Survey of Hospital Pharmacy Directors: Assessment of the Current State of Unit-Dose Acquisition

SCOTT J MASON, RUSSELL D MELLER, LISA M THOMAS, JENNIFER A PAZOUR, AND SARAH E ROOT

Background: Many hospitals are in the planning stage of barcode point-of-care (BPOC) implementation. One of the challenges that hospital pharmacies face in BPOC implementation is unit-dose acquisition.

Objective: This article presents the results of a survey of hospital pharmacy directors to assess the current state of unit-dose acquisition to support bedside barcode-enabled dispensing practices.

Methods: An online survey was administered over 2 months and was available from September to November 2008. The University of Arkansas Institutional Review Board approved the survey before it was disseminated. The survey was developed in collaboration with 2 hospital pharmacy directors. Ninety-one valid survey responses were representative in terms of the distribution of hospital size compared with previous surveys of the American Society of Health-System Pharmacists. Though there were 91 total respondents, not all provided responses to all of the survey questions. Thus, some of the figures, tables, and text refer to fewer than 91 respondents.

Results: The results of interest to pharmacy technicians indicated that most hospitals today are able to purchase at least 40% of their medications in unit-dose packaging directly from the manufacturer. For medications that cannot be acquired in unit-dose packaging, 85% of the hospitals surveyed perform repackaging operations in-house. However, 87% of the hospitals that use a high-speed oral solid repackager only use this equipment, at most, 4 hours per day. Our survey results showed that only 8% of the hospitals surveyed used a third-party repackager to acquire unit-dose medications, compared with 85% of hospitals that are either currently using or in the planning phase of using BPOC.

Conclusions: The survey found that most hospital pharmacy directors choose to repackage medications in-house, despite the high cost of repackaging equipment and a relatively low utilization of that equipment. Hospitals indicated that cost and turnaround time were the 2 issues of greatest concern when considering outsourcing unit-dose medication repackaging to a third-party repackager.

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The Center for Innovation in Healthcare Logistics (CIHL) at the University of Arkansas conducted a survey of hospital pharmacy directors to determine by which methods and to what extent hospitals acquire unit-dose medications to support barcode point-of-care (BPOC). A 2006 study revealed that using barcode technology in a hospital pharmacy can substantially reduce medication dispensing errors.[1] Because BPOC requires that medications be administered in unit-dose form, a major focus of the survey was to assess how hospitals handle the repackaging of drugs that do not arrive in unit-dose packaging from the manufacturer. In early 2004, the FDA mandated that drug products must contain a linear barcode with a National Drug Code number. The ruling by the FDA requiring barcodes on drug products, along with a decrease in unit-dose product availability from manufacturers, may explain the steady increase in the repackaging of medications to unit-dose form.[2] Hospitals can repackage medications into unit-dose form in-house with the help of pharmacy technicians (under the supervision of a pharmacist) and their own repackaging equipment, or they can outsource the repackaging to a third-party repackager. To address each alternative, the survey included questions related to both in-house repackaging practices as well as third-party repackaging concerns.

SCOTT J MASON PhD, Associate Professor and Associate Head, Department of Industrial Engineering, University of Arkansas, Fayetteville, AR; **RUSSELL D MELLER PhD**, Hefley Professor of Logistics and Entrepreneurship and Deputy Director of the Center for Innovation in Healthcare Logistics, University of Arkansas; **LISA M THOMAS MS**, Graduate Research Assistant, University of Arkansas; **JENNIFER A PAZOUR MS**, Graduate Research Assistant, University of Arkansas; and **SARAH E ROOT PhD**, Assistant Professor, University of Arkansas. *Reprints:* Dr. Mason, Department of Industrial Engineering, University of Arkansas, 4207 Bell Engineering Center, Fayetteville, AR 72701, fax 479/575-8431, mason@uark.edu

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Methods

QUESTIONNAIRE DEVELOPMENT

The survey was developed by a team of professors and graduate students at the University of Arkansas through research funded by CIHL. A draft of the survey was presented to 2 hospital pharmacy directors from different organizations and geographical areas to validate the questions in the survey. The hospital pharmacy directors helped to condense the survey by identifying nonessential questions. The final survey consisted of 22 questions and was administered online. The survey was distributed to approximately 500 hospital pharmacists through electronic mailing lists and emails. A total of 91 valid responses were received, yielding a response rate of roughly 18%.

