



## **Parent Preferences and Perceptions of Milliliters and Teaspoons: Role of Health Literacy and Experience**

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## Parent Preferences and Perceptions of mLs and Teaspoons: Role of Health Literacy and Experience

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### Abstract

**Background and Objectives**—A recent AAP policy statement recommends mL-exclusive dosing for pediatric liquid medications. Little is known about parent preferences regarding units, perceptions about moving to mL-only, and the role of health literacy and prior mL-dosing experience.

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Deesha Patel, Kwang-Youn Kim: Ms. Patel and Dr. Kim participated in the design the study, analyzed and interpreted the data, critically revised the manuscript for important intellectual content, and approved the final manuscript as submitted.  
Jessica Jimenez: Ms. Jimenez participated in the design of the study, assisted in acquisition of data, analysis and interpretation of the data, drafting of the manuscript, and approved the final manuscript as submitted.  
H. Shonna Yin: Dr. Yin conceptualized and designed the study, analyzed and interpreted the data, drafted the initial manuscript, critically revised the manuscript for important intellectual content, provided study supervision, and approved the final manuscript as submitted.

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**Methods**—Cross-sectional analysis of data collected as part of a randomized controlled study in 3 urban pediatric clinics (SAFE-Rx for Kids study). English/Spanish-speaking parents (n=493) of children 8 years were randomized to 1 of 4 study arms and given labels/dosing tools which varied in label instruction format (text+pictogram, text-only) and units (mL-only, mL/tsp). Outcomes: teaspoon preference in dosing instructions, perceived difficulty with mL-only dosing. Predictor variable: health literacy (Newest Vital Sign; low[0-1], marginal[2-3], adequate[4-6]). Mediating variable: prior mL-dosing experience.

**Results**—Over two-thirds of parents had low or marginal health literacy. The majority (>70%) preferred to use mL, perceived mL-only dosing to be easy, and had prior mL-dosing experience; 11.5% had a teaspoon preference, 18.1% perceived mL-only dosing will be difficult, and 17.7% had no prior mL-dosing experience. Parents with lower health literacy had a higher odds of having a teaspoon preference (*low vs. adequate*: AOR=2.9[1.3-6.2]), and greater odds of perceiving difficulty with mL-only dosing (*low vs. adequate*: AOR=13.9[4.8-40.6]), *marginal vs. adequate*: AOR=7.1[2.5-20.4]). Lack of experience with mL-dosing partially mediated the impact of health literacy.

**Conclusions**—Most parents were comfortable with mL-only dosing. Parents with low health literacy were more likely to perceive mL-only dosing to be difficult; educational efforts will need to target this group to ensure safe medication use.

### Keywords

medication errors; dosing errors; dosing units; health literacy; ambulatory care; health communication

### Introduction

Medication dosing errors resulting from confusion between units of measurement (e.g. milliliter, teaspoon, and tablespoon) by parents and healthcare providers have contributed to serious adverse events in pediatrics.<sup>1,2</sup> Standardization of units, with a move to milliliter (mL)-only dosing, is a priority issue of the Centers for Disease Control and Prevention's PROTECT (Preventing Overdoses and Toxic Exposures in Children Task force) Initiative.<sup>3</sup> Recently, the American Academy of Pediatrics (AAP), a key PROTECT partner, issued a policy statement recommending a move to mL-only dosing, and avoidance of teaspoon and tablespoon terms<sup>4</sup>; the American Academy of Family Physicians (AAFP), American Association of Poison Control Centers (AAPCC), and the Institute for Safe Medication Practices (ISMP) have also recently come out in support of mL-only dosing.<sup>1,5-7</sup>

Currently, a range of units may be found as part of instructions on medication labels and dosing tools, increasing the likelihood of multi-fold errors by prescribers, pharmacists, and parents.<sup>8-11</sup> Terms like teaspoon and tablespoon may also inadvertently endorse the parent use of kitchen spoons; it is well recognized that nonstandard kitchen spoon use increases the risk of dosing errors.<sup>12,13</sup>

For health care providers, the transition to a metric system in the outpatient setting represents an extension of current recommended inpatient standards.<sup>14</sup> These standards resulted from concerns regarding the increased likelihood of provider mistakes in

calculating/dispensing correct doses for inpatients due to unit confusion.<sup>1,7</sup> One contributor to errors is the similarity of abbreviations for teaspoon and tablespoon terms (e.g. “tsp”, “tbsp”).<sup>15</sup>

For parents and other caregivers who administer liquid medications to children outside the hospital, there are concerns that moving to an mL-exclusive system could result in confusion and errors, as the US has historically relied on a non-metric spoon-based system.<sup>16</sup> While one study found that parents had fewer dosing errors when they thought of their child's dose in mL vs. teaspoon/tablespoon units,<sup>17</sup> a move to mL-only is not unanimously supported; many providers continue to utilize teaspoon terms.<sup>9</sup> One concern is an mL-only system could inadvertently lead to more dosing errors, especially if dosing tools with mL-markings are not readily available.<sup>18</sup>

