

## **ASHP Guidelines on Managing Drug Product Shortages in Hospitals and Health Systems**

### **Purpose**

Drug product shortages can adversely affect drug therapy, compromise or delay medical procedures, and result in medication errors.<sup>1,2</sup> Health care professionals are increasingly concerned about the clinical impact shortages have on patients and the tremendous resources required to address shortages.<sup>3-5</sup> Adverse patient outcomes related to drug product shortages<sup>1,2,6-9</sup> have prompted aggressive management strategies by health care providers and gained the attention of The Joint Commission,<sup>10</sup> government,<sup>11,12</sup> and the media.<sup>13,14</sup> Drug product shortages adversely affect health-system finances by increasing the cost of delivering patient care, largely through higher drug acquisition and personnel costs.<sup>6</sup> In addition, shortages create a high level of frustration for everyone involved, including purchasing agents, pharmacists, nurses, physicians, and patients.<sup>7</sup>

Managing drug product shortages is particularly complex for practitioners in hospitals and health systems (hereinafter, “health systems”), because these facilities routinely treat patients with acute or emergent conditions, use a significant number of medically necessary or single-source products, and use high-cost new drug technologies. These health care providers are challenged during drug product shortages to ensure the provision of seamless, safe, and therapeutically equivalent drug therapy, preferably at comparable costs. The pharmacy department must take a leadership role in efforts to develop and implement appropriate strategies and processes for informing practitioners of shortages and ensuring the safe and effective use of therapeutic alternatives. Strategic planning is required for managing drug product shortages, just as it is for disasters such as major weather events or mass casualty incidents.

Because a thorough understanding of the reasons drug product shortages occur is

essential for their successful management, these guidelines begin with a description of factors that contribute to or exacerbate shortages. The guidelines then recommend a three-phase approach to contingency planning for management of drug product shortages and include strategies for prevention. Given the differences and complexities in health-system organizational arrangements and practice settings, some aspects of these guidelines may not be applicable in all settings. Pharmacy managers should use their professional judgment in assessing and adapting these guidelines to meet their needs.

### **Contributing Factors**

For the purpose of these guidelines, a drug product shortage is defined as a supply issue that affects how the pharmacy prepares or dispenses a drug product or influences patient care when prescribers must use an alternative agent. Shortages can be the result of one or a combination of factors throughout the supply chain. The supply chain includes sources of raw materials, manufacturers, regulators, wholesalers/distributors, prime vendors, group purchasing organizations, and end-user health care systems. The factors that follow contribute to disruptions in the availability of drug products.

***Raw and Bulk Material Unavailability.*** Disruptions in the supply of raw or bulk materials are especially problematic when the primary or only source experiences production difficulties or discontinues production, affecting multiple manufacturers. An estimated 80% of the raw materials used in pharmaceuticals comes from outside the United States.<sup>4</sup> Availability problems can arise when armed conflict or political upheaval disrupts trade; animal diseases contaminate tissue from which raw materials are extracted; climatic and other environmental conditions depress growth of plants used to produce raw material; or raw materials are degraded or contaminated during harvesting, storage, or transport.

***Manufacturing Difficulties/Regulatory Issues.*** Drug product shortages can also occur when the primary or only manufacturer of a drug product halts or delays production in response to a Food and Drug Administration (FDA) enforcement action concerning noncompliance with Current Good Manufacturing Practices (CGMPs). Contributing factors may include antiquated manufacturing equipment, a shift of resources from maintenance of equipment and facilities to research and development, loss of manufacturer personnel experienced in production and compliance issues as a result of company mergers or retirements, CGMP-related problems with subcontractors who supply products to multiple pharmaceutical manufacturers, and limited FDA resources for timely manufacturing site inspections.<sup>4</sup> Resolution of these issues is often a lengthy process and may include inspections to ascertain CGMP compliance, issuance of an injunction against the manufacturer, or seizure of products. In some instances, a manufacturer's decision to close a specific manufacturing facility results in unintended drug product shortages. Such was the case when the sole source for hyaluronidase production closed, leaving no supplier.<sup>5</sup>

FDA enforcement actions are intended to protect the public from potentially unsafe drug products. These actions are evaluated by the FDA Center for Drug Evaluation and Research (CDER) drug shortage coordinator to determine if the action might create a shortage of a medically necessary drug product.<sup>12</sup> (The FDA definition of a medically necessary product is discussed in **Government intervention**, below.) In the event that a significant corrective action involves a medically necessary product, FDA will help the manufacturer return to compliance, consider qualifying additional manufacturing sites, or, in extreme circumstances, permit importation of the product(s) from a foreign manufacturing source once the required quality controls are met.

***Voluntary Recalls.*** Voluntary recalls, generally related to manufacturing problems, can cause

shortages, especially when a sole manufacturer's drug product dominates the market supply.

Voluntary recalls are generally temporary and occur as a result of a minor lapse in manufacturing procedures that would not be subject to FDA legal action. Recalls usually affect specific lots and are conducted either because of a lack of assurance that the recalled product is safe or for reasons not related to safety, such as technical deficiencies in the drug's labeling. An ethical dilemma could arise when it is predictable that complying with the voluntary recall may cause a drug product shortage in a given health system.

***Change in Product Formulation/Manufacturer.*** Changes in a product's formulation or manufacturer may also delay product availability. An example is the transition from albuterol metered dose inhalers (MDIs) containing chlorofluorocarbons to MDIs containing hydrofluoroalkanes in 2006.

***Manufacturer Production Decisions/Economics.*** Manufacturers' business decisions are based on a variety of factors, including availability of generic products, market size, patent expiration, drug approval status, regulatory compliance requirements, and anticipated clinical demand. Occasionally, manufacturers temporarily or permanently reduce production quantities of certain drug products as they shift production or reallocate resources to other products. A manufacturer's reasoned, sound business decision to discontinue production of a drug product because of insufficient financial return or a high cost to correct manufacturing issues can cause an unanticipated, serious shortage, especially in the instance of a sole-source or medically necessary product.<sup>15</sup> For example, a shortage of diphtheria and tetanus toxoids and acellular pertussis vaccine adsorbed was precipitated when one of the manufacturers, claiming low revenues, discontinued its product in 2000.<sup>5</sup> Manufacturers are not required to give notice to FDA of a drug discontinuation unless the product is a sole-source, medically necessary product.<sup>16</sup> For medically

necessary drugs, FDA can encourage other manufacturers to produce the product or request that the manufacturer not suspend production until an alternative source is available. However, FDA does not have the authority to require a firm to make any product, even if it is medically necessary. Even with advance notice, some agents such as vaccines or antibiotics are complex to manufacture, and shortages may result even if other manufacturers are willing and able to produce the product. Similarly, business decