8 years old.	2099 for all arms	NVS	Majority of the parents (99.3%) made dosing errors. More errors with the 2 and 7.5 mL dosing amount when compared with the 10 mL (2 mL vs 10 mL aOR=3.7; 7.5 mL vs 10 mL aOR=1.4). Parents who received text and pictogram dosing instructions with mL only labels and tools had decreased odds of making a dosing error compared with received mL/tsp labels and tools with or without pictographic dosing instructions.

Continued

Table 2 Continued

Study information		Participants characteristics			Findings		
First author (year)	Setting	Methods	Aim	Age of the recruited sample	Sample Size	Health literacy test used	Outcomes and gaps
Yin *et al* (2008)[25]	Paediatric emergency department	Randomised controlled trial	To evaluate the efficacy of a pictogram-based health literacy intervention to decrease liquid medication administration errors by caregivers of young children.	Parents and caregivers of children aged 30 days to 8 years.	245	Test of Functional Health Literacy in Adults	Caregiver's dose accuracy was higher among the intervention group prescribed daily and as needed medications regardless of the cut-off point was 20% or 40%. 5.4% of the intervention caregivers whose children had been prescribed daily doses gave inaccurate dose at the 20% cut- off point, compared with 47.8% of control caregivers. The study suggested that there is no health literacy association with the dosing errors.

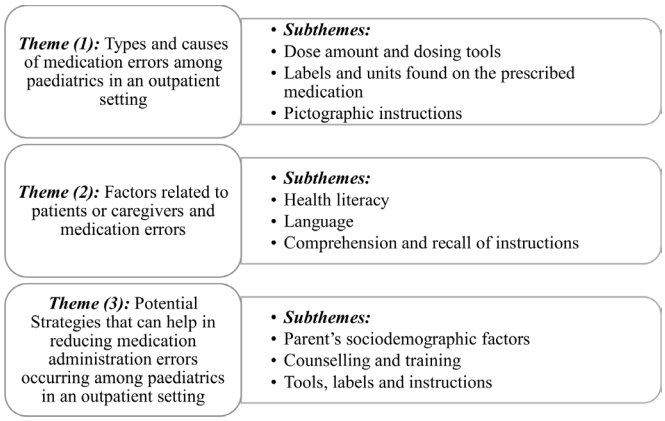

Figure 2 List of the review results.

Tools, labels and instructions

Yin *et al* suggested a promising strategy that could potentially help to reduce paediatric-dosing errors, which was to match the dosing tool with the prescribed dose volume and move towards more simplified numerical markings on the measurement tools as well as to move to millilitre-only units.[24 26 28] Wallace *et al*[22] indicated in his study that some parents would prefer instructions with explicit dosage intervals with the exact time and dose to be specified on the label. Harris *et al*[21] suggested improving the availability of language concordant labels that could accommodate for different health literacy levels. Three studies from this review strongly suggested the importance of using pictographic dosing instructions and how it could be a positive aid in reducing paediatric dosing errors.[23 25 26] Majority of parents would be comfortable with millilitre dosing instructions only.

DISCUSSION

The results of this study suggest that parents appear to make a range of medication errors, particularly with liquid medications as documented by prior studies that were conducted also in the USA as well as studies from this review.[2 4 23 25] The majority of the included studies indicated that dosing errors were among the most common medication errors made by parents, which is consistent with another study, which was conducted on Spanish-speaking Latino parents.[15 19 21 25 29] This review identified possible causality behind parents dosing errors other than just the effect of health literacy; these errors could be linked to the: dose volume prescribed, measurement tools used, units used on the labels and the instructions provided.

Although standardised measurement tools are usually dispensed with the prescribed liquid medications in the UK, this review identified that the studies published in the USA indicated that parents still use non-standardised liquid dosing tools as their primary measuring tool; this has been previously linked with medication administration errors by both Yaffe *et al* and McMahon *et al*.[30 31] The review found that pairing the medication labels to the

closest measurement tool size, particularly for millilitre-only labels and tools, could be associated with a reduction in parent dosing and administrating error rates, as well as a decrease in the likelihood of parents using non-standardised measurement tools as suggested by another research.[19 32]

The review showed that the use of simple pictographic-based medication instructions with explicit dosage intervals could reduce dosing errors by parents. This finding was consistent with previous existing data from both South and West Africa as well as the USA regarding the use of pictographic illustrations as a supportive tool to aid parents in administering medication to their children correctly.[33–41] Potentially, this could benefit both parents and caregivers with limited or low health literacy levels.

Our findings are consistent with prior USA studies investigating the link between adult's sociodemographic factors, particularly health literacy, and medication administration problems.[42–45] Four studies explicitly highlighted that sociodemographic factors, such as health literacy and language, must be incorporated into any future intervention that aims to reduce parental dosing and administration errors.

The results of the review highlighted several interventions to aid parents and patients to potentially reduce medication administration errors at home. This include the use of plain language combined with provision of using the dosing tool provided as well as incorporating pictographic instructions which were consistent in four of the included studies.[15 23 25 26] Pictographic-plain instructions significantly improve the accuracy of dosing and administering medication to children especially for those parents with insufficient health literacy.[25 26]

This study emphasised potential areas that could be incorporated into real practice that could help with reducing medication administration errors done by parents/caregivers and patients. Potential strategies include personalised training and coaching that accommodate different health literacy levels and languages as well as the possibility to match the dosing tool with the prescribed volume alongside the use of millilitre units.

Our review is subject to several limitations. There were two major limitations to our study. First, we only included studies in English, so publication bias may exist and non-English studies that are related to this topic might have been missed. Second, we only included studies that evaluated literacy using a validated tool. This resulted in only studies from the USA being included. The excluded studies that are of relevance to the topic, but outside the scope of this review are listed in (online supplemental table S2). Literacy is a problem worldwide, but of greater importance in low-income and middle-income countries. Future reviews should include these studies by broadening the search strategy.

Furthermore, although the study aimed at including medication administration challenges for younger people aged between 16 and 18 years old, however, none was included, as they did not pass the eligibility criteria for this review. Future research are needed where younger people aged 16–18 years old are included as participants. In addition, the generalisability of the study results maybe low; this is because the majority of the studies were conducted in the USA and emerged from the same research group Yin *et al*. This research group has highlighted several limitations in their studies, such as the use of hypothetical scenarios that might not be a true reflection on how parents measure the dose at home.[16 23 24 26] For some randomised trial studies in this review, it was difficult for the research team to maintain blindness as some of the participants revealed their allocated group, while for the cross-sectional studies, no conclusion of the causes could be drawn.[17 19 25] Finally, the date of publication for one of the studies was 13 years old,[17] which would not take into account the changes that have occurred in terms of interventions that would vary locally, nationally and internationally. However, this review highlights that non-standard dosing still occurs to date due to parent preference based on recent evidence in 2018.[28]

CONCLUSIONS

The findings suggest that in order to optimise medication use by parents, further work is needed to address the nature of these issues at home. Counselling, medication administration instructions and measurement tools are some of the areas in addition to the sociodemographic characteristics of parents and young people are among the factors to be considered when designing any future potential intervention aimed at reducing medication errors among children and young people at home.

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