To date, there has been limited research examining parents' unit preferences and experiences with mL-dosing. Implementation science principles advocate for the assessment of individual preferences as an important strategy to improve the effectiveness of public health initiatives.<sup>19,20</sup> A better understanding of parent preferences and experiences related to mL-dosing would help ensure that the needs of those at greatest risk are considered in the design of educational campaigns and other intervention strategies to promote the safe use of pediatric medications under the new system. As it is unlikely that a move to an mL-only system will occur without a period of transition, a better understanding of parent preferences can be leveraged such that there is a smoother, faster transition. In addition, few studies have looked at these issues from a health literacy perspective, even though low health literacy is widely recognized to be linked to caregiver misunderstanding of medication instructions and increased odds of dosing errors.<sup>18,21,22</sup> We therefore sought to examine the interrelationships between parents' preferences and perceptions regarding units of measurement, parent mL-dosing experiences, and parent health literacy.

## Methods

### Setting, Participants and Recruitment

Data was collected as part of the second experiment of the SAFE-Rx for Kids study, a randomized controlled experiment to examine the degree to which specific features of medication labels/dosing tools impact parent dosing errors; findings from the first experiment have been previously published.<sup>12,18</sup> Subjects were enrolled from three pediatric outpatient clinics [Bellevue Hospital Center, Gardner Packard Children's Health Care Center, and Children's Healthcare of Atlanta at Hughes Spalding], which serve predominantly low income families. Northwestern University served as the data management site. Institutional review board approval was obtained from each site.

Parents/legal guardians were approached consecutively by trained research assistants (RAs) to determine eligibility. Inclusion criteria were: English- or Spanish-speaking parent/legal guardian (≥ 18 years of age) of a child ≥ 8 years, presenting for clinic care; parent with primary responsibility for administering medications to their child; parent who had not previously participated in a dosing study. Exclusion criteria included: parent visual acuity worse than 20/50 (Rosenbaum Pocket Screener); uncorrectable hearing impairment; and

child to be seen for emergent care. Written, informed consent was obtained from parents prior to participating in the study. Following subject enrollment, parents were randomized to one of four groups that differed in the manner in which hypothetical medication label instructions were provided.

### Assessments

Trained research assistants conducted survey assessments in English or Spanish, per caregiver preference. Dosing assessments were conducted first, with two groups randomized to receive mL-only labels/dosing tools, while two groups received mL/tsp labels and tools. Subsequently, parents were asked about their unit preferences, perceived difficulty dosing with mL-only instructions, and prior mL-dosing experience. This was followed by a structured survey to assess sociodemographic characteristics and health literacy. A gift card (\$20) was provided to study subjects as a nominal incentive.

### Primary Outcome Variables: Unit Preferences, and Perceived Difficulty Dosing with mL-only Instructions

Unit preference was assessed for 2 dose amounts - 5 mL and 7.5 mL. These two doses were chosen as parents may be impacted by the presence of whole numbers vs. numbers that include decimals/fractions. Parents were asked, "Please look at this card and choose the one way you would like your child's dose of medicine to be written on the medicine bottle. The words on the card show the same amount of medicine but are written differently." For the 5 mL amount, options included: "5 mL," "5 milliliter," "1 tsp," "1 teaspoon," and "no preference." For the 7.5 mL amount, options included: "7.5 mL," "7.5 milliliter," "1½ tsp," "1½ teaspoon," and "no preference." For each dose, parents who selected options with "mL" or "milliliter" were considered to prefer milliliter-dosing for that amount and parents who selected "tsp" or "teaspoon" options were considered to prefer teaspoon-dosing for that amount, with the remainder categorized as having "no preference." A composite variable was created to identify those parents with an overall preference for teaspoon dosing, composed of those parents who preferred "tsp" or "teaspoon" units for both the 5 mL and 7.5 mL doses. This composite variable was created to identify those parents who prefer teaspoon dosing as they may therefore have greater difficulty adjusting to a move to mL-only dosing.

To assess perceived difficulty dosing with mL-only instructions, parents were asked, "If instructions for liquid medicines only came in milliliters, how hard would it be for you to measure just with milliliters?", with responses of very hard, somewhat hard, somewhat easy, or very easy. A composite variable was created, with parents who selected very or somewhat hard grouped together to designate those parents who perceived that it would be difficult to move to mL-only dosing.

### Mediating Variable: Lack of Experience Dosing with mL

To assess experience with mL dosing, parents were asked, "Before today, have you ever had to measure a liquid medicine in a milliliter (mL) amount?" with response choices of yes, no, don't know/unsure. Those parents who answered "no" or "don't know/unsure" were categorized as not having prior mL-dosing experience.

### **Predictor Variable: Health Literacy**

Health literacy was individually assessed in-person using the Newest Vital Sign (NVS), which has been validated in both English and Spanish.<sup>23</sup> A score of 0 or 1 was considered “low” health literacy, representing a high likelihood of limited literacy; 2 or 3, “marginal” health literacy, representing possible limited literacy; 4 to 6, “adequate” health literacy.

