



Preparing and Dispensing Oral Liquids

An update and review of best practices for health-system pharmacy

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Origins:

Aristotle stated, *“If you would understand anything, observe its beginning and its development.”*¹ To appreciate the standard of practice regarding the preparation and dispensing of oral liquids in the hospital setting, one must examine the origins and evolution of unit dose dispensing.

In the 1950s and 1960s, a group of forward-thinking and action-oriented hospital pharmacy leaders suspected that the traditional methods of preparing and dispensing medications, e.g., “floor-stock” and “multi-dose,” were inadequate. Furthermore, they believed that the hospital pharmacist could play a key role in envisioning, validating, and implementing more effective and more efficient systems.

Thus, the notion of “unit dose” dispensing evolved. Throughout the 1960s, researchers conducted studies demonstrating that the new system was feasible and that it reduced the potential for error compared with the traditional systems.² The American Society of Health-System Pharmacists (ASHP)³ defines unit dose dispensing mainly by its characteristics:

“The unit dose system may differ in form, depending on the specific needs of the organization. However, the following distinctive elements are basic to all unit dose systems: medications are contained in single unit packages; they are dispensed in as ready-to-administer form as possible; and for most medications, not more than a 24-hour supply of doses is delivered to or available at the patient-care area at any time.”

Furthermore, ASHP⁴ distinguishes between a “single-unit” package and a “unit dose package,”— a distinction that will be useful throughout the White Paper:

“A single unit package is one that contains one discrete pharmaceutical dosage form, i.e., one tablet, one 2-mL volume of liquid, one 2-g mass of ointment, etc. A unit dose package is one that contains the particular dose of the drug ordered for the patient. A unit dose package could, for example, contain two tablets of a drug product. A single unit package is also a unit dose or single dose package if it contains the particular dose of the drug ordered for the patient.”

Challenges:

The challenge to hospital pharmacists was and continues to be how to align commercially-available products with the demands of unit dose dispensing. Because of the variety of dosage forms, there are variations on this theme. For example, most commercially-available injectables must be converted, i.e., “compounded,” to produce patient-specific, unit dose products. Thus, IV Admixture Services were created. Some injectables are now commercially-available as syringes, but of course, they only qualify as “unit dose” if the patient’s dose matches the product’s dose. Oral solids are less challenging because the manufacturers often supply those in single-unit packages, with one-or-more packages constituting a patient’s dose. However, when the dose equals a partial tablet, e.g., $\frac{1}{4}$ or $\frac{1}{2}$, pharmacies should ideally split the tablet.

Most commercially-available oral liquids are manufactured in bulk bottles, commonly in 4oz, 8oz, or pint bottles, designed for ambulatory care dispensing. In the hospital setting, the bulk bottles double as reservoirs for multiple unit doses. Fortunately, some manufacturers provide their products in single unit cups to match the doses commonly prescribed for adult patients. But the utility of these packages is somewhat limited. First, although single unit, they do not qualify as unit doses for adults receiving unconventional doses. Second, they frequently do not meet the needs of children, who usually receive smaller doses misaligned with the single unit packaging.

The emergence of unit-based dispensing cabinets (UBCs) presents another challenge for practitioners determined to adhere to the intent and tenets of oral liquid unit dose dispensing. Ideally, single unit cups, usually 15ml and 30ml, would only be accessed when the patient's dose matches the dose in the cup. Barcode Medication Administration (BCMA) programs match the drug with the patient's profile but not the volume drawn.

Note: The term “commercially-available” encompasses manufacturer-supplied and outsourced products.

Medication Errors (Safety):

A complete discussion of medication errors is beyond the scope of this White Paper. Hundreds, if not thousands, of commentaries, research articles, position statements, and books have been published in practitioners' quest to “do no harm.” Several key references are cited.^{5,6,7,8}

Because this White Paper focuses on oral liquids, and oral liquids are prescribed much more frequently in children than adults, several key references regarding medication errors in pediatrics are cited.^{9,10,11,12,13}

And because this White Paper focuses on oral liquids, several key references regarding the preparation and dispensing of oral liquids are cited.^{14,15,16,17}

Best Practice for Oral Liquid Preparation and Dispensing:

A critical review of the unit dose and medication error literature supports the premise that the safest practice in oral liquid dispensing is for the pharmacy to prepare and dispense a patient-specific, properly-labeled, ready-to-administer medication container (oral syringe or cup) that contains the prescribed dose for that patient. Although, we will focus on patient-specific pharmacy-prepared and dispensed doses, we will not ignore the challenge of reducing the potential for error via UBC dispensing.

