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Primary Care Provider Perceptions and Practices Regarding Dosing Units for Oral Liquid Medications

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Abstract

Introduction: To prevent errors, healthcare professional and safety organizations recommend using milliliters (mL) alone for oral liquid medication dosing instructions and devices. In 2018, for federal incentives under the Quality Payment Program, one requirement is for Electronic Health Records (EHRs) to automatically use mL alone whenever oral liquid medications are prescribed. Current perceptions and practices of primary care providers (PCPs) regarding dosing units for oral liquid medications were assessed.

Methods: Pediatricians, family practitioners, nurse practitioners, and internists participating in the 2015 DocStyles web-based survey were asked about their perceptions and practices regarding dosing units for oral liquid medications.

Results: Three-fifths of PCPs (59.0%) reported that using mL alone is safest for dosing oral liquid medications; however, nearly three-quarters (72.0%) thought that patients/caregivers prefer instructions that include spoon-based units. Within each specialty, fewer PCPs reported they would prescribe using mL alone than reported that using mL alone is safest ($P<.0001$ for all). Among PCPs who think mL-only dosing is safest, those who perceived patients/caregivers prefer spoon-based units were less likely to prescribe using mL alone (odds ratio: 0.45, 95% CI: 0.34–0.59).

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Pediatricians were more likely than other PCPs to report that it is safest to use mL alone (80.8% vs 54.7%) and that they would use mL alone when prescribing (56.8% vs 30.9%) (P<.0001 for both).

Conclusions: Because fewer than two-thirds of pediatricians and one-third of other PCPs would use mL alone in dosing instructions, additional education to encourage prescribing and communicating with patients/caregivers using mL alone may be needed.

Keywords

dosing errors; medication errors; dosing devices; electronic health records; electronic prescribing; metric units

To prevent medication errors, many healthcare professional organizations, safety advocates, standard-setting groups, and regulatory agencies now recommend using metric units alone (i.e., milliliters [mL]) on dosing instructions and devices and avoiding spoon-based units (e.g., teaspoons [tsp], tablespoons [TBSP]) for oral liquid medications.[1–5] Voluntary industry guidelines also recommend using mL alone in the dosing instructions for all over-the-counter pediatric oral liquid medications.[6] Using one consistent measurement unit when prescribing, dispensing, labeling, and communicating about medication doses can reduce errors from confusing different scales (i.e., mixing up mL and tsp). Furthermore, use of spoon-based units on medication labels promotes use of non-standard household spoons, which is associated with a greater likelihood of error.[7–9]

In 2018, clinicians participating in the Centers for Medicaid and Medicare Services Quality Payment Program will be incentivized to use electronic health records and other health information technology (IT) systems that automatically use mL alone whenever oral liquid medications are prescribed.[10] To inform the transition to mL-only dosing, we evaluated perceptions and practices of primary care providers (PCPs) regarding dosing units for oral liquid medications.

Methods

Data Source

Data were collected through DocStyles, an annual web-based survey that focuses on health-related attitudes and practices of U.S. clinicians.[11] The DocStyles survey is conducted by public relations firm Porter Novelli, with input from federal public health agencies. From June 4, 2015 - June 23, 2015, PCPs (pediatricians, family practitioners, nurse practitioners, and internists) who participated in the 2015 DocStyles survey were asked which unit of measurement they: (1) think is safest for dosing oral liquid medications; (2) think patients/caregivers prefer; and (3) would actually use in instructions for dosing oral liquid amoxicillin. For this survey, a random sample of PCPs, drawn from 330,000 U.S. providers in the SERMO Medical Panel, were invited to participate until preset quotas were attained for each specialty. Eligible PCPs resided in the United States, treated a minimum of 10 patients weekly, worked in an individual, group, or hospital practice, and had practiced medicine for at least 3 years. Demographic information of respondents was collected, including age, gender, region, specialty, whether pediatric patients are seen, and number of years in practice.

Statistical Analysis

McNemar tests were used to compare responses by the same respondent; chi-square tests were used to compare responses by different respondents. Logistic regression was used to assess the effects of age, gender, and perceived patient/caregiver preferences on actual prescribing. Analyses were conducted using SAS version 9.3 (SAS Institute). *P*-values <.05 were considered significant. Since data were de-identified, this study was exempt from institutional review board approval.

Results

Among 1,501 PCPs (77.6% response rate), mean provider age (46.1 years) and number of years in practice (15.5) was similar for all specialties (Table). Across specialties, three-fifths of PCPs reported that using mL alone is safest for dosing oral liquid medications (59.0%; ranging from 50.3% of internists to 80.8% of pediatricians); however nearly three-quarters thought that patients/caregivers prefer instructions that include spoon-based units alone or together with mL (72.0%; ranging from 66.0% of pediatricians to 78.5% of nurse practitioners) (Figure). Within each specialty, significantly fewer PCPs reported they would prescribe oral liquid amoxicillin using mL alone, than reported that using mL alone is safest (*P*<.0001 for all). The difference was largest among nurse practitioners; one-half as many reported that they would prescribe using mL alone (27.9%) as reported that using mL alone is safest (54.6%). However, among nurse practitioners, those who treat pediatric patients were more likely than those who do not treat pediatric patients to report that they would prescribe using mL alone (33.8% vs 19.8%; *P*=.015) and that using mL alone is safest (62.1% vs 44.3%; *P*=.005).