### **Sociodemographic Data and Child Health Status**

Child characteristics measured included: age, gender, and chronic disease status. Chronic disease status was assessed using questions from the Children with Special Health Care Needs screener adapted to evaluate chronic disease and medicine use in any child in the household.<sup>24</sup> Parent characteristics included: age, gender, relationship to child, marital status, income, country of birth, race/ethnicity, language, education level. To assess English proficiency, parents were asked “How well do you speak English?” A response of “very well” was considered English proficient. Responses of “well,” “not well,” or “not at all” were considered limited English proficient.<sup>25-27</sup>

### **Statistical Analyses**

Data were analyzed using SAS software version 9.4 (SAS Institute, Inc., Cary, North Carolina). Descriptive statistics were calculated for each variable. Kruskal-Wallis and chi-square analyses were conducted to examine unadjusted associations between study sample characteristics and outcome and mediating variables of interest. Chi-square analyses were used to examine the relationship between the outcome and mediating variables.

Multiple logistic regression analyses were performed to examine the relationship between health literacy and: 1) preference for teaspoon dosing, and 2) perceived difficulty with mL-only dosing. Only factors found to be associated with the outcomes, based on forward and backward stepwise selection, were included in the models; variables included in our final model were parent age (continuous), country of birth (US-born, non-US born), and health literacy (adequate, marginal, low). Path analysis was used to examine whether lack of mL-dosing experience mediated the impact of health literacy on dependent variables of interest (teaspoon preference and perceived difficulty of mL-only instructions) (Baron and Kenny).<sup>28</sup> Specifically, we assessed whether the following criteria were met in logistic regression models: 1) health literacy was associated with dependent variables of interest, adjusting for parent age and country of birth; 2) health literacy was associated with lack of mL dosing experience, adjusting for age and country of birth; 3) lack of mL dosing experience was associated with dependent variables, adjusting for parent age, country of birth, and health literacy; and 4) the association between health literacy and dependent variables was attenuated when lack of mL dosing experience was included in the models outlined in the first step.

For all analyses, a 2-tailed  $p < 0.05$  was considered statistically significant.

## Results

Between 2/20/2015-7/23/2015, of 805 parents consecutively presenting in clinic and assessed for eligibility, 580 were found to be eligible, and of these, 493 (85.0%) parents were enrolled in the study and randomized. Data from 487 parents were included in analyses; 6 had incomplete data related to unit experience, preference, or perception of difficulty moving to mL-only labeling (Figure 1). Over two-thirds had limited health literacy (low (27.9%), marginal (44.2%)) (Table 1).

### Parent Unit Preferences and Perceived Difficulty Dosing with mL-only Instructions

The majority of parents expressed a preference for mL/milliliter over tsp/teaspoon, across the two medication amounts assessed (preferred mL/milliliter for 5 mL dose=78.8%, for 7.5 mL dose=70.4%). About 1 in 10 parents (11.5%) preferred medicine amounts in teaspoons only, regardless of the dose quantity (Table 2). Over 80% of parents perceived that a change to mL-only instructions would be easy, while the remainder felt it would be difficult (4.1% very hard, 14.0% somewhat hard). Parents with a teaspoon preference were more likely to perceive difficulty dosing with mL-only instructions (42.9 vs. 14.9%,  $p<0.001$ ).

### Parent mL-Dosing Experience, and its Role in Unit Preferences and Perceived Difficulty Dosing with mL-only Instructions

The majority of parents (82.3%) had experience dosing with milliliters (Table 2). Parents who had no experience in dosing with milliliter were more likely to have a teaspoon preference (*preferred for both 5 and 7.5 mL doses: 26.7%, preferred for either dose: 18.6%*), compared to parents who had prior mL-dosing experience (*preferred for both 5 and 7.5 mL doses: 8.2%, preferred for either dose: 12.5%*);  $p<0.001$  (Table 3). Parents who had never dosed in milliliter were also more likely to perceive difficulty in moving to mL-only dosing (48.8% vs. 11.5%;  $p<0.001$ ).

### Predictors of Unit Preferences and Perceived Difficulty Dosing with mL-only Instructions: Adjusted Analyses

In adjusted analyses, health literacy was the variable most strongly associated with preference for teaspoon units. Parents with low health literacy had almost 3 times the odds of having a teaspoon preference compared to parents with adequate health literacy (*low vs. marginal vs. adequate: 19.4 vs. 7.6 vs. 9.7%*,  $p=0.001$ ; *low vs. adequate: AOR=2.9 [1.3-6.2]*,  $p=0.007$ ) (Figure 2). Older parent age and non-US birth were also associated with a preference for teaspoon units.

Health literacy was also the variable most strongly associated with perceived difficulty with mL-dosing. Parents with lower health literacy had greater odds of perceiving difficulty in moving to mL-only instructions (*low vs. marginal vs. adequate: 33.6 vs. 18.4 vs. 3.0%*,  $p<0.001$ ; *low vs. adequate: AOR=13.9 [4.8-40.6]*, *marginal vs. adequate: AOR=7.1 [2.5-20.4]*) (Figure 2). Older parent age was also associated with perceived difficulty with mL-only instructions.

