



Parent Dosing Tool Use, Beliefs, and Access: A Health Literacy Perspective

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Objectives 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.

Study design Cross-sectional analysis of data collected for randomized controlled study in 3 urban pediatric clinics. English/Spanish-speaking parents (n = 493) of children ≤8 years of age enrolled. Outcomes: reported tool use, beliefs, and access. Predictor variable: health literacy (Newest Vital Sign; limited [0-3], adequate [4-6]). Multiple logistic regression analyses conducted.

Results Over two-thirds of parents had limited health literacy. Oral syringes (62%) and dosing cups (22%) were most commonly used. Overall, 24% believed dosing cups were the best tool type for dosing accuracy; 99% reported having access to ≥1 dosing tools with standard measurement markings. Parents with limited health literacy had greater odds of dosing cup use (limited vs adequate: aOR = 2.4 [1.2-4.6]). Parents who believed that dosing cups are best for accuracy had greater odds of dosing cup use (aOR = 16.3 [9.0-29.3]); this belief mediated health literacy-effects on dosing cup use.

Conclusions Factors associated with dosing tool choice, including parent health literacy and beliefs are important to consider in the design of interventions to reduce dosing errors; future larger-scale studies addressing this issue are needed. (*J Pediatr* 2019;215:244-51).

Administration of medication to children in the outpatient setting can be challenging for parents and caregivers; studies have documented that >40% make dosing errors.¹⁻⁷ Dosing medicine for children is more complex than for adults because of reliance on liquid formulations; liquids account for the majority of pediatric dosing errors.⁸

With liquid medications, a key contributor to inaccurate dosing is the type of dosing tool used.^{2,9} There is longstanding recognition¹⁰ that parents should use tools with standard measurement markings (eg, oral syringe, dosing cup, dropper) rather than kitchen spoons,^{2, 10-13} which should not be used due to wide variability in their size/shape.^{10,11,14-16} Of tools with standard measurement markings, oral syringes are widely accepted among health professionals as the best tool for dosing when accuracy is critical.^{3,17-19} Although dosing cups have standard measurement markings, and thus, are preferred over kitchen spoons, errors are common.^{3,15} Both the US Food and Drug Administration and US Poison Control Centers track overdoses involving dosing cups; over 5500 calls involving dosing cup-associated errors are made to US poison centers annually.²⁰ Recent experimental studies found dosing cups to be associated with a 3-4 times increased odds of a 2-fold or greater error,⁹ with measurements of small doses (eg, <5 mL) associated with the most multifold errors,²¹ likely because of the large amount of available space in the dosing cup where medication can be inadvertently poured.

Although it is widely accepted that oral syringes can dose more accurately than dosing cups, there are special circumstances in which parents may have difficulty measuring accurately with an oral syringe. For example, if a small sized oral syringe is provided for a large dose (eg, 5 mL capacity syringe is provided for a 7.5 mL dose), parents must use numeracy skills to divide the prescribed dose volume into multiple instrument-fulls. Recognizing this, the recommended approach to dosing tool provision is to consider the relationship between the prescribed dose volume and the dosing tool capacity. For small dose volumes (eg, <5 mL), there is general consensus that it is easier to dose accurately with an oral syringe than a dosing cup.

Parent beliefs about which tool type would allow for greatest dosing accuracy and lack of access to certain tool types may contribute to parent tool choice.

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AAP	American Academy of Pediatrics
OTC	Over-the-counter
SAFE-Rx for Kids	Safe Administration for Every Prescription for Kids

Examining these issues is especially timely given the recent nationwide push by the Centers for Disease Control and Prevention and others to move to mL-only and avoid spoon-based dosing, which included an American Academy of Pediatrics (AAP) policy statement on this topic^{22,23}; concerns have been raised regarding whether parents have access to standardized dosing tools, especially tools with mL markings.

Health literacy, defined as “the degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions,”²⁴ has been linked to parent misunderstanding of medication instructions and increased odds of liquid medication dosing errors.^{7,9,13,25} Parents with limited health literacy may not be aware of tool type-associated dosing accuracy and overdose risk.

As dosing cup use has been associated with large multifold errors, we specifically focus on the relationship between parent health literacy and dosing cup use, and the degree to which beliefs regarding tool dosing accuracy plays a role in this relationship.

