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Reducing Waste with **Dose-Rounding Protocols**

Drug expenditures represent the largest portion of a health-system pharmacy's operating budget, often consuming as much as 70% of the yearly spend, making medications one of the most scrutinized components of the overall hospital budget. Because of declining patient volumes and reimbursement issues, hospitals and their pharmacies are challenged to meet the demands for pharmaceuticals despite fewer resources and increased costs.[1] In particular, the costs of antineoplastic chemotherapy agents and antimicrobials have risen significantly and steadily over recent years.[2,3] It is not uncommon for an intravenous antibiotic to cost more than $1000 per course of treatment[4] or for intravenous chemotherapy to exceed $100 per milligram.[5]

Health-system executives often turn to pharmacy administrators to reduce the drug budget using conventional methods, such as managing the formulary, restricting the use of certain agents, employing automatic substitution, and altering prescribing patterns. One approach that often is overlooked or underestimated is reducing waste through dose rounding.

Reasons for Implementing a Dose-Rounding Protocol

Medication prescribing often requires a series of calculations to determine the correct dose for a patient, especially when using drugs with a narrow therapeutic index. Doses for these drugs, which are commonly used for pediatric and oncology patients, are usually expressed as a quantity of drug (ie, mg per kg of patient weight). Using CPOE, a provider simply chooses a weight-based dose for a medication, and the system calculates the patient-specific dose based on the patient's weight. Although this practice makes the ordering process safer and more convenient, the specificity of the calculation may result in an immeasurable or impractical dose. In addition, a non-standard dose requires additional provider and pharmacist time and introduces the potential for waste from partially used units.

Dose rounding is a standardizing technique that reduces waste and, consequently, cost, without sacrificing efficacy or increasing toxicity. Typically, any calculated dose within 5% to 10% of the established dose is rounded. The key to dose rounding is to identify expensive drugs and then establish an appropriate range of doses that can be rounded to accommodate the amount of drug in commercially available dosage units and to do so without altering efficacy or safety.

Identifying Need

To determine the appropriateness of a dose-rounding protocol, an institution should examine its medication purchasing history and identify those medications that represent a majority of the expense. Consider the time-honored 80/20 rule; look at the 20% of medications that may be responsible for up to 80% of the drug budget. Then conduct a medication utilization evaluation for each high-cost medication identified to determine the institution's prescribing patterns and opportunities to establish a dose-rounded dose or set of doses for that drug.

Pay special attention to medications available only in single-use vials. These medications have the highest potential to generate waste because unused product must be discarded after the vial is opened.

TABLE 1
Distribution of Daptomycin Doses Before and After Implementing a Dose-Rounding Protocol

	Before Protocol		After Protocol	
Dose (mg)	No. of Doses	No. of Vials	No. of Doses	No. of Vials
250	38	38	1	1
300	4	4	0	0
350	15	15	55	55
400	22	22	8	8
450	26	26	11	11
500	166	166	299	299
550	41	82	4	8
600	70	140	45	90
650	37	74	1	2
700	3	6	3	6
750	38	76	151	302
800	4	8	15	30
850	40	80	2	4
900	8	16	3	6
950	2	4	0	0
1000	52	104	113	226
1200	4	12	0	0
1250	1	3	1	3
1300	1	3	0	0
1400	1	3	0	0
1500	3	9	8	24
1600	2	8	0	0
1900	2	8	0	0
2000	1	4	6	24
Total	**581**	**911**	**726**	**1099**

For example, suppose that a physician electronically orders daptomycin 70 mg/kg for a 75-kg person, resulting in a 525-mg dose. Daptomycin is commercially available as a single-use, 500-mg vial. In order to dispense the order as written, two 500-mg vials are required, which results in 475 mg of unused, wasted drug from the second vial unless another order for the same product presents within the authorized time frame. To complicate matters, the excess medication often may not be billed, resulting in not only wasted drug, but lost compensation. The dose range for daptomycin is between 6 mg/kg and 10 mg/kg. In this example, if the dose is rounded down to 500 mg, which is within the recommended dosing range, no waste is generated, and the provider can bill for the full cost of a single vial. (See **CASE STUDY** for how to implement a daptomycin dose-rounding protocol.)

Risks and Limitations

Concerns commonly raised by prescribers when discussing dose rounding include the potential for dose reductions to result in unfavorable patient outcomes or for dose increases to result in greater toxicity. Therefore, prescriber education is vital to gaining acceptance for implementing dose-rounding protocols. Present physicians with literature that demonstrates the safety and efficacy of the practice while reducing costs.[6] Establishing the standard dose-rounding range in concert with the literature and eliciting physician input and approval usually helps to allay concerns about under- or over-dosing.

Protocol enforcement also must be considered. Depending on the hospital, its policies, culture, and best practices, and the nature of the protocol dose, rounding may be presented as a recommendation rather than a rule. For example, prescribers may have discretion about whether or not to adhere to the dose-rounding protocol for daptomycin. When a protocol is optional, adherence becomes paramount, because as fewer prescribers participate, the likelihood increases that potential benefits will be negated. Therefore, establishing a rule is preferable when possible.