## Role of Prior mL-Dosing Experience in Associations Between Health Literacy and Preference for Teaspoon Units and Perceived Difficulty with mL-only Dosing

Those with lower health literacy levels were more likely to lack experience dosing in mL (*low vs. marginal vs. adequate*: 44.7 vs. 48.2 vs. 7.1%,  $p=0.001$ ; *low vs. adequate*: 9.0[3.6-22.6], *marginal vs. adequate*: 5.4[2.2-13.1]) (Figure 2).

Parents who lacked mL-dosing experience had a greater odds of having a teaspoon preference (AOR=3.4[1.8-6.6]). Path analyses showed that lack of mL-dosing experience partially mediated health literacy effects on teaspoon preference (4 Baron and Kenny criteria for mediation were met) (Figure 2).

Parents who lacked mL-dosing experience also had a greater odds of perceiving difficulty in moving to mL-only instructions (AOR=5.7[3.2-9.9]). Path analyses showed that lack of experience dosing in mL partially mediated health literacy effects on perceived difficulty of a move to mL-only instructions (Figure 2).

## Discussion

This study is the first to examine parents' unit preferences and perceptions of a move to mL-only dosing instructions, with a specific focus on the role of health literacy and prior mL-dosing experience. In our study population, which included a large percentage of low income families with limited health literacy, with nearly half non-US born, we found that >70% of parents prefer to see dosing instructions with mL units, >80% perceived a change to mL-only instructions as not being difficult, and >80% had prior mL-dosing experience. We did find, however, that 11.5% of parents prefer teaspoon units, and nearly 20% perceive that it will be difficult to move to mL-only dosing instructions. Parents with limited health literacy had the greatest likelihood of having a teaspoon preference and to perceive difficulty in a move to mL-only dosing; these associations were explained to a large extent by a lack of mL-dosing experience.

The high rates of parent experience with mL-dosing that we found is consistent with findings from other studies which show that mL units are already commonly used in healthcare in the US. One study of pediatric liquid medications found that mL-only was used frequently on both prescriptions sent to pharmacy (68%) as well as pharmacy labels (62%).<sup>9</sup> Studies of US OTC pediatric liquid medications found that mL units, whether alone or in combination with teaspoon units, were found in nearly 75% of medications, with 28% of directions using mL-only.<sup>8,29</sup> Our finding that the majority of parents prefer seeing doses in mL-only, and are comfortable with mL-only dosing, is consistent with another study in a similar population which illustrated that parents were able to dose accurately in mL, making fewer dosing errors when doing so compared to when teaspoon units were used.<sup>17</sup>

Notably, however, 1 in 4 parents expressed a preference for teaspoon units for at least 1 of the 2 doses presented, and nearly 1 in 5 perceived that a change to mL-only will be difficult. This finding is unsurprising, as the US is one of several countries that is non-metric and has historically relied on spoon-based units.<sup>16,30</sup> Spoon-based units remain common despite evidence that these units are associated with a higher likelihood of dosing errors and use of

nonstandard kitchen spoons;<sup>12,13,17,31</sup> confusion between teaspoon and tablespoon units can lead to three-fold dosing errors.<sup>32</sup>

Addressing patient preferences is recognized to be an important quality aim. Plans for implementation of an mL-only system would benefit from consideration of parent preferences, in order to ensure that the needs of vulnerable groups are adequately considered. A move to mL-only is unlikely to occur without a transition period; parent preferences regarding teaspoons can drive behaviors related to how parents choose and use medications, including dosing tool selection. Targeting of interventions to at-risk groups could help ease the transition to mL-only dosing. We acknowledge that while a universal precautions approach is indeed advocated with respect to clear communication of dosing instructions between providers and patients, regardless of health literacy status, public health campaigns may be more effective with segmentation of messages to target at-risk groups who may have unique issues and concerns. A number of countries were in the process of transitioning to metric units in the 1970s;<sup>16</sup> one paper by McQueen argued that minimal education of the Canadian public was needed to ensure safety during the transition.<sup>30</sup> To our knowledge, however, no study specifically examined the impact of these policy changes on error rates, or the specific impact of changes on at-risk, low literacy populations.

Our study found that low health literacy was the characteristic most strongly associated with having a teaspoon preference and perceived difficulty dosing with mL-only. Compared to parents with adequate health literacy, parents with low health literacy had about 3 times the odds of having a teaspoon preference, and over 10 times the odds of perceiving difficulty dosing with mL-only instructions. These findings point to the need to carefully consider the needs of those with low health literacy if an mL-only system is adopted.