The survey was divided into 4 sections: Demographics, Unit-Dose Usage, Packaging, and Third-Party Repackaging. The survey questions were designed in such a way as to allow swift responses to encourage a higher response rate. Questions consisted of the following types: multiple choice (9), blank(s) provided for number or percentage inputs (9), ranking (2), and comments (2). A complete listing of the survey questions and response options is included in Appendix I, and a list of definitions for terminology used in this article is included in Appendix II. (Appendices available online at hwbooks.com/appendices/JM056.pdf)

SURVEY SAMPLE

The online survey link was emailed to the pharmacy directors of VHA (Voluntary Hospital Association), a nationwide alliance of healthcare organizations that helps improve supply chain performance and a partner of CIHL, as well as the Council of Boston Teaching Hospitals electronic mailing lists. In total, 91 valid survey responses were received from hospital pharmacy directors in 38 states. In terms of the most frequently responding states, Pennsylvania had 9 respondents and Florida had 7 responses, while Ohio and Oklahoma hospitals each supplied 5 survey responses. On average, the respondents required 11.8 minutes to complete the 22-question survey. Again, the purpose of this survey was not to disseminate an extensive survey, but to obtain an overview of the practices used to procure medications in unit-dose form.

DATA COLLECTION

The survey was disseminated online through QuestionPro (Seattle, WA; www.questionpro.com), an online survey research technology provider. An email stating the purpose of the survey with a link to the survey questionnaire was sent to a list of email addresses provided by VHA. The survey was launched in late September 2008 and closed in late November 2008. At the end of the questionnaire, respondents were offered the option of receiving survey results.[3] A summary of the results was issued in late December to those survey respondents who requested it. This article provides contextual background to those results.

DATA ANALYSIS

Each respondent who submitted a completed survey was identified by a unique Internet protocol address that allowed for the elimination of duplicate responses. One survey response was deleted because only demographic information was completed (ie, none of the 22 questions were answered). The 22-question survey consisted of 4 categories: demographics, unit-dose practices, packaging, and third-party repackaging. Where appropriate, survey responses were segmented by hospital size in an attempt to identify any trends or patterns that existed. χ^2 Analysis was used to verify how responses varied by hospital size; χ^2 values are shown with the associated p values, where p values of less than 0.05 are considered statistically significant, indicating actual differences in the responses of hospitals of different size.

Results and Discussion

A total of 91 completed surveys were received from hospitals of varying sizes in terms of the number of beds (Table 1). The distribution of survey respondents' hospital sizes was comparable to the distribution of sizes reported in a 2007 survey that appeared in the *American Journal of Health-System Pharmacy* (AJHP),[4] as shown in the Comparison column of Table 1. As expected, formulary size increased with the size of the hospital (ie, larger hospitals tended to have a larger number of line items on their formulary; $\chi^2 = 38.7$; df = 9; $p < 0.001$).

MEDICATION AND DOSING PRACTICES

A total of 89 respondents supplied responses for the percentage breakdown of medications into categories. Survey responses were consistent across hospital size. Based on the survey responses, oral solids comprise the majority of a hospital's formulary (50.7% on average), followed by premixed intravenous formulations (24.5%), injectables (9.1%), oral liquids (7.9%), and other medications (7.8%).

Table 1. Survey Respondents

HOSPITAL SIZE (beds)	RESPONDENTS, n (%)	COMPARISON, %
<100 28 (30.77)	33	
100–299	36 (39.56)	40
300–500	15 (16.48)	
>500	12 (13.19)	26

Survey responses indicated that, on average, a patient receives approximately 10.8 medications per day, independent of hospital size. Hospitals with greater than 100 beds administer on average 2 more medications per patient per day than do hospitals with fewer than 100 beds. While the overall average number of medication doses that each patient receives per day was 20.5, when averaged across all survey responses, a significant amount of variability was present in the responses as shown in Figure 1.