Methods

Data were collected as part of phase 1 experiment 2 of the Safe Administration for Every Prescription for Kids (SAFE-Rx for Kids) study, a study to investigate the degree to which specific features of medication labels and dosing tools impact parent errors in dosing liquid medications. Main findings from phase 1 have been previously published.^{9,21,26} Subjects were enrolled from the following institution-affiliated pediatric outpatient clinics that serve low-income families: NYC Health + Hospitals/Bellevue Hospital Center (New York University, New York, New York) and Gardner Packard Children’s Health Care Center (Stanford University, Atherton, California), which both serve a predominantly Hispanic, immigrant population, and Children’s Healthcare of Atlanta at Hughes Spalding (Emory University, Atlanta, Georgia), which serves a predominantly African American, US-born population. Each site obtained institutional review board approval. Northwestern University served as the data management site.

Trained research assistants consecutively approached parents/legal guardians to determine eligibility. Those who met inclusion criteria were English- or Spanish-speaking parents or legal guardians (≥ 18 years old) with a child ≤ 8 years old presenting to the pediatric outpatient clinic, who was the primary person responsible for administering medications to their child. Parents were excluded if they had visual acuity worse than 20/50 (Rosenbaum Pocket Screener, McCoy Health Science Supply, Maryland Heights, Missouri), uncorrected hearing impairments, the child was presenting for emergency care, or either the parent or child had previously participated in a study involving dosing medication. All parents provided written, informed consent.

Survey Assessments

Survey assessments were performed on the day of study enrollment. Trained research assistants conducted survey assessments in either English or Spanish based upon caregiver preference. A structured survey was used to inquire about parent dosing tool-related outcomes and to assess sociodemographics and health literacy. A gift card (\$20) was provided as a nominal incentive.

Primary Outcome Variables: Outcomes Related to Dosing Tool Types

Parent dosing tool-related use, beliefs, and access were assessed using a structured survey. A response card was referred to which displayed tool type names, accompanied by a photograph (kitchen teaspoon, kitchen tablespoon, dosing spoon, measuring spoon, dosing cup, dropper, oral syringe; **Figure 1** [available at www.jpeds.com]).

Use of Dosing Tool Types. Parents were asked “Which one of these dosing tools do you use most of the time to give liquid medicine?” Parents could select only 1 tool from the response card, or could name a tool not on the card. Because dosing cups are associated with an increased odds of errors compared with other tools,⁹ responses were also dichotomized into those who reported using dosing cups most of the time and those who chose other tools.

Beliefs about Tool Dosing Accuracy. Parents were asked “Which one of these dosing tools do you think is the best to use if you want to measure the right amount of medicine?” Parents could select only 1 tool from the response card or could name a tool not on the card. As parent belief that dosing cups are best for dosing accuracy may influence parent decisions to use a dosing cup, responses were dichotomized into those who considered dosing cups as best to use for dosing accuracy and those who chose other tools.

Access to Dosing Tools Types. Parents were asked: “At home, do you have a...” (1) “dosing spoon?”, (2) “measuring spoon?”, (3) “dosing cup”?, (4) “dropper”?, and (5) “oral syringe”? Responses of “yes,” “no,” or “don’t know” were recorded for all questions. Responses of “don’t know” were grouped with responses of “no” reflecting not having home access to the dosing tool type.

Predictor Variable: Health Literacy

Parent health literacy was assessed in-person using the Newest Vital Sign, which is validated in both English and Spanish.²⁷ The Newest Vital Sign categorizes parents as having either low (score 0-1), marginal (score 2-3), or adequate (score 4-6) health literacy. For analyses, we categorized parents as having either limited (score 0-3) or adequate (score 4-6) health literacy.^{28,29}