Path analyses revealed that the association between low health literacy and both teaspoon preference and perceived difficulty of mL-only instructions was partially mediated by lack of mL-dosing experience. This supports the notion that interventions which help parents gain exposure to dosing with mL might improve parent comfort with and confidence in dosing in mL. As a growing number of professional organizations endorse mL-only dosing, it is vital for these groups to promote provider awareness that parents with low health literacy may especially have difficulty with mL-only dosing, and provide recommendations to providers regarding how to best address these concerns. Evidence-based health literacy-informed strategies for medication counseling including use of teachback/showback,<sup>33</sup> drawings or pictures of the dose,<sup>34</sup> and dose demonstrations,<sup>35</sup> are potential tools for ensuring adequate parent understanding; provision of dosing tools with mL units can also support parent ability to safely act on medication instructions.<sup>12</sup> Public health campaigns related to dosing units may also be needed to help educate families about mL-only dosing and address parent concerns.

There are limitations to this study. Conclusions about causality cannot be made, as this cross-sectional analysis examined associations between study variables. We relied on parent self-report, which can be inaccurate. We were careful during the interview, however, to not indicate whether we supported mL or teaspoon dosing, in order to minimize social desirability bias. Parents were asked about mL-experience after the dosing assessment,

where they were randomized to receive mL-only, or mL and teaspoon, units on medication labels and tools; this may have influenced their responses for unit preference and perceived difficulty. We note, however, that there was no difference in unit preferences and perceived difficulty between those who were exposed to mL-only versus mL/tsp in the assessment (analyses not shown). There were also no differences in parent report of mL-dosing experience by group. In addition, we assessed for any mL-dosing experience, and do not know the extent of parent mL-dosing experience. In analyses, we also combined mL preference as those who chose “mL” or “milliliter”, and teaspoon preference as those who chose “tsp” or “teaspoon”; further qualitative study would be helpful to further explore the extent to which these terms have the same meaning for respondents. We did not incorporate in these analyses parent access to different dosing devices, which may impact their familiarity with units of measurement, although in our sample over 99% had access to standardized devices which likely include mL markings. This analysis focused on health literacy; we did not perform analyses involving numeracy, which may also influence parent perceptions and preferences around mL dosing. Finally, we conducted this study with predominantly English- and Spanish-speaking parents with low health literacy who brought their children to be seen at university-affiliated pediatric clinics serving low income families, and our results may therefore not be generalizable due to selection bias. We note that we purposely targeted these parents, however, given their higher risk for making medication errors. Despite the limitations described above, we believe our study contributes important information to the literature as no previous research has examined parent unit preferences and prior mL experiences, and we did so in a diverse population from three geographically distinct areas in the US.

## Conclusion

Our findings confirm that although the majority of parents are comfortable with a move to mL-only dosing, a significant number of parents known to be vulnerable to medication dosing errors are not as comfortable with such a change. Initiatives to support the move to mL-only dosing will require heightened efforts over time to ensure comfort and accuracy of dosing especially for patients with lower health literacy and limited experience with mL-only dosing.

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## Abbreviations

<b>mL</b>	milliliter
<b>tsp</b>	teaspoon
<b>HL</b>	health literacy

**What's New**

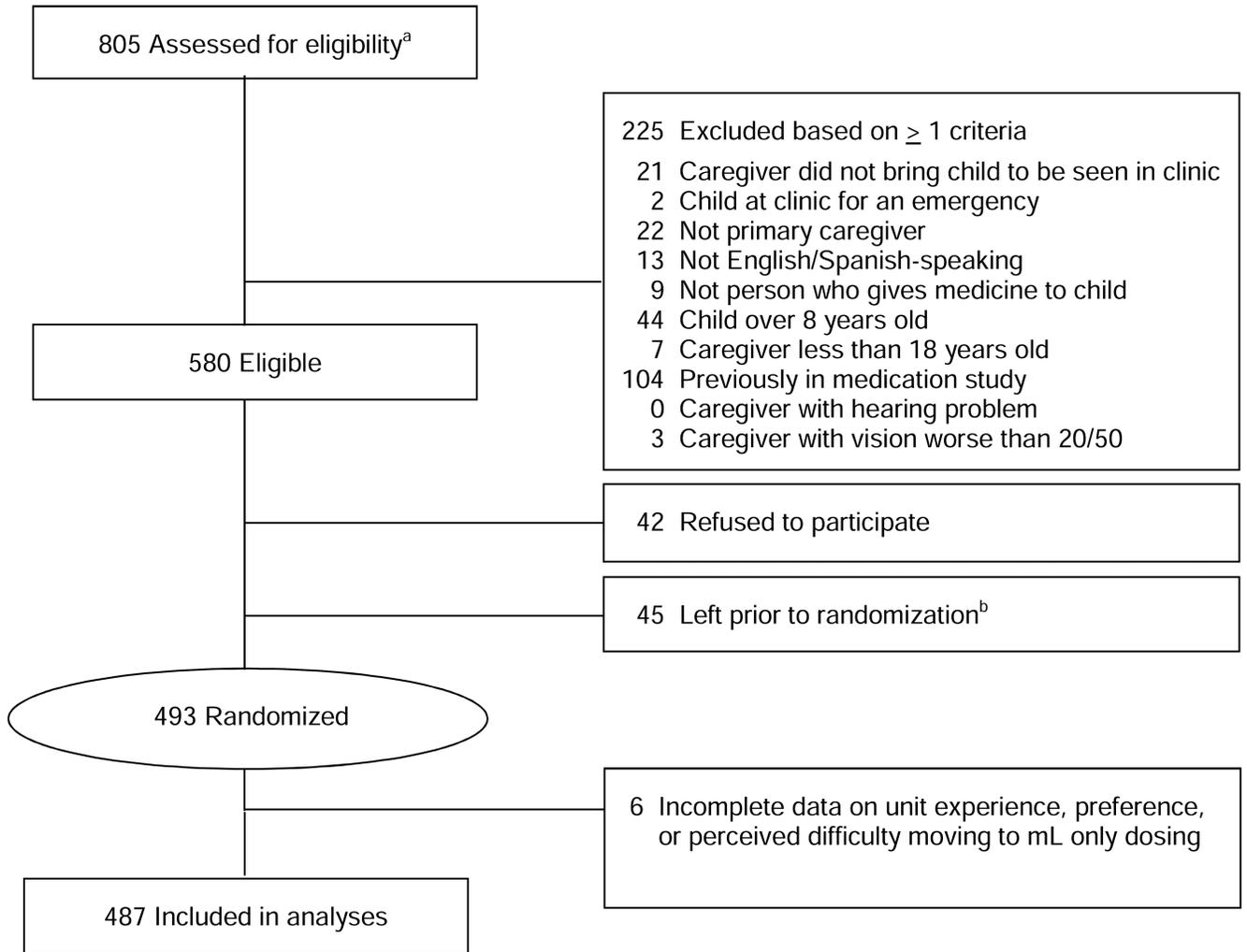
In this multisite study, most parents felt comfortable with a move to mL-only dosing. Parents with low health literacy were more likely to perceive mL-only dosing to be difficult; initiatives to support this at-risk group will be important.

