

Oral Medication Dispensers in Clinical Research

By Michael Hurst

Abstract

Oral dispensers (syringes) have long been recognized as the safest and most accurate method to administer oral liquid medications. These advantages are greatly magnified in pediatrics, geriatrics, and in hospital environments where potential confusion with intravenous and enteral lines and inhalation systems make dosing with standard hypodermic (injectable) syringes even more dangerous. They are especially valuable in clinical research where dosage accuracy has fundamental importance.

Introduction

The vast majority of drugs are taken orally. Most oral drugs take the form of tablets or capsules, usually with solid contents but sometimes containing gels or liquids. However, some oral drugs, e.g., cough syrups, are taken as liquids.

Liquid oral drugs have three main advantages:

- Some patients are unable to use solid forms due to their clinical condition or young age.
- Some medications require a larger volume than practical for tablets or capsules.
- It is far easier to individualize the dose of a liquid than a solid medication.

However, measuring drug liquids accurately is more difficult than just taking whole tablets or capsules. The most basic methods used to measure and administer drug liquids in the home have been the venerable "teaspoon" and "tablespoon." Medicine cups, dosing spoons, and droppers are also used. An all-too-common method in hospitals is using the standard injectable (hypodermic) syringe without a needle. The problems with each device are explored in the following sections.

Administering Oral Medications at Home

For many years, pharmacy practice generally assumed that a teaspoon is 5 mL and that a tablespoon is 15 mL. Unfortunately, this assumption is not consistently true. In 1980, Kimminau published a study that documented a wide range of dosing errors with the calibration and use of various dosing devices.¹ Kimminau concluded that oral syringes are probably the best device available. Dedicated oral syringes are also referred to as oral dispensers, and the terms are used interchangeably. They are very similar to injectable (hypodermic) syringes, but with a larger opening at the tip and no place to attach a needle.

The following year, another article on administration of oral medications to infants and young children reached the same conclusions. The author found that household teaspoon volumes range from 2.5 mL to 9.7 mL.² The deviation becomes even greater when different individuals fill the same teaspoon. The actual prepared volume was rarely close to 5 mL.

The above results are also far outside of the National Formulary and USP standards of a $\pm 10\%$ error dosage range for oral dosing devices. It is safe to say that predictable clinical outcomes should not be expected if actual drug dosing is this random due to the measuring containers.

Unfortunately, the problem of inaccurate dosing and accidental overdoses continues to this day, 25 years later. A 2006 Institute for Safe Medication Practices Safety Alert notified readers to the possible dangers of accidental childhood acetaminophen overdoses.³ The article further suggested that oral syringes may be more accurate than manufacturer-provided dosing cups.

Oral syringes are superior dosing devices beyond just accurate measurement:

- Doses can be expelled directly into the side of the patient's mouth to minimize gagging, choking and spillage. This technique is particularly useful with small children who tend not to stay still for drug dose delivery.
- Large doses can be administered in several small increments.
- Oral syringes more completely dispense viscous drugs because the plunger exerts pressure on the liquid and cleans the liquid from the sides of the syringe.

Healthcare providers sometimes dispense injectable syringes for use at home. An FDA Consumer Magazine article cautioned that multiple children have choked on the plastic caps of hypodermic syringes prefilled with drug when the care giver expelled the drug and integral cap literally down the throats of pediatric patients.⁴ One 6-month-old girl required cardiopulmonary resuscitation following such an incident. The problem is that the caps can look like an integral part of the syringe to the untrained eye.

In home use, oral syringes can be washed and reused. Regulatory rules prohibit reuse in U.S. hospitals, but it is allowed in other countries.

Administering Oral Medications in Hospitals

Hospitals and clinical settings share all of the problems of dosing oral liquids at home except for the use of teaspoons and tablespoons. Medication cups are frequently used to measure liquids in hospitals, but many nurses use a standard injectable syringe if an oral syringe is not handy.

Using injectable syringes for oral doses in presents a serious danger of misadministration. It takes but a momentary mental lapse to fill an injectable syringe with an oral medication and then inject it parenterally or into an intravenous or enteral line or inhalation system. Unfortunately, such errors occur far too often; they are the primary reason for using oral syringes in hospitals.

The safe alternative is to keep oral medications out of injectable syringes. Oral syringes have specially engineered hubs that cannot be connected to standard IV lines and cannot accommodate a needle attachment. To further avoid confusion, they look different than injectable syringes. For example, they have white plungers vs. the clear plungers of injectable syringes.^{5,6,7}

Administering Oral Medications in Clinical Research Studies

The problems above apply to the administration of oral medications in clinical trials. In clinical trials, accurate dosing becomes even more important. Efficacy and safety data may be invalid, especially with narrow therapeutic ranges. Dose-ranging studies with inaccurate doses are pointless. Also, ease of use encourages subject compliance.

Some drug studies require changing or titrating doses. Oral liquid doses can be changed far more easily than solid forms, and without the expense of compounding new tablets or capsules. Obviously, the advantage of oral liquids in managing dosages is realized only if they are measured accurately. In some cases, the absorption properties of a drug may

permit its formulation as a liquid for use in clinical trials. With the increasing acceptance of adaptive trials, adaptive dosing strategies may become more common.

Given the accuracy, ease of use, and other advantages of oral syringes, there is no good reason not to use them in clinical trials. Improvements in safety, data quality and subject compliance easily justify their use. Ideally, the sponsor should provide them to sites along with other study supplies. However, given their modest cost, sites can purchase them for their own use, just as many sites purchase their own butterfly injectable syringes. A bit of education for study personnel will pay high dividends in study results.

References

1. Kimminau, MD: New findings on oral dosing. *Am Pharm NS20*:19-25. August 1980.
2. McKenzie, MW: Administration of Oral Medications to Infants and Young Children. *US Pharmacist*: 55-72. June/July 1981.
3. ISMP Medication Safety Alerts: How Are You Preventing Accidental Acetaminophen Overdoses? August 8, 2003; Accidental Childhood Acetaminophen Overdoses Illustrate Our Responsibility to Educate Parents. August 7, 2002. Acetaminophen Toxicity: Are Your Patients at Risk? December 2004.
4. Kurtzweil, P: Avoiding Problems – Liquid medication and dosing devices. *FDA Consumer Magazine*, Publication No. FDA 94-3209. October 1994
5. Joint survey by the ISMP and Pediatric Pharmacy Advocacy Group, Hospital Survey Shows Much More Needs to be Done to Protect Pediatric Patients from Medication Errors. April 19, 2000.
6. Use of syringes for medications intended for oral use and for inhalation. Letter from the Directorate for Health and Social Affairs, Norway, to all hospitals in Norway. October 13, 1993.
7. Pediatric Pharmacy Administrative Group Committee on Pediatric Pharmacy Practice: Pediatric pharmacy practice guidelines. *Am J Hosp Pharm*: 48:2475-2476.

Author

Michael Hurst, R.Ph., is Vice President of Baxa Corporation, a leading supplier of oral syringes. Contact him at 1.303.617.2189 or mike.hurst@baxa.com.