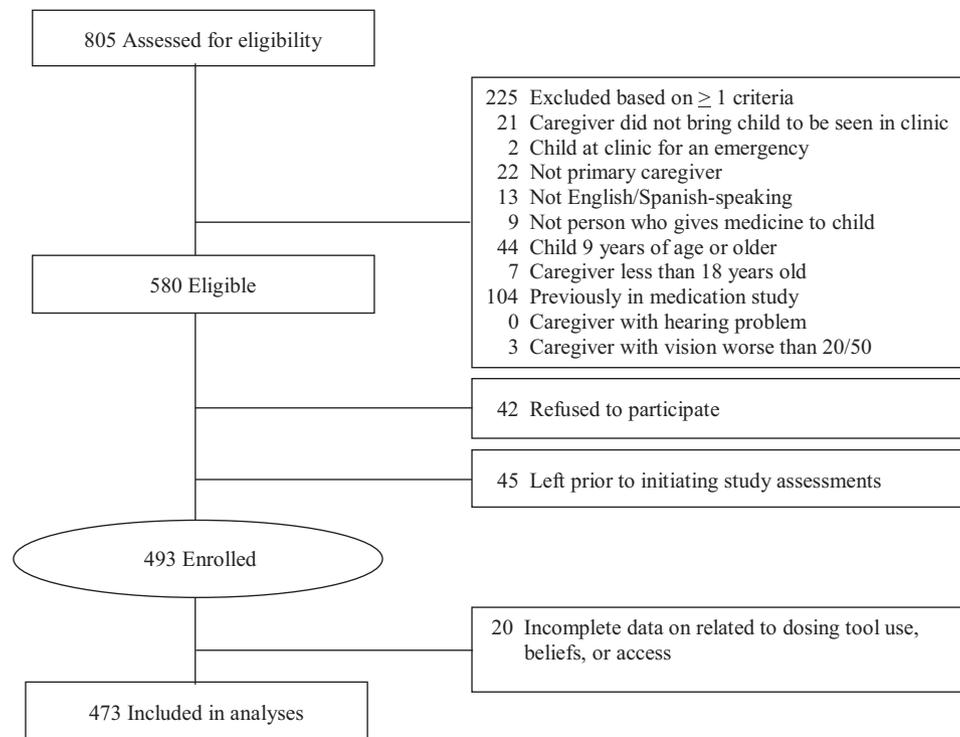


Figure 2. Recruitment and enrollment of study population.

Sociodemographic Data and Child Health Status

Sociodemographic data were obtained during the survey assessment. Child characteristics obtained included age, sex, and chronic disease status. Parent characteristics obtained included age, relationship to child, income, country of birth, race/ethnicity, language, education, and health literacy. Child chronic disease status with medication use was assessed using questions from the Children With Special Health Care Needs screener.³⁰

Statistical Analyses

Data were analyzed using SPSS software v 25 (IBM, Armonk, New York). Bivariate analyses were conducted to look at outcome variables by parent, child, and site-related characteristics, using χ^2 and t tests as appropriate. Multiple logistic regression analyses were performed to examine the relationship between health literacy and dosing cup use. The following variables were included in our model a priori based on prior literature: parent age (continuous), race (Hispanic, non-Hispanic whites, non-Hispanic blacks, and other), language (English or Spanish), country of birth (US born and non-US born), income (<\$10 000, \$10 000-\$19 999, \$20 000-\$39 999, \geq \$40 000, and unknown), education (less than high school graduate, high school graduate or equivalent, and higher than high school graduate), child age (continuous), and site (New York University [NYU], Stanford, and Emory). Path analysis was used to examine whether parent beliefs that dosing cup is the best tool for dosing accuracy mediated health literacy-effects on dosing cup use (Baron and Kenny criteria for mediation).³¹

Results

Between February 20, 2015 and July 23, 2015, 493 parents were enrolled in phase 1 experiment 2 of the SAFE-Rx for Kids study; 473 parents were included in this study analysis, as 20 parents had incomplete data related to dosing tool use, beliefs, or access (Figure 2). Over two-thirds of parents had limited health literacy (limited [71.8%], adequate [28.2%]) (Table I).

Outcomes Related to Dosing Tool Types

Use of Dosing Tool Types. The type of tool parents reported using most of the time was oral syringes (61.5%). The second most reported tool was dosing cups (21.8%) (Table II).

Beliefs about Tool Dosing Accuracy. Sixty-six percent of parents reported that oral syringes are the best tool for dosing accuracy, and 23.5% of parents reported that dosing cups are the best tool for dosing accuracy (Table II).

Access to Dosing Tool Types. Nearly all parents (98.7%) reported having access to at least 1 tool with standard measurement markings present in the home; there was no difference in access by parent/child characteristics, or by site. The tools most parents reported having access to were oral syringes (88.8%) and dosing cups (85.2%) (Table II).