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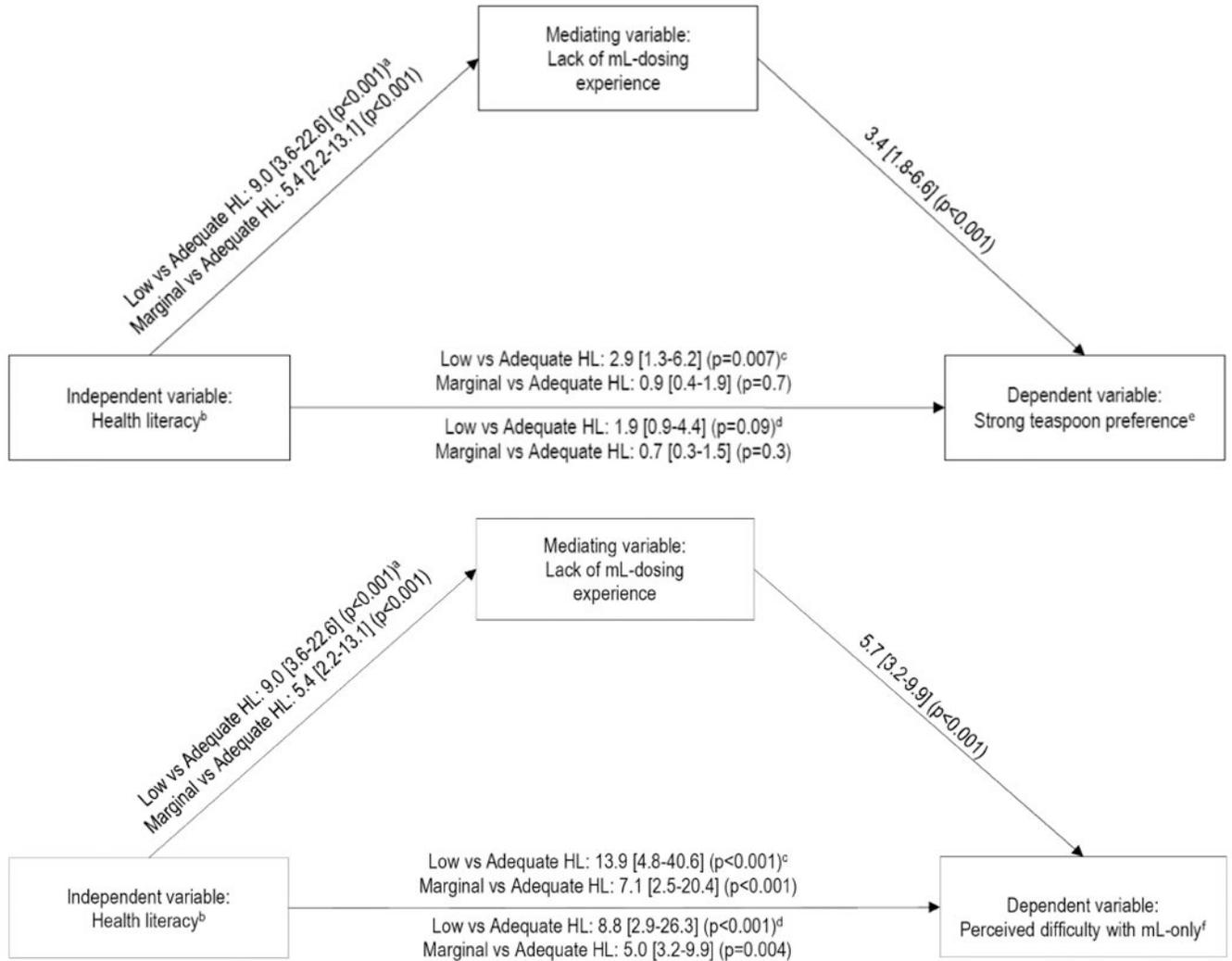
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**Figure 1. Recruitment and Enrollment of Study Participants**