Among PCPs who report mL-only dosing to be safest, those who perceived patients/caregivers prefer spoon-based units in dosing instructions (alone or together with mL) were significantly less likely to report that they would prescribe amoxicillin using mL alone (odds ratio: 0.45, 95% confidence interval [CI]: 0.34–0.59) after controlling for age, gender, region, and specialty.

Pediatricians were more likely than other PCPs to report that it is safest to use mL alone (80.8% vs 54.7%) and that they would use mL alone when prescribing oral liquid amoxicillin (56.8% vs 30.9%) (*P*<.0001 for both comparisons). Internists were most likely to report that using spoon-based units alone is safest, compared with PCPs in other specialties (26.4% vs 14.2%; *P*<.0001).

PCPs aged <50 years were more likely to report that they would use mL alone in amoxicillin dosing instructions compared with PCPs aged ≥50 years (odds ratio: 2.03, 95% CI: 1.60–2.60) after controlling for gender, region, and specialty (*P*<.0001). Gender was not significantly associated with PCP reporting that mL alone would be used in the dosing instructions (*P*=.23).

Discussion

While three-fifths of PCPs agreed that dosing oral liquid medications in mL alone is the safest practice, significantly fewer reported they would write prescriptions using mL alone. Roughly one-half of pediatricians (56.8%) and one-third of other PCPs (30.9%) reported that they would prescribe oral liquid amoxicillin with dosing instructions that use mL alone, the practice recommended by numerous healthcare professional organizations (e.g., American Academy of Pediatrics (AAP), American Academy of Family Physicians, American Pharmacists Association, American Society of Health-System Pharmacists) and incentivized by a federal health IT program expected to be implemented in 2018.[1,10,12–14]

The perception that patients/caregivers prefer instructions with spoon units may often override PCP beliefs about safe prescribing. PCPS most commonly reported that they would use both mL and tsp in dosing instructions, suggesting that PCPs may attempt to reconcile their perceptions about what is safest with their perceptions about what their patients prefer by using both mL and tsp. However, confusion between mL and tsp can lead to 5-fold errors and has caused serious patient harms,[15] and dosing instructions that include spoon-based units may endorse use of non-standard household spoons.[7,9]

More than 1 in 3 nurse practitioners and family practitioners reported that using spoon-based units alone or together with mL is safest; however, recent studies have found that parents, including those with low health literacy, make fewer errors when dosing medications using mL alone compared with instructions using teaspoons.[8] The American Board of Pediatrics Practice Improvement Module on reducing errors in prescriptions and medication orders includes mL-only prescribing,[16] but additional clinician education is needed, and should incorporate study findings showing that parents/caregivers, including those with low health literacy, are familiar with mL units,[17] and can safely and accurately dose medications using mL alone.[18] Although existing efforts have often focused primarily on pediatric providers, who more commonly prescribe oral liquid medications, educational programs should target all types of clinicians (e.g., nurses, physicians, pharmacists), including those in other specialties. These efforts could be complemented by educational programs that focus on safe dosing practices for patients/caregivers.[19–21]

The study has several limitations. First, the DocStyles sample includes only PCPs who were part of the SERMO Medical Panel and may not be nationally-representative. Second, the data were self-reported and are subject to bias. Third, the survey was conducted in 2015, just 2 months after an AAP Policy Statement recommending mL-only dosing was published; future studies should assess whether there has been broader implementation of recommendations as awareness of the AAP Policy Statement and other efforts increase. Finally, reasons for reported perceptions and practices were not specifically assessed, but could help identify ways to address the observed discord.

Nonetheless, these survey findings suggest several actions that can facilitate the pending transition to mL-only e-prescribing. All clinicians (e.g., nurses, physicians, pharmacists) should use mL in written and verbal communications with patients/caregivers, so that mL-dosing instructions are repeated and reinforced across settings. Clinician education programs

can help raise awareness among the next generation of providers (e.g., through medical school curricula) and among those who currently practice (e.g., through professional society policies or other communications). Clinician demonstration of dosing using appropriate devices (e.g., oral syringes, dosing cups) with units of measurement that match those in the dosing instructions, and having patients/caregivers show back dose measurement can help ensure accurate administration.[22] Increasing availability of dosing devices with mL-only markings will also facilitate the translation of mL-only instructions to administration by patients and caregivers.

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What's New: Three-fifths of primary care providers report that using mL alone is safest for oral liquid medications; however, significantly fewer would prescribe using mL alone, as most perceive patients/caregivers prefer including spoon-based units. Education to encourage mL-only prescribing may be needed.