The use of automatic dispensing cabinets (ADCs) varied by hospital size. A survey that appeared in the AJHP in 2002[2] also reported a significant difference in the use of ADCs by hospital size. In our survey, the largest number of ADCs for hospitals with fewer than 100 beds was 5, hospitals with 100–200 beds had fewer than 60 ADCs, and hospitals with 300–500 beds had fewer than 80 ADCs. However, for hospitals with more than 500 beds, the largest number of ADCs was 150, and all but 4 of the 9 large hospitals had at least 81 ADCs. Of the large hospitals with fewer than 81 ADCs, the number of ADCs ranged from 21 to 60.

The percentages of medication doses on hospital formularies stored in ADCs were consistent across all hospital sizes. Almost half (49.4%) of the respondents reported storing 81–100% of their medications in ADCs, 18% stored 51–80% in ADCs, 20% stored 11–50% in ADCs, and 12% stored 10% or less in ADCs. ADCs were originally designed to track and dispense narcotics on hospital floors, but more recently, hospitals have been using them to dispense as much as 90% or more of the medications in patient areas.[5] The distribution of the responses suggests that twice as many hospitals (49%) fully or almost exclusively utilize ADCs compared with the number of hospitals that do not use ADCs extensively. Twelve percent of the respondents store 10% or less of the formulary in ADCs.

Pharmacy technicians restock ADCs by scanning each medication, using an on-board barcode scanner attached to the ADC. The Institute for Safe Medication Practices recommends that a pharmacist check all medications before they leave the pharmacy, especially when they are being placed in ADCs that do not have barcode technology. Upon scanning of the barcode, the correct drawer automatically opens for restocking.[6] Barcode use is essential to the operation of such systems to achieve automation and ultimately reduce medication dispensing errors. The next section describes the state of barcode use by survey respondents.

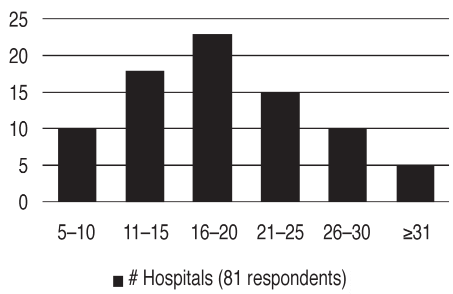

Figure 1. Average medication doses per patient.

BARCODE USE

A 2006 study of medication dispensing errors and potential adverse drug events (ADEs) before and after implementing barcode technology in the hospital found that potential ADEs decreased by 63%.[7] In addition, when the staff of the hospital was required to scan all doses, there was a reduction in potential ADEs of 86–87%. These findings support the claim that BPOC can reduce medication errors and thus increase patient safety.

According to our survey, smaller hospitals are less likely to use barcode retrieval-based systems for pharmacy dispensing, while approximately half of the larger hospitals utilize them ($\chi^2 = 18.3$; df = 3; $p < 0.001$). Similar findings were reported in the 2002 AJHP survey,[2] in which 16% of hospitals with 100 or more beds used BPOC and only 6% of hospitals with fewer than 100 beds used BPOC. A 2005 national telephone survey of 387 rural hospitals with fewer than 100 beds was conducted by the Upper Midwest Rural Health Research Center. The purpose of the survey was to assess the capacity of rural hospitals to implement medication safety practices. According to the survey, 26% of rural hospital pharmacists said that the first step they would take to improve medication safety would be to implement barcode technology. The survey also found that cost is a major reason that specific medication safety-related technologies are not implemented in small, rural hospitals. (For the complete study, see www.uppermidwestrhrc.org/pdf/medication _safety.pdf.)

Of the 91 respondents in our study, 85% of hospitals are either currently using BPOC or are in the planning stage of implementing BPOC. The 2002 AJHP survey[2] reported that only 9.4% of hospitals were using BPOC at that time. This difference suggests that BPOC use has been on the rise. In fact, automation and technology have been top concerns for hospital pharmacy directors, and barcode technology is essential to achieving these objectives.[8] Table 2 shows the breakdown of BPOC use by hospital size. The results indicate that BPOC use is independent of hospital size ($\chi^2 = 11.4$; df = 9; $p = 0.25$).