The safest (best) practice in oral liquid dispensing is for the pharmacy to prepare and dispense a patient-specific, properly-labeled, ready-to-administer medication container (oral syringe or cup) that contains the prescribed dose for that patient.

Examples of this ideal would be dispensing a 15ml cup of a Maalox® for a patient when 15mls are prescribed, dispensing a 60mcg/1.2ml oral syringe of digoxin when 60mcg are prescribed, or dispensing a 1ml oral syringe the formulary's multiple vitamin when 1ml is prescribed.

Another approach to evaluate the integrity of a unit dose system is from the nurse's perspective--does the pharmacy-prepared dose support the nurse's ability to adhere to the five rights?¹⁸

For example, providing a medication that is ordered to be administered by mouth (“po”) in an injectable vial (if the medication is not available as

an oral dosage form) does not. Stocking non-patient-specific bulk bottles of 120ml (62.5mg/ml) acetaminophen on the patient care unit does not. Stocking a patient-specific bulk bottle of 60ml (10mg/ml) of furosemide on the patient care unit or in a UBC does not. And stocking 10mg/10ml cups of metoclopramide in a UBC that are used for 5mg doses does not.

Now that we have established best practice, the challenge is to design a system in which most doses meet that best practice. Even unit dose purists and avid medication safety advocates acknowledge that occasional compromises in unit dose integrity are justified to meet certain patient care demands in certain situations. But they warn that compromises be made thoughtfully and sparingly and not based solely on convenience.

FIVE RIGHTS

1. RIGHT MEDICATION

Is this the medication that the provider ordered?

2. RIGHT DOSE

How many milliliters, tablets or doses are to be given?

3. RIGHT TIME

What time of day is the medication to be taken?

4. RIGHT ROUTE

Should the medication be given by mouth, via feeding tube, or is it an injectable medication?

5. RIGHT PATIENT

Is the medication for this patient or is it for someone else?

Implementing the Best Practice for Oral Liquids

Two Decision Points

Decision Point #1

For drugs and doses that are not commercially-available in single-unit packaging or in doses that match a specific patient's dose, two options exist—either:

- 1. Draw each dose individually as a separate and distinct operation; or**
- 2. Repackage doses in bulk quantities anticipating later use, either for patient-specific dispensing or UBC stocking.**

Each pharmacy leader must establish the threshold that justifies bulk repackaging of product for his/her institution. Some institutions have established dose standardization policies and procedures, which reduce unnecessary variation in doses and create a standard dose for select dose ranges, increasing the likelihood that a threshold is met for repackaging.^{19,20} Prime candidates for dose standardization are calcium carbonate, docusate, ferrous sulfate, furosemide, lansoprazole, and metoclopramide.¹⁵

ASHP provides a useful technical assistance bulletin on the repackaging process to assist the pharmacist in developing procedures for repackaging drugs in a safe and acceptable manner.²¹

Decision Point #2:

For each drug and dose to be repackaged, two options exist—either:

- 1. Draw and label each dose manually as a bulk process; or**
- 2. Employ technology to automate the drawing and labeling of the doses.**

As established above, unit dose systems reduce the potential for error. Automating the repackaging operation to prepare single unit packages as opposed to repackaging them manually reduces the error potential even further. Once the pharmacist verifies the accuracy of the drug, the volume, and the labeling, the entire batch run, e.g., 100 syringes, will be accurate. A hundred opportunities for error are compressed to one, albeit a crucial one, that confirms the accuracy of the entire batch.

Also, automation prints barcodes on the labels or the packages to support Barcode Medication Administration (BCMA).

Selection and Assessment of Oral Cup and/or Oral Syringe Automation:

Technology to facilitate the repackaging of oral liquids is available. A final decision is whether to purchase a machine to repackage oral liquids into oral cups or oral syringes or both.

An analysis of the drugs and the volumes that will be repackaged will assist in the decision. If the repackaging volumes are predominantly 5ml and more, a machine that fills unit dose cups should suffice. But cups have volume limitations; therefore, it is not advisable to package less than 3-5ml in a unit dose cup because of the possibility of filling volume variability (standard practice allows $\pm 5-10\%$) or significant dose residual.

Institutions with large neonatal and pediatric populations should consider automation that fills

oral syringes to accommodate the lower volumes (less than 3-5ml). Commonly-available lower-volume syringe sizes are 0.5ml, 1ml, and 3ml.

Oral syringe filling automation also accommodates higher volume doses because higher-volume oral syringes are available (5ml, 10ml, 20ml, 30ml 60ml). The trade-off is that the oral syringes are more expensive than the cups. Each institution must do a cost analysis based on its estimated ratio of syringes/cups. Institutions with anticipated large volumes of syringes and cups might consider both machines.