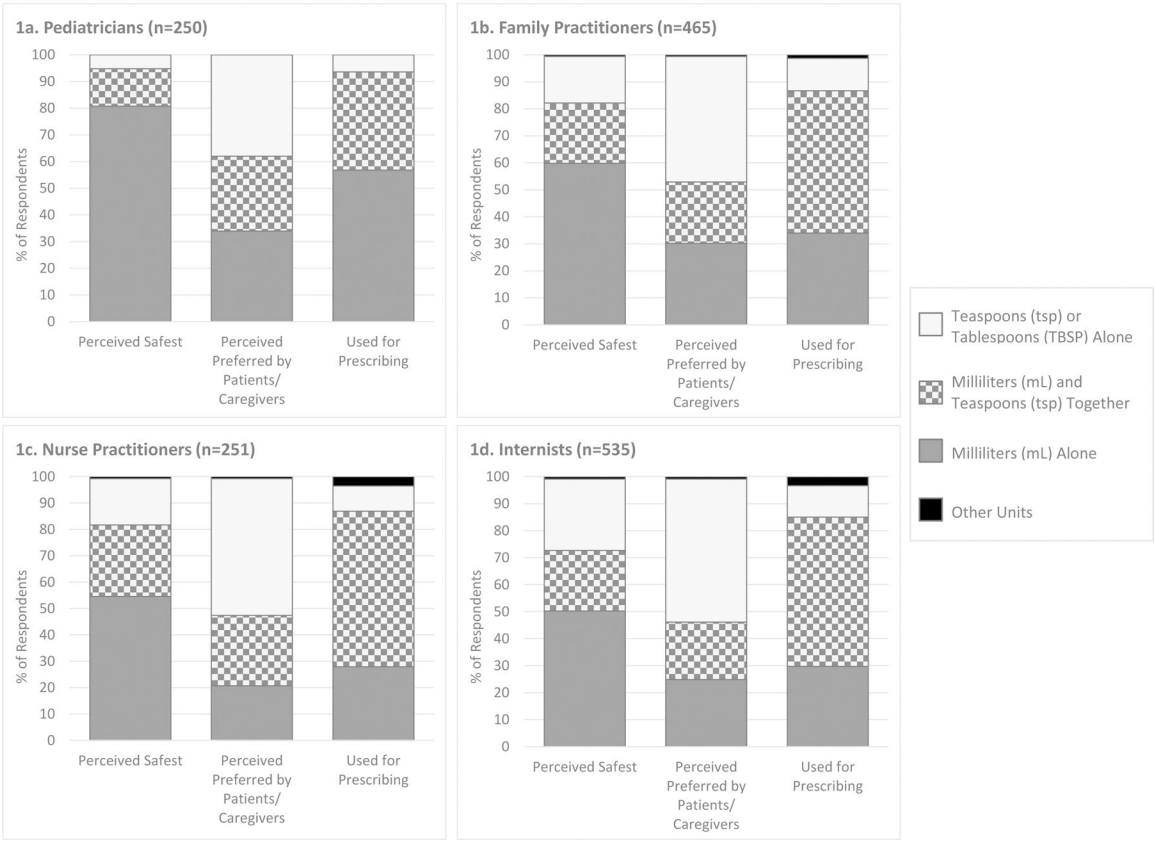

Figure.

Perceptions and Practices Regarding Dosing Units for Oral Liquid Medications, By Specialty, 2015

Table.

Respondent Characteristics

Characteristic	Specialty							
	Pediatrician		Family Practitioner		Nurse Practitioner		Internist	
	No.	%	No.	%	No.	%	No.	%
Age (Years)								
25–39	75	30.0	134	28.8	85	33.9	173	32.3
40–49	80	32.0	174	37.4	67	26.7	185	34.6
50–59	65	26.0	100	21.5	71	28.3	116	21.7
>59	30	12.0	57	12.3	28	11.2	61	11.4
Gender								
Male	145	58.0	327	70.3	33	13.2	416	77.8
Female	105	42.0	138	29.7	218	86.9	119	22.2
Region								
South	90	36.0	155	33.3	109	43.4	149	27.9
Northeast	58	23.2	89	19.1	59	23.5	168	31.4
Midwest	55	22.0	133	28.6	45	17.9	101	18.9
West	47	18.8	88	18.9	38	15.1	117	21.9
Treat Children[a]								
Yes	250	100.0	442	95.1	145	57.8	234	43.7
No	0	0.0	23	5.0	106	42.2	301	56.3
Years in Practice								
<10	60	24.0	124	26.7	95	37.9	155	29.0
10–19	103	41.2	199	42.8	90	35.9	220	41.1
>19	87	34.8	142	30.5	66	26.3	160	29.9
Total	**250**	**100.0**	**465**	**100.0**	**251**	**100.0**	**535**	**100**

[a]Refers to ever treating patients aged ≤17 years.