Hospital pharmacy directors indicated that the biggest challenge for implementing BPOC is the cost of implementation, followed by additional labor requirements. Additional labor is required to repackage medications that are not already in unit-dose form with a readable barcode. One hospital that implemented BPOC required 2 additional full-time pharmacy technicians to perform the repackaging that was necessary.[7] The additional labor required for BPOC is performed by pharmacy technicians, whose roles in the pharmacy continue to evolve.[9] The larger hospitals also had concerns with availability of unit-dose and nursing buy-in. The least challenging issue associated with BPOC implementation was pharmacy and information technology buy-in.

From the survey, almost one third of the respondents indicated that 20% or more of the medications purchased directly from the manufacturer in unit-dose form do not have a barcode; of the unit-dose medications purchased directly from the manufacturer that do have a barcode, 18 of the 84 respondents reported that at least 20% of the barcodes are nonreadable. These exceptions require pharmacy technicians to create labels that are readable for automated medication dispensing processes. This difficulty with barcode readability, along with the number of medications without a barcode, may help to explain why some hospitals do not prefer to purchase medications directly from the manufacturer in unit-dose form, as explained in the next section.

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BPOC use has been on the rise.

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UNIT-DOSE PROCUREMENT

Hospital pharmacy directors were asked if they prefer to purchase medications in unit-dose form directly from the manufacturer when available. Surprisingly, 42% of the hospitals with more than 500 beds and 33% of hospitals with 300–500 beds did not prefer to purchase medications in unit-dose form from the manufacturer. This could be attributed in part to the fact that large hospitals have already invested in repackaging technologies that allow them to repackage medications into unit-dose form themselves. Similarly, the 2002 AJHP survey[2] of dispensing and administration practices reported that 99% of hospitals with 400 or more beds repackaged oral medications, whereas only 74% of smaller hospitals (fewer than 50 beds) repackage medications. In addition, the lack of readable barcodes mentioned above may play a part. For hospitals with fewer than 100 beds, 96% prefer to purchase medications that arrive from the manufacturer in unit-dose form, which correlates with the result above that smaller hospitals have invested less in repackaging technology. More than half of the respondents (52%) acquire at least 61% of their medications in unit-dose form directly from the manufacturer. Again, the lower percentage of unit-dose drugs purchased by larger hospitals may correlate to their in-house repackaging technologies. Table 3 shows the breakdown of unit-dose medications purchased directly from the manufacturer by hospital size, and Figure 2 shows the breakdown of unit-dose availability by drug category. The results indicate that unit-dose availability varies by hospital size ($\chi^2 = 22.4$; df = 12; $p = 0.033$). Of the unit-dose medications, oral solids are the primary type that can be purchased directly from manufacturers, followed by injectables.

Table 2. BPOC Use by Hospital Size[a]

BPOC USE	BEDS, n (%)			
	<100	100–299,	300–500	>500
In all pt. care units	2 (7.14)	5 (13.89)	3 (20.00)	2 (16.67)
In some pt. care units	3 (10.71)	4 (11.11)	2 (13.33)	3 (25.00)
In planning phase	16 (57.14)	22 (61.11)	10 (66.67)	5 (41.67)
Not planning to implement	7 (25.00)	5 (13.89)	0 (0.00)	2 (16.67)

BPOC = barcode point-of-care.
[a] $\chi^2 = 11.4$; df = 9; $p = 0.25$.

The majority of the hospitals in the survey indicated that they purchase medications in bulk and repackage the medications into unit-dose packaging on-site. Pharmacy technicians typically perform repackaging operations, with the use of either manual, semiautomated, or fully automated technologies. In a manual process, a pharmacy technician inserts the medication into a container, such as a blister pack or plastic cup, and seals the container with a foil seal or plastic overwrap. The semiautomated technology consists of a tabletop repackager (eg, a Euclid tabletop repackager) with a rotary wheel. The induction of medications into the rotary wheel is a manual process, but the packaging, sealing, and labeling are automated. The semiautomated process usually requires that the rotary wheel be cleaned between medication runs. In the fully automated machines (eg, a SafetyPak), the induction of medications, packaging, sealing, and labeling is completely automated. Table 4 shows a breakdown of repackaging practices by hospital size. The results indicate that repackaging practices vary by hospital size ($\chi^2 = 18.5$; df = 9; $p < 0.03$).