<sup>a</sup> Parents consecutively approached in the clinic

<sup>b</sup> Ran out of time after signing consent



**Figure 2. Path Analysis: Lack of mL-Dosing Experience as a Mediator of Low Health Literacy-associated Teaspoon Preference and Perceived Difficulty with mL-only Instructions<sup>a</sup>**

**Figure 2A.** Lack of mL-Dosing Experience as a Mediator of Low Health Literacy-associated Teaspoon Preference

**Figure 2B.** Lack of mL-Dosing Experience as a mediator of Low Health Literacy-associated Perceived Difficulty with mL-only Instructions

Abbreviations: HL=health literacy

<sup>a</sup> Baron and Kenny criteria for mediation met for both models: health literacy associated with dependent variables of interest [strong teaspoon preference and perceived difficulty with mL-only instructions] in analyses without lack of experience dosing with mL in model; health literacy associated with lack of experience dosing with mL; lack of experience associated with dependent variables; and association between health literacy and dependent variables reduced when lack of experience dosing with mL included in the model. Note wide confidence intervals in Figure 2 for relationship between health literacy and lack of mL-dosing experience due to skewed data, such that among those with adequate health literacy,

95% had experience with mL-dosing (for lack of experience vs. experience with mL-dosing, n's by health literacy level were: *low*: 38 vs. 96, *marginal*: 41 vs. 171, *adequate*: 6 vs. 128).

<sup>b</sup> Health literacy assessed using the Newest Vital Sign (NVS).

<sup>c</sup> Multiple logistic regression analysis adjusting for parent age and country of birth (US-born vs. non-US born), and health literacy. Note wide confidence interval in Figure 2B for the relationship between health literacy and perceived difficulty with mL-only dosing due to skewed data; among those with adequate health literacy, 97% did not perceive difficulty with mL-only dosing (for perceived difficulty vs. no difficulty, n's by health literacy level were: *low*: 89 vs. 45, *marginal*: 173 vs. 39, *adequate*: 130 vs. 4).

<sup>d</sup> Multiple logistic regression analysis with lack of experience included in the model and adjusting for variables listed in footnote c. Note wide confidence interval in Figure 2B due to skewed data as described above.

<sup>e</sup> Strong teaspoon preference created as a composite variable including parents who chose teaspoon/tsp for both 5 and 7.5 mL dose amounts. For strong teaspoon preference, low vs. marginal vs. adequate health literacy (n(%)): 26(19.4) vs. 16(7.6) vs. 13(9.7), p=0.001. In the adjusted model predicting strong preference for teaspoon, other than health literacy, parent age and non-US country of birth (vs. US-born) were statistically significantly related (AOR=1.05[1.01-1.08] and AOR=2.3[1.2-4.4], respectively). With addition of experience dosing with mL in the model, both factors remained statistically significantly related (AOR=1.04[1.004-1.08] and AOR=2.2[1.2-4.2], respectively).

<sup>f</sup> Perceived difficulty created as a composite variable with parents who selected very or somewhat hard with respect to mL-only dosing. For perceived difficulty, low vs. marginal vs. adequate health literacy (n(%)): 45(33.6) vs. 39(18.4) vs. 4(3.0), p<0.001. In the adjusted model predicting difficult with mL-only dosing, parent age [AOR=1.04[1.01-1.08]] was the only variable that was statistically significantly related. With addition of experience dosing with mL in the model, parent age remained statistically significantly related (AOR=1.04[1.001-1.07]).

**Table 1**  
**Characteristics of Study Population, and Associations with Parent Preference for Teaspoon Units, Perceived Difficulty with mL-only instructions, and Prior mL-dosing Experience (n=487)**