Predictors of Reported Dosing Cup Use

In bivariate analyses, older child age, older parent age, being non-US born, Spanish language, having limited health literacy, and being from NYU/Stanford was associated with dosing cup

Table I. Characteristics of study population, and associations with dosing cup as the tool used most of the time and as the tool believed best for dosing accuracy (n = 473)^{*,†}

	Tool used most of the time: Dosing cup				Tool believed best for dosing accuracy: Dosing cup		
	Entire sample	Yes	No	P value	Yes	No	P value
		n = 103	n = 370		n = 111	n = 362	
	n (%)	n (%)	n (%)		n (%)	n (%)	
Child characteristics							
Age, mean (SD), y [‡]	2.3 (2.4)	3.6 (2.7)	1.9 (2.2)	<.001	3.7 (2.8)	1.8 (2.1)	<.001
Sex							
Male	247 (52.2)	51 (20.6)	196 (79.4)	.6	50 (20.2)	197 (79.8)	.1
Female	226 (47.8)	52 (23.0)	174 (77.0)		61 (27.0)	165 (73.0)	
Chronic medical problem treated with medication[§]							
Yes	81 (18.5)	17 (21.0)	64 (79.0)	.99	17 (21.0)	64 (79.0)	.7
No	358 (81.5)	78 (21.8)	280 (78.2)		86 (24.0)	272 (76.0)	
Parent characteristics							
Age, mean (SD), y [‡]	30.4 (7.7)	31.9 (7.0)	30.0 (7.8)	.02	31.7 (7.2)	30.0 (7.8)	.04
Relationship to child							
Mother	434 (91.8)	93 (21.4)	341 (78.6)	.5	101 (23.3)	333 (76.7)	.7
Other ^{**}	39 (8.2)	10 (25.6)	29 (74.4)		10 (25.6)	29 (74.4)	
Income (annual)							
<\$10 000	100 (21.1)	17 (17.0)	83 (83.0)	.3	20 (20.0)	80 (80.0)	.5
\$10 000-\$19 999	118 (24.9)	28 (23.7)	90 (76.3)		30 (25.4)	88 (74.6)	
\$20 000-\$39 999	150 (31.7)	39 (26.0)	111 (74.0)		39 (26.0)	111 (74.0)	
≥\$40 000	59 (12.5)	13 (22.0)	46 (78.0)		15 (25.4)	44 (74.6)	
Unknown/missing	46 (9.7)	6 (13.0)	40 (87.0)		7 (15.2)	39 (84.8)	
Country of birth^{¶,††}							
US born	230 (49.1)	36 (15.7)	194 (84.3)	.002	35 (15.2)	195 (84.8)	<.001
Non-US born	238 (50.9)	66 (27.7)	172 (72.3)		75 (31.5)	163 (68.5)	
Race/ethnicity^{¶,‡‡}							
Hispanic	203 (43.5)	56 (27.6)	147 (72.4)	.005	67 (33.0)	136 (67.0)	<.001
Non-Hispanic							
White, non-Hispanic	32 (6.9)	9 (28.1)	23 (71.9)		7 (21.9)	25 (78.1)	
Black, non-Hispanic	165 (35.3)	21 (12.7)	144 (87.3)		22 (13.3)	143 (86.7)	
Other, non-Hispanic	67 (14.3)	16 (23.9)	51 (76.1)		14 (20.9)	53 (79.1)	
Language^{¶,§§}							
English	317 (67.0)	55 (17.4)	262 (82.6)	.001	58 (18.3)	259 (81.7)	<.001
Spanish	156 (33.0)	48 (30.8)	108 (69.2)		53 (34.0)	103 (66.0)	
Education^{¶¶}							
Less than HS graduate	129 (27.6)	28 (21.7)	101 (78.3)	.98	36 (27.9)	93 (72.1)	.4
HS graduate or equivalent	145 (31.0)	31 (21.4)	114 (78.6)		31 (21.4)	114 (78.6)	
Higher than HS graduate	193 (41.3)	43 (22.3)	150 (77.7)		43 (22.3)	150 (77.7)	
Health literacy^{¶¶¶}							
Limited	331 (71.8)	81 (24.5)	250 (75.5)	.03	88 (26.6)	243 (73.4)	.02
Adequate	130 (28.2)	20 (15.4)	110 (84.6)		21 (16.2)	109 (83.8)	
Site characteristics							
Enrollment site^{¶¶¶}							
Emory	157 (33.2)	19 (12.1)	138 (87.9)	.002	21 (13.4)	136 (86.6)	.001
NYU	158 (33.4)	41 (25.9)	117 (74.1)		42 (26.6)	116 (73.4)	
Stanford	158 (33.4)	43 (27.2)	115 (72.8)		48 (30.4)	110 (69.6)	