Survey results indicate that 88% of hospitals that use high-speed oral solid repackagers use them 4 or fewer hours per day, a surprising finding considering the investment cost of repackaging equipment. Oral liquid repackagers are utilized even fewer hours per day. Overall, there was a parallel between the number of person-hours per day to support the repackaging equipment and the number of hours that the equipment is operating. Interestingly, the number of technician-hours required to support the repackaging machines was as high as or greater than the number of machine hours. These findings support a statement in the 2007 article on unit-dose dispensing automation: "Many ROI [return on investment] projections are not fully realized due to less than ideal implementations or as a result of inappropriate expectations."[5] As repackaging equipment can be very capital intensive, the low utilization of these machines suggested by the survey may explain in part why the ROI is not always realized with such systems.

Hospitals gave higher satisfaction ratings for automated technologies and lower ratings for manual systems. On a scale of 1–5 (5 being most satisfied), the average rating for the high-speed oral solid repackager was 4.1, followed by the semiautomated (tabletop) repackager at a rating of 3.9. The oral liquid repackager and manual technologies received average ratings of 3.1 and 3.2, respectively.

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THIRD-PARTY REPACKAGING

Pharmacy directors were asked to rank their concerns with outsourcing unit-dose repackaging to third parties who perform this service. The greatest concern for hospital pharmacy directors in using third-party repackagers was cost, followed by turnaround/order fulfillment time. The concern for cost in outsourcing is not surprising. In the third article of a 1997 AJHP 5-part series on outsourcing drug distribution services,[10] financial benefit was a stated barrier to outsourcing. As stated in the article, not every pharmacy operates at the same level of efficiency and productivity, and not all potential outsourcing partners have the same ability to reduce costs. In addition, flexibility was listed as a criterion in selecting an outsourcing partner in the second article of the 5-part series.[11] The survey respondents' concerns and average ratings (where 1 represents the greatest concern and 5 represents the least concern) were as follows: cost (1.8), turnaround time (2.6), quality (3.0), narrow product offerings (3.5), and insufficient barcode capabilities (4.1).

Twelve of the 91 respondents in our survey provided the name of their outsourcing repackager. The names of the third-party repackagers are listed in Table 5.

Respondents' answers varied with regard to the longest acceptable turnaround time for third-party repackagers. Table 6 shows the breakdown of acceptable times for all hospitals.

Some examples of quality concerns include mislabeling of medications, issuing of expired medications, and hygiene issues, such as cross-contamination. Insufficient barcode capabilities refer to issues such as nonreadable barcodes or barcodes that do not contain the information that a hospital needs (such as an internal medication identification number). The cost concerns that hospitals have regarding third-party repackagers are that the upcharge for repackaging and shipping is not justified by outsourcing

Table 3. Drugs Available in Unit-Dose Form from Manufacturer[a]

RESPONSE, %	BEDS, N (%) <100	100–299	300–500	>500
<20	2 (7)	3 (8)	6 (40)	5 (42)
20–40	3 (11)	3 (8)	1 (7)	2 (17)
41–60	2 (7)	10 (28)	3 (20)	1 (8)
61–80	14 (50)	13 (36)	2 (13)	3 (25)
>80	7 (25)	7 (20)	3 (20)	1 (8)

[a]χ^2 = 22.4; df = 12; p = 0.033.

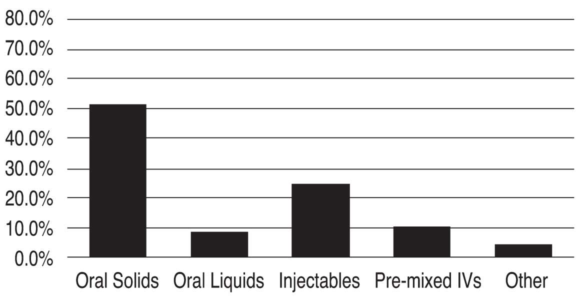

Figure 2. Medications available in unit-doses from the manufacturer. IVs = intravenous formulations.