A useful method to propose automation to hospital administrators is to evaluate how each piece of automation objectively and subjectively meets **“Seven Technology Goals,”** developed by the author and outlined below. Each pharmacy manager can adapt the example to meet his/her needs.

SEVEN TECHNOLOGY GOALS

TECHNOLOGY GOAL	ADVANTAGES/COMMENTS
1. Promotes Quality and Safety	<ul style="list-style-type: none"> Reduces the potential for error by converting a manual repackaging process to an automated one. The bar-coded labeling supports BCMA programs.
2. Improves Efficiency/ Reduces Cost	<ul style="list-style-type: none"> Converts a time-consuming manual process to an efficient automated process.* Decreases medication waste because returned oral syringes can be recycled due to the prolonged expiration date.
3. Enhances Work Satisfaction	<ul style="list-style-type: none"> Converts a tedious and cumbersome process to a sophisticated one. Especially increases work satisfaction for the technicians. Reduces potential for repetitive stress injuries (RSIs).
4. Improves Compliance (with Regulatory Requirements and Practice Standards)	<ul style="list-style-type: none"> Ensures the uniformity of labeling and record keeping.
5. Advances Clinical Practice	<ul style="list-style-type: none"> Enables the transfer of saved pharmacist time to patient care-oriented activities.
6. Advance Sustainability Initiative	<ul style="list-style-type: none"> Converts paper documents to electronic documents
7. Improves Medication Security	<ul style="list-style-type: none"> No implications.

*One author claims a 75% time savings from 4-5 hours per day to 1 hour.²² Another author claims a “savings of approximately 3 hours per day.”²³

In a survey of about 100 institutions that belong to the Pediatric Pharmacy Advocacy Group (PPAG), pharmacists cite four main challenges in filling oral syringes:²⁴

1. <i>Time committed to filling</i> (corresponds to technology goal number 2)	3. <i>Labeling errors</i> (corresponds to technology goal number 1)
2. <i>Filling errors</i> (corresponds to technology goal number 1)	4. <i>Medication waste</i> (corresponds to technology goal number 2)

Additional Issues:

A brief **discussion** of several particularly thorny issues follows:

Establishing Beyond-Use Dating (BUD) for Repackaged Products: Although ASHP’s Technical Assistance Bulletin on Repackaging Oral Solids and Liquids in Single Unit and Unit Dose Packaging²¹ contains a reference that suggests a methodology for determining beyond use dating (formerly called “expiration dates”)--six months or ¼ the difference between the repackaging date and the manufacturer’s expiration date, whichever is less,²⁵ the current USP (38 General Chapter 1136) recommendation is one year or the time remaining until the expiration date, whichever is shorter.²⁶

Labeling Repackaged Products: Labeling should be designed for accuracy and clarity and to meet all regulatory and safety standards. The Institute for Safe Medication Practice (ISMP) publishes “Principles of Designing a Medication Label for Oral Liquids for Patient Specific, Inpatient Use.”¹⁴

Dispensing Oral Liquid Controlled Substances: The strict regulatory requirements surrounding controlled substances present an extreme challenge for pharmacists to adhere to the unit dose philosophy and simultaneously maintain accountability through chain-of-custody. To meet regulatory requirements, pharmacists place controlled substances in UBCs. However, to minimize the potential for error, many pharmacists establish dose standards, especially for children, and produce containers (cups or syringes) of various sizes to limit the impact of an inadvertent administration of the entire container. Finally, some

pharmacists prepare and dispense select doses as unit doses to ensure patient safety in spite of the logistical challenges and paperwork.

Expelling Air: When drawing oral syringes manually, many pharmacists expel residual air whether the syringes are drawn as individual patient-specific doses or in bulk.²⁴ However, more are inclined to leave the residual air if automation is used. In these cases, pharmacists may consider adjusting the fill volume an equivalent amount, e.g., 0.1ml, for low volume syringes (2ml and less) to avoid a significant proportional loss of drug. In these situations, the nurses should be notified and the labeling modified to inform the nurses and avoid confusion.

Summary:

Oral liquids represent a primary dosage form for hospitalized patients, especially for children. This White Paper describes the origin of unit dose dispensing. It also describes how pharmacists can apply core principles and practice elements of unit dose to improve the efficiency of oral liquid preparation and dispensing and reduce the potential for error.

Call to Action:

Medical Packaging Inc. (MPI) sponsored this White Paper. Medical Packaging Inc. is one of the leading manufacturers of unit dose packaging systems used in hospital, long term care (LTC)/extended care (EC) pharmacies, and repackaging centers.

To find out more about how MPI can help your pharmacy can advance safety and improve efficiency in the repackaging of oral liquids call 800.257.5282 or visit us at www.medpak.com.

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