Training

Staff training is critical to ensure compliance with dose-rounding protocols. Pharmacists and pharmacy technicians can help educate and remind providers about protocols and encourage adherence. Employing a physician champion who actively supports the protocols also is key to success, as he or she can communicate the importance of the protocol to peers and educate fellow physicians on the process. Securing the endorsement of medical staff committees prior to approval also will help with gaining physician buy-in.

In our experience, non-adherence to protocols is usually the result of a lack of awareness. However, education and reminders alone are unlikely to result in ongoing, consistent compliance. Institutions must adopt more effective methods to enforce adherence, such as forced functions and constraints within the CPOE system. Another option is to empower pharmacists to round doses when

CASE STUDY

Implementing a Daptomycin Dose-Rounding Protocol

A daptomycin dose-rounding protocol was recently implemented at a large urban medical center. After a careful analysis of prescribing practices, daptomycin was identified as a significant expenditure with a high potential for waste due to its weight-based dosing and its availability only in single-use vials. The prescribing analysis demonstrated that doses were inconsistent and that an opportunity for dose rounding existed.

An infectious disease (ID) physician was recruited to champion the project, and representatives from pharmacy and the ID division met to develop the protocol. Recommended doses were assigned based on patient weight ranges and added to the CPOE system. Daptomycin prescribing was restricted to ID physicians. Providers were encouraged to select one of the protocol orders; however, they also could manually enter a dose if warranted. Hospital staff was educated about the protocol, and pharmacists were encouraged to contact providers if the recommended dose was not ordered. The antimicrobial stewardship team closely monitored use of the dose-rounding protocol.

After implementation, prescribers began standardizing daptomycin doses based on the protocol. **TABLE 1** displays the doses dispensed during the 3 months before and after the protocol was implemented. It was determined that 88% of the doses dispensed adhered to the protocol. Because the available vial size is 500 mg, a considerable amount of waste was noted proximal to the 500-, 1000-, and 1500-mg doses before the protocol was implemented. After the protocol was implemented, a significant number of doses were appropriately rounded to the nearest 500-mg mark.

In analyzing the cost savings, 1.57 vials were required per dose in the pre-protocol group. In the post-protocol group, 1.51 vials were used per dose. Given that 726 doses were dispensed in the post-protocol group, 0.06 vials (1.57-1.51) were saved per dose after dose rounding. During the 3 months of the study period, 44 vials were saved. At the time, the average wholesale price was $372.51 per vial, resulting in an extrapolated cost savings of over $65,000 per year.

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prescribers fail to adhere to the approved protocol and do not specify that a nonstandard dose must be dispensed. In addition, pharmacists should periodically (ie, monthly or quarterly) review protocol compliance and address any discovered barriers to adherence.

Nurses also must be aware of the protocol because the dose ordered may differ from the dose dispensed; as a result, nurses may interpret the dispensed dose as incorrect when in fact the dose adheres to the protocol. Consider adding a notation on the medication label, such as *Medication has been rounded according to protocol,* to alert the nurse of the altered dose.

Implementation

Certain strategies increase the likelihood that a dose-rounding protocol will be successful. The protocol must be simple and easy for providers to understand and should be implemented in the electronic ordering system or available via a pre-printed order set. If neither of these capabilities exists, then to ensure adherence, pharmacists should be empowered to make the changes necessary to meet the criteria of the protocol.

The best way to ensure compliance is to apply forced functions to medication orders in CPOE so that the orders adhere automatically to the protocol. Another relatively simple way to facilitate compliance is to develop standard orders that adhere to a protocol. For example, the CPOE system can be set up to display only the following prescribing choices: vancomycin 750 mg IV q 12h, vancomycin 1 g IV q 12h, vancomycin 1.5 g IV q 12h, or vancomycin 2 g IV q 12h. Although vancomycin dosing is weight-based, the prescriber is most likely to choose an order that is available when the options are clear. Some CPOE systems can be constructed to automatically round within the established range (eg, one percent). In this case, the system can be configured to adhere to the protocol.

Cost-Savings Analysis

After a dose-rounding protocol has been implemented, an individual or team should analyze the cost savings generated. The easiest way to conduct this analysis is to compare purchasing costs pre- and post-implementation. However, this method does not account for changes in prescribing, such as seasonal variation, prescriber-specific preferences, or fluctuations in price or product availability. A more accurate analysis method is to determine how many vials were needed per dose during a defined period before and after implementation. For example, if 500 doses were dispensed requiring 1.8 vials per dose before implementation of the dose-rounding program and 1200 doses were dispensed requiring 1.2 vials per dose after implementation, the average savings is vial cost ($372.51) x vials saved per dose (0.6) x number of doses (for example, 100 doses in a 1-month period). That would yield a savings of $22,350.60 for that month.

Conclusion

As health systems are asked to provide more services with fewer resources, reducing drug waste represents a prime cost-savings opportunity. Not only is dose rounding associated with significant cost savings, but it also can improve preparation efficiency and medication order turnaround times. Evaluating drug utilization and identifying opportunities for dose rounding can positively impact the hospital's bottom line without altering safety or efficacy. ■

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