HS, high school; NYU, New York University.

*Row %s shown for outcomes of interest.

†Findings presented as n (%) unless otherwise specified.

‡In adjusted analyses, older child age remained associated with being more likely to report dosing cup use and to report that dosing cups are the best tool for dosing accuracy.

§Missing for 34 children.

¶In adjusted analyses, older parent age, being non-US born, race/ethnicity, Spanish language, and site were no longer associated with dosing cup use or the belief that dosing cups are best for dosing accuracy.

**Other includes father and legal guardian.

††Missing for 6 parents.

‡‡Missing for 5 parents.

§§Language of survey administration.

¶¶¶Health literacy measured using Newest Vital Sign [limited = 0-3; adequate = 4-6]. Data missing for 12 subjects who did not complete the Newest Vital Sign. **Figure 3** shows the adjusted analyses involving health literacy.

use; being Black, non-Hispanic was associated with not using dosing cups (**Table I, Figure 3**).

In adjusted analyses, health literacy was the variable most strongly associated with reported dosing cup use. Parents with limited health literacy were more likely to report that

dosing cups were the tool used most of the time (aOR = 2.4 [1.2-4.6]). Older child age remained associated with being more likely to report dosing cup use. Older parent age, being non-US born, race/ethnicity, Spanish language, and site were no longer associated with dosing cup use.

Table II. Parent report of dosing tool-related use, beliefs, and access (n = 473)

Parent report	Dosing tools						
	Kitchen teaspoon	Kitchen tablespoon	Dosing spoon	Measuring spoon	Dosing cup	Dropper	Oral syringe
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Use: Tool used most of the time*	10 (2.1)	7 (1.5)	19 (4.0)	3 (0.6)	103 (21.8)	39 (8.2)	291 (61.5)
Beliefs: Tool considered best for dosing accuracy†	2 (0.4)	0 (0.0)	18 (3.8)	2 (0.4)	111 (23.5)	26 (5.5)	312 (66.0)
Access: Tools present in the home‡,§,¶	-**	-**	177 (37.4)	206 (43.6)	403 (85.2)	202 (42.7)	420 (88.8)

*1 parent, n (%) = 1 (0.2), responded with "other."
 †2 parents, n (%) = 2 (0.4), responded with "other."
 ‡Parents were able to select more than 1 dosing tool.
 §467 parents (98.7%) reported having at least one dosing tool in the home.
 ¶Parents who responded with "no" or "don't know" were grouped together. For each dosing tool, the following n (%) parents responded with "don't know": dosing spoon: 2 (0.4); measuring spoon: 4 (0.8); dosing cup: 2 (0.4); dropper: 5 (1.1); oral syringe 1 (0.2).
 **Not asked; participants were presumed to have access to these dosing tools.

Role of Parent Beliefs that Dosing Cups are the Best Tool for Dosing Accuracy in Association between Health Literacy and Dosing Cup Use

In bivariate analyses, older child age, older parent age, being non-US born, being Hispanic, Spanish language, having limited health literacy, and being from NYU/Stanford was associated with the belief that dosing cups are the best tool for dosing accuracy; being Black, non-Hispanic was associated with not believing dosing cups are the best tool for dosing accuracy (Table I).

In adjusted analyses, parents with limited health literacy were more likely to report that dosing cups are the best tool for dosing accuracy (aOR = 2.1 [1.1-4.1]) (Figure 3). Older child age remained associated with being more likely to report that dosing cups are the best tool for dosing accuracy. Older parent age, being non-US born, race/ethnicity, Spanish language, and site were no longer

associated with the belief that dosing cups are best for dosing accuracy.