	Entire Sample	Preference for Teaspoon Dosing <sup>a</sup>		Perceived Difficulty Dosing with mL-only Instructions <sup>d</sup>		Prior mL-dosing Experience <sup>e</sup>	
		Yes	No	Yes	No	Yes	No
		n=56	n=431	n=88	n=399	n=401	n=86
	n(%) <sup>b</sup>	n(%) <sup>b</sup>	n(%) <sup>b</sup>	n(%) <sup>b</sup>	n(%) <sup>b</sup>	n(%) <sup>b</sup>	p value
<b>Child Characteristics</b>							
Age, mean (SD), y	2.2 (2.4)	2.3 (2.5)	2.2 (2.4)	2.9 (2.7)	2.1 (2.3)	2.6 (2.6)	0.2
Gender							
Female	239 (49.1)	28 (11.7)	211 (88.3)	40 (16.7)	199 (83.3)	42 (17.6)	0.96
Chronic medical problem treated with medication <sup>c</sup>	81 (17.2)	10 (12.4)	71 (87.7)	15 (18.5)	66 (81.5)	12 (14.8)	0.4
<b>Parent Characteristics</b>							
Age, mean (SD), y	30.4 (7.6)	32.6 (9.1)	30.1 (7.4)	32.9 (8.5)	30.1 (7.5)	31.6 (8.2)	0.2
Relationship to Child							
Mother	445 (91.4)	53 (11.9)	392 (88.1)	81 (18.2)	364 (81.8)	79 (17.8)	0.9
Marital Status Single <sup>d</sup>	192 (39.5)	20 (10.4)	172 (89.6)	27 (14.1)	165 (85.9)	28 (14.6)	0.1
Income							
<\$10,000	103 (21.2)	10 (9.7)	93 (90.3)	26 (25.2)	77 (74.8)	29 (28.2)	0.003
\$10,000-\$19,999	120 (24.6)	17 (14.2)	103 (85.8)	24 (20.0)	96 (80.0)	21 (17.5)	
\$20,000-\$39,999	156 (32.0)	18 (11.5)	138 (88.5)	22 (14.1)	134 (85.9)	17 (10.9)	
\$40,000	63 (12.9)	8 (12.7)	55 (87.3)	6 (9.5)	57 (90.5)	8 (12.7)	
Unknown/Missing	45 (9.2)	3 (6.7)	42 (93.3)	10 (22.2)	35 (77.8)	11 (24.4)	



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<sup>a</sup>Row %'s shown for outcomes of interest

<sup>b</sup>Findings presented as n(%) unless otherwise specified.

<sup>c</sup>Missing for 17 children overall.

<sup>d</sup>Missing for 1 parent.

<sup>e</sup>p exactly equal to 1.0 using Fisher's exact test.

<sup>f</sup>Language of survey administration.

<sup>g</sup>Missing for 1 parent.

<sup>h</sup>Health literacy measured using Newest Vital Sign (NVS) [low=score 0-1; marginal=2-3; adequate=4-6]. Data missing for 7 subjects who did not complete the NVS.

**Table 2**  
**Parent Unit Preferences, Perceived Difficulty with mL-only Instructions and mL-dosing Experience (n=487)**

	n (%)
<b>Unit Preferences</b>	
Teaspoon preference	
With both 5 and 7.5 mL dose <sup>a</sup>	56 (11.5)
With either 5 or 7.5 mL dose	66 (13.6)
mL preference (both doses)	365 (75.0)
<b>Perceived Difficulty with mL-only Instructions</b>	
Very hard	20 (4.1)
Somewhat hard	68 (14.0)
Somewhat easy	138 (28.3)
Very easy	261 (53.6)
Perceived that dosing with mL-only would be difficult (very hard or somewhat hard)	88 (18.1)
<b>Prior mL-dosing Experience</b>	
Yes	401 (82.3)
No <sup>b</sup>	86 (17.7)

<sup>a</sup>Parents who chose “1 tsp” or “1 teaspoon” for both 5 mL and 7.5 mL dose amounts were considered to prefer teaspoons.

<sup>b</sup>No category includes responses of no (n=75), don't know/unsure (n=11).

**Table 3**  
**Role of Parent Experiences in Unit Preferences, and Perceived Difficulty Dosing with mL-only Instructions (n=487)**

	Preference for Teaspoon Dosing		
	Teaspoon preference <sup>a</sup>	Any mL	p-value
	n(%)	n(%)	
<b>Parent mL-dosing Experience</b>			
Yes	33 (8.2)	368 (91.8)	
No	23 (26.7)	63 (73.3)	<0.001
	Perceived Difficulty Dosing with mL-only Instructions		
	Difficult	Not difficult	p-value
	n(%)	n(%)	
<b>Parent mL-Dosing Experience</b>			
Yes	46 (11.5) <sup>b</sup>	355 (88.5) <sup>c</sup>	
No	42 (48.8) <sup>d</sup>	44 (51.2) <sup>e</sup>	<0.001

<sup>a</sup>Parents who chose “1 tsp” or “1 teaspoon” for both 5 mL and 7.5 mL dose amounts were considered to have a teaspoon preference.

<sup>b</sup>Includes 5 (1.3%) parents who perceived it would be very hard, and 41 (10.2%) who perceived it would be somewhat hard.

<sup>c</sup>Includes 112 (27.9%) parents who perceived it would be somewhat easy, and 243 (60.6%) who perceived it would be very easy.

<sup>d</sup>Includes 15 (17.4%) parents who perceived it would be very hard, and 27 (31.4%) who perceived it would be somewhat hard.

<sup>e</sup>Includes 26 (30.2%) parents who perceived it would be somewhat easy, and 18 (20.9%) who perceived it would be very easy.