

Estimation of volume in liquid chemical ingestions: a source of systematic error?

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Objective: Many toxic chemicals, such as pesticides and toxic alcohols, are ingested intentionally or accidentally as liquid preparations. Pesticide poisoning is common throughout the Asia-Pacific region and associated with a high mortality rate. Knowledge of the ingested volume in patients presenting with liquid chemical ingestion is important for accurate risk assessment and determining further management. In our experience patients and parents of children who ingest liquid preparations will generally estimate the volume left in a bottle, rather than actually measuring the volume. Commonly they present to the ED with the bottle of liquid that was ingested. The aim of this study was to determine how good people, including physicians, are at estimating the volume of liquid in a bottle. **Methods:** Individuals were asked to estimate the remaining volume in 2L and 1L opaque and transparent bottles of antifreeze. The volume of the liquid in each bottle was measured before the study and participants could estimate the volumes in any order. The known volumes in the bottles were the same in both the opaque and transparent bottles: 1820, 1440 and 650mL in the 2L bottles and 840, 630 and 210mL in the 1L bottles. **Results:** 30 individuals (15 physicians, 15 members of the public) completed the study. There was a large variation in the estimates for all three of the volumes used, with overestimations of up to 66.7% and underestimations of up to 69.2% of actual volume in that individual bottle. Overall only 41.7% of estimates were within 5%, 63.6% within 10% and 82.5% within 20% of actual volume. Estimates were more accurate in the transparent compared to the opaque bottles (mean % error \pm SD: opaque - 9.93 \pm 9.78, transparent -0.89 \pm 4.23, $p < 0.0001$). The tendency to underestimate volumes was greater amongst the public than amongst physicians (mean % error \pm SD, public -7.64 \pm 4.35, physicians -3.18 \pm 5.70, $p = 0.02$). **Conclusions:** Ingestion of liquids, both toxic and non-toxic, is commonly seen in the ED and estimation of the volume ingested is important in accurate toxicological risk assessment. Physicians, and particularly members of the public, are poor at accurately estimating the volume remaining in a bottle, particularly when the liquid is in an opaque bottle. This could have significant implications on patient management. Clinical Toxicologists and Emergency Department staff involved in managing patients with suspected ingestion of liquid chemicals should make every effort to accurately measure rather than estimate the volume left in containers.