Parents who reported that dosing cups are best for accuracy had a greater odds of reported dosing cup use (aOR = 16.3 [9.0-29.3]) (Figure 3). Path analyses showed that parent beliefs that dosing cups are the best for accuracy mediated health literacy effects on reported dosing cup use (Baron and Kenny criteria for mediation were met). In this model, older child age was associated with increased dosing cup use. In addition, Spanish-speaking parents also had an increased odds of dosing cup use (aOR = 2.6 [1.01-6.9]).

Discussion

This study examined the interrelationships between parent dosing tool use, beliefs, and access, and differences by health

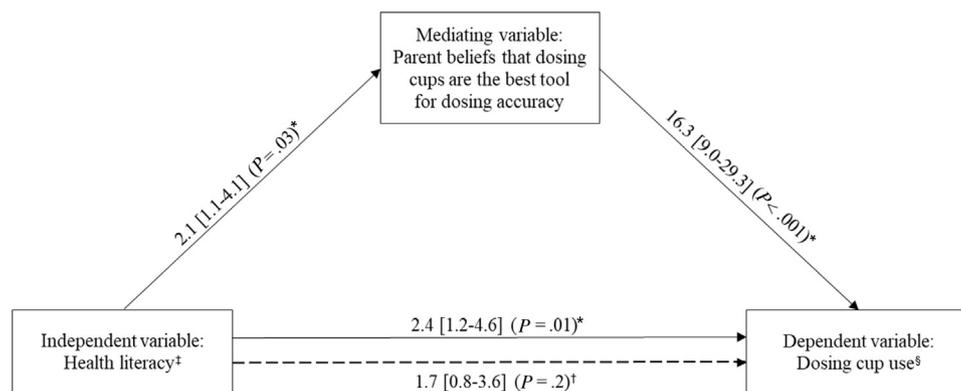


Figure 3. Limited health literacy and reported dosing cup use: mediation by beliefs about dosing cup accuracy. Baron and Kenny criteria for mediation met: health literacy associated with dosing cup use in analyses without parent beliefs in model; health literacy associated with parent beliefs; parent beliefs associated with dosing cup use; and association between health literacy and dosing cup use reduced when parent beliefs is included in model. †Multiple logistic regression analysis adjusting for parent age, race, language, country of birth, income, education, child age, and site. ‡Multiple logistic regression analysis with parent beliefs included in the model as well as adjusting for variables listed in footnote *. †Health literacy assessed using the Newest Vital Sign. §In the adjusted model predicting dosing cup use, having an older child age was statistically significantly related to dosing cup use, as was speaking Spanish (vs English) (aOR = 2.6 [1.01-6.9]).

literacy level. Most parents reported oral syringe or dosing cup use, and nearly all had home access to dosing tools with standardized measurement markings. Two-thirds reported that oral syringes are best for dosing accuracy, and nearly 1 in 4 reported a belief that dosing cups were best for dosing accuracy. Parents with limited health literacy had a 2-fold increased odds for dosing cup use. Beliefs that dosing cups are best for dosing accuracy mediated the association between health literacy and dosing cup use.

This study provides important insights into parent dosing tool use in the context of the recent push to move to mL-only dosing for pediatric liquid medications, led by the Centers for Disease Control and Prevention as part of their PRevention of Overdoses and Treatment Errors in Children Taskforce (PROTECT) initiative; this includes recommending the use of mL as part of dosing instructions as well as on dosing tools.^{22,32,33} A 2015 AAP Policy Statement also supports the move to mL-only, and avoidance of teaspoon and tablespoon units, along with use of standardized dosing tools with metric markings to support accurate dosing, preferably oral syringes.²² Our findings alleviate the concerns of some who worry that a move toward mL-only dosing will be difficult for those who do not have access to tools with standardized measurement markings; our study, which involved at-risk families from predominantly low socioeconomic status backgrounds, found that the vast majority (>98%) have access to at least 1 dosing tool with standardized measurement markings. Although parents may have access to these tools, they may not know how to use these tools correctly³; dosing cups are especially error prone.^{3,15} Our findings suggest that expanded recommendations which address circumstances in which dosing cups may not be optimal to use (eg, small volume doses, medications with a narrow therapeutic index, etc) may be helpful, especially for those with low health literacy.