Table 4. Unit-Dose Repackaging Practices[a]

METHOD OF OBTAINING DRUGS	BEDS, N (%) <100	100–299	300–500	>500
Contract vendor to package at my facility	0 (0)	0 (0)	2 (13)	0 (0)
Purchase bulk medications; outsource repackaging to third party	0 (0)	3 (8)	1 (7)	3 (25)
Purchase bulk medications; repackage on-site	26 (96)	31 (89)	11 (73)	8 (67)
Purchase from large distributor that repackages bulk drugs into unit-dose form	1 (4)	1 (3)	1 (7)	1 (8)

[a]χ^2 = 18.5, df = 9, p = 0.03.

Table 5. Third-Party Repackagers

COMPANY	LOCATION
Shamrock	Massachusetts
Morris Dickson Advantage Dose[a]	Louisiana
Ameridose	Illinois
Atlantic Biologicals	Florida
McKesson	Pennsylvania
MedPrep	New Jersey
Safecor Health, LLC (dba Regional Service Center)	Massachusetts
Vibranta	Florida

dba = doing business as.
[a]Morris Dickson has since discontinued packaging operations and has partnered with Safecor Health, LLC to service their customer base.

these services. In other words, hospital pharmacies may be able to repackage in-house for much less than they would pay to outsource these services. The issue of narrow product offerings arises when a repackager cannot handle all of the dose types required by a hospital (ie, a repackager can repackage oral solids, but not oral liquids).

The survey indicates that most hospitals are either using BPOC or are in the planning stage of implementing BPOC. Successful BPOC implementation requires that medications be in unit-dose form. When medications do not come directly from the manufacturer in unit-dose form, hospitals are faced with the challenge of repackaging medications themselves. The challenge is compounded when medications that do come in unit-dose form from the manufacturer either do not have any barcode or do not have a readable barcode. Most hospitals handle repackaging functions in-house. However, repackaging equipment is utilized only a few hours a day, so equipment cost may be difficult to justify.

Outsourcing is another option for repackaging medications into unit-dose form, but cost and turnaround time are concerns for hospital pharmacies. Other stated concerns are drug pedigree laws, packaging size, and drug chain of custody. Smaller hospitals indicated that using a third-party repackager was not necessary given the small number of medications that needed to be repackaged. From other comments supplied by the respondents, it is clear that each hospital has its own unique set of concerns, and no single solution exists for all hospitals regarding the repackaging of medications into unit-dose form.

LIMITATIONS

The limitations of this study stem in part from the intent of the survey, which was to obtain an overview of the practices used to procure medications in unit-dose form. Since the survey was not extensive in scope, it did not address certain important aspects of unit-dose acquisition, such as repackaging hazardous drugs. This is an issue for many hospitals since hospitals cannot use their in-house repackagers to repackage hazardous medications.

Another limitation of the study is that it does not segregate data by hospital type. Classifying data by hospital type might have revealed that certain hospital types (eg, Children's Hospitals) are challenged even more in achieving unit-dose packaging. Likewise, the study did not address the concerns of implementing BPOC in outpatient units. Additionally, the study did not consider the case where a network of hospitals repackage at a single site, taking advantage of the volume of the entire network. This consideration would change the number of hours that repackaging machines are utilized.

Responses to the survey came from 38 different states. However, the survey was sent to only 2 electronic mailing lists and may not be representative of all hospital pharmacists. Further, since the survey took, on average, only 11.8 minutes to complete, the answers supplied by the respondents are, at best, estimates for the questions that ask for time and percentages. Again, the questions were aimed at obtaining an overall picture of unit-dose acquisition; to achieve this purpose, many were worded with phrases such as, "Roughly what percent….?" Finally, not all aspects of unit-dose acquisition and BPOC were addressed. Issues that were not addressed but that are important to pharmacists include: the ability/inability of BPOC software to alert nurses to expired drugs or recalls, limitations in the size of packaging that is available, and other limitations of the BPOC software and equipment that are required to support BPOC. ≏

Table 6. Acceptable Turnaround Time for Third-Party Repackagers[a]

ACCEPTABLE TURNAROUND TIME, DAYS	HOSPI TALS, n (%)
>5 2	
1 25	
2 34	
3–5	39

[a]Total respondents = 83.

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