



Parents' understanding of and accuracy in using measuring devices to administer liquid oral pain medication

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More than one-third of children report having postoperative pain after routine restorative dental procedures,^{1,2} and 95 percent of children undergoing full-mouth rehabilitation report pain of moderate intensity.³ Most cases of postoperative pain resulting from dental treatment have an inflammatory component and are managed with over-the-counter (OTC) nonsteroidal anti-inflammatory medications as first-line treatments.⁴ OTC liquid pain medications often are administered by parents and are considered an important component of treating pain and illness in children. In a large telephone survey, researchers found that 40 percent of parents reported having administered acetaminophen, ibuprofen or both within the preceding seven days to a child aged six to 11 months, and that acetaminophen, ibuprofen and multivitamins were the pharmaceutical products used most commonly throughout childhood.⁵

Parental dosing errors when administering liquid medications occur often, and the results from several studies suggest that incorrect dosing occurs more than 50 percent of the time.⁶⁻⁸ Some medication errors can have serious consequences. For example, the American Academy of Pediatrics has written a policy statement regarding acetaminophen toxicity in children.⁹ The U.S. Food and Drug Administration has published industry guidance that details appropriate specifications for dosage devices for administering liquid OTC drugs.¹⁰ Parental dosing errors can arise from a multitude of factors: not understanding that pediatric dosing is based on the child's weight, being rushed or hurried, confusing teaspoon and tablespoon, combining medications (that is, administering additional acetaminophen after already having administered a cough medicine that contains acetaminophen), using the incorrect formulation or concentration, using an inaccurate measuring device

ABSTRACT

Background. Dentists recommend over-the-counter medications for postoperative pain in children, and parents often make dosing errors when administering these medications. The authors compared the dosing accuracy when parents used various measuring devices and aimed to identify risk factors associated with dosing errors.

Methods. The authors recruited parent-child pairs visiting the Pediatric Clinic at the College of Dentistry at The University of Tennessee Health Science Center, Memphis, and three private dental offices. The parents completed a survey and a liquid measuring exercise. The authors instructed parents to measure 5 milliliters of liquid by using a medicine cup with clear markings, a medicine cup with printed markings, a cylindrical measuring spoon and an oral syringe. For the medicine cup with printed markings, the authors placed the parents randomly into one of two groups: those receiving text-only instructions or those receiving text-pictogram instructions. The authors weighed each device before and after the measuring exercise and compared the difference in weight with a reference weight of 5 mL.

Results. A total of 120 parent-child pairs participated. The results of a McNemar test revealed a significant difference in parents' ability to measure accurate doses with the various devices. The results of a Pearson χ^2 test showed no statistically significant difference between the control and study groups for dosing accuracy. The χ^2 analysis results showed no significant differences in risk factors that could be associated with dosing errors.

Conclusions. Medicine cups were the devices parents reported using most frequently. Medicine cups had a higher occurrence of dosing errors when compared with the other devices. No sociodemographic factors were associated with dosing errors.

Practical Implications. Dentists can improve pain management in pediatric patients by educating parents about accurate measuring devices, weight-based dosing and correct interpretation of medication dosing charts.

Key Words. Dental care for children; drugs; pain; palliative care; pediatric dentistry.

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Figure 1. Variesly sized household spoons.

such as a household spoon or using a proper measuring device incorrectly (for example, thinking that the entire medicine cup should be full).¹¹⁻¹³

Health literacy is another factor affecting dosing errors.¹⁴ According to the National Assessment of Adult Literacy, 43 percent of U.S. adults have only a “basic” or “below basic” ability to read and understand prose text such as instructional material.¹⁵ Furthermore, the discrepancy between patient literacy levels and the comprehension of written health care instructions, as well as the readability of the instructions, is well documented.^{12,16,17} Survey data reveal that the mean reading level of adults in the United States is eighth grade, but the mean reading level of people enrolled in Medicaid is fifth grade.¹⁸ Limited literacy is associated substantially with poorer understanding of medication names, indications, instructions and adherence to treatment regimens.¹²

Few studies in which investigators evaluate techniques to prevent medication errors associated with liquid measuring devices have been conducted with consumers,¹⁹ and to our knowledge none have examined dental patients as a study population. Therefore, we conducted a study to examine the current knowledge of parents regarding OTC liquid pain medication and to identify risk factors associated with dosing errors such as sociodemographics (level of education and insurance type), and we identified parents’ measuring device preferences and if their ability to read a medication dosing chart accurately was a risk factor for making dosing errors.

METHODS

We recruited parent-child pairs visiting the clinic associated with the Graduate Pediatric Department at the College of Dentistry at The University of Tennessee

Health Science Center, Memphis, and from three private practice pediatric dental offices in the greater Memphis, Tenn., area. We received approval from The University of Tennessee Health Science Center institutional review board to conduct this study (approval 12-01883-XM), and we received oral consent from the participants. We excluded pairs if the parent or guardian who accompanied the child was not the primary administrator of medication in the home.

We administered a 13-question survey to participants during an oral interview in which we collected demographic data and asked them questions related to medication dosing. We asked participants to report their children’s current weights, what factor they used to determine dosage (age, weight, other), which medication measuring device they used most often, what medication they would administer if their children were having tooth pain and whether a health care professional had ever taught them how to measure and administer liquid medication. We also asked them to read a medication dosing chart and choose a dosage for their children. We showed parents a picture of four variously sized household spoons (Figure 1) and asked them to select which one would hold 1 teaspoon of liquid medicine. We obtained and recorded each child’s current weight.

After administering the survey, we asked each participant to measure 5 milliliters (1 teaspoon) of a liquid formulated to simulate an acetaminophen suspension into the following measuring devices: a graduated medication cup with clear markings, a cylindrical measuring spoon, an oral syringe and a graduated medication cup with black markings (AccuCup, Comar, Bueno, N.J.). The simulated liquid consisted of 8 ounces of water and 4 teaspoons of cornstarch, which mimicked the viscosity of acetaminophen. We added flavored, colored sugar to the liquid to obtain a light pink color. We mixed and heated the solution and then placed it in a covered plastic container for two days until it reached the desired consistency.

We weighed all dosing devices on a calibrated scale to obtain a preassessment weight. We calculated the magnitude of error by comparing the weight of the measured dose minus the preassessment instrument weight. We compared the calculated weight with a reference weight. We determined the reference weight by using the average of five separate 5-mL doses measured by five dentists by means of an oral syringe. An acceptable range was within 20 percent of the reference weight. We used this criterion on the basis of other studies of medication dosing accuracy.^{20,21}

For the fourth measuring device, the medicine cup with printed markings, we assigned participants randomly by means of a computer-generated number to a control or to a study intervention group. The control

ABBREVIATION KEY. OTC: Over the counter.

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