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Reproducibility and accuracy of measurement of oral liquid pharmaceutical forms, using a dosing spoon

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Introduction: Dose measurement is a common cause of error in drug administration, especially in the case of liquid formulations, such as sticky, sugary syrups, which are hard to measure accurately [1]. Our goal was to study the ability of pharmacy students to accurately measure syrup using a dosing spoon, over several days.

Materials and methods: This pilot study was conducted at IUEM, with 26 randomly selected pharmacy students that were asked to measure 5 mL of 20% (w/v) chloral hydrate syrup using a metered dose spoon, as if they were to take it. Participants repeated the procedure during five days. Error magnitude was determined by an established protocol. The weight of the measured dose was compared with a reference weight (5 mL syrup = 6.2642 g), accurately measured with a volumetric pipette. All these measurements were done in triplicate, using analytical balance (KERN ABJ, $d=0.0001$ g). Participants provided written, informed, consent and their visual problems were registered. Data analysis was performed using IBM SPSS Statistics v. 24.0 for Windows (Armonk, NY: IBM Corp.). The statistical analysis comprised descriptive measures of experimental outcomes, such as means and standard deviations. Inferential statistics were applied for group comparisons (*t*-Student's test) and time-dependent comparisons (repeated measures ANOVA). Test assumptions were verified and validated for each inferential procedure. The level of significance was set at 5%, in all comparative statistical inference analysis.

Results: Average measured values ranged from 4.89 (± 0.55) g (5th measure) to 5.30 (± 0.66) g (2nd measure). All average daily values were significantly lower than the reference dose ($p < 0.001$). Additionally, time was shown to be a significant factor when comparing the average daily measurements ($p = 0.007$). Last average measured value was significantly lower than the first two (1st measure, $p = 0.050$) and (2nd measure, $p = 0.005$). Subject reported eyesight problems did not influence the measurement outcome ($p = 0.506$).

Discussion and conclusions: Despite the use of a dosing spoon, the measurement accuracy of syrup doses, was poor, resulting in significant underdosing. Time affected the participant's ability to measure doses. This study shows that the use of dosing accessories accompanying liquid dosage forms does not guarantee their desirable dosage accuracy. Clinicians should always consider the possibility of a medication dosing error when faced with an apparent treatment failure.

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Table 1. Amount of syrup measured during 5 days ($n = 26$), presented as mean ($\pm$ standard deviation) and 95% confidence intervals for mean. Different letters indicate statistically significant differences.

Days	Mean ($\pm$ SD) (g)	95% CI
1	5.23 ^{ab} (± 0.55)	[5.01–5.45]
2	5.30 ^a (± 0.66)	[5.03–5.57]
3	4.91 ^{bc} (± 0.58)	[4.68–5.15]
4	5.03 ^{bc} (± 0.38)	[4.88–5.19]
5	4.89 ^c (± 0.68)	[4.62–5.17]

Reference

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