We found that nearly one-half of parents reported using oral syringes most of the time, and approximately 1 in 5 reported using dosing cups most of the time. Few (<5%) reported nonstandard kitchen spoon use; avoidance of kitchen spoons for dosing is a message long endorsed by healthcare providers, and is included in a 1975 AAP Policy Statement.¹⁰ In contrast to our study, a 2008 study found that one-half of parents reported using oral syringes, about two-thirds dosing cups, and over 60% kitchen teaspoons.¹⁷ We also found in our study that although nearly two-thirds of parents believed that the best tool for accuracy is an oral syringe, approximately 25% believed that dosing cups are best for accuracy. A prior study found that a similar percentage of parents (~60%) believed that oral syringes were the most accurate device, and only 13% believed that dosing cups were¹⁷; this study, however, was conducted with a predominately non-Hispanic population, most of whom had at least some college education.¹⁷ Parent beliefs that dosing cups are best for accuracy may be influenced by the fact that most over-the-counter (OTC) liquid medications are packaged with dosing cups. We found that

parents who reported that dosing cups are best for accuracy had ~16 times the odds of reporting dosing cup use.

Our findings suggest that intervention strategies to reduce parent errors in dosing pediatric liquid medications should include a focus on educating parents about circumstances in which dosing cups may not be optimal to use (eg, small volume doses, medications with a narrow therapeutic index, etc). Such efforts are especially important for parents with lower health literacy who are at increased risk for making clinically significant, multi-fold, dosing errors. Improving provider use of evidence-based health literacy-informed strategies for medication counseling, including the use of teach-back/show-back,³⁴ pictures/drawings of the dose,¹ and dose demonstration,³⁵ can help promote adequate parent understanding of how to correctly dose medications.

We found that parents of older children were more likely to report using dosing cups and to believe dosing cups to be best for dosing accuracy. Dosing errors involving older children are often less concerning than errors in younger children, however, as older children are more likely to have larger recommended dose amounts, and an error of a specific absolute amount equates to a smaller relative error for a large dose amount compared with a small dose amount.

Of note, the data for our analyses came from the SAFE Rx for Kids study, which was focused on dosing tools for prescription rather than nonprescription medications. As few prescription medications come packaged with a dosing tool, parents typically take on a greater decision-making role related to dosing tools, as it is not standard practice for dosing tools to be provided in clinical or pharmacy sites.^{36,37} Even when dosing tools are provided, there is evidence that a large proportion of the time, the tools provided are not optimal (eg, provided tool is too small, requiring the need for multiple instrument-fulls).³⁶ When dosing tools are packaged with medications, such as with the majority of OTC liquid medications, the AAP and other groups recommend that parents use the dosing tool that comes with their medication,³⁸⁻⁴⁰ as such tools may specifically be designed to be concordant with the dosing instructions on the medication box/bottle, and to account for the viscosity of the liquid provided in an effort to promote dosing accuracy.^{15,21} Unfortunately, lack of concordance between the design of dosing tools and OTC medication remains a problem,^{41,42} and parents often make the decision to use dosing tools that are packaged with specific OTC medications with other OTC and prescription medications.¹⁵

There are limitations to this study. As this is a cross-sectional analysis, our ability to draw conclusions about causality is limited. We relied on parent self-report, which can be inaccurate and is subject to social desirability bias; we were careful during the interview, however, not to reveal tool preferences. In addition, we did not conduct in-depth interviews to examine factors which impact parent beliefs and use of specific dosing tools; future qualitative study would bolster our understanding of barriers to optimal dosing tool use. Furthermore, this study

was conducted with English- and Spanish-speaking parents at risk for limited health literacy who brought their children to 1 of 3 academic institution-affiliated pediatric clinics serving low-income families; our results may, therefore, not be generalizable. We purposely targeted these parents, however, given their higher risk for making dosing errors. Notably, however, the study populations were from 3 geographically distinct areas in the US. Despite the limitations described above, we believe our study contributes important information to the literature regarding dosing tool use, beliefs, and access. ■

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Kitchen Teaspoon



Kitchen Tablespoon



Dosing Spoon



Measuring Spoon



Dosing Cup



Dropper



Oral Syringe

Figure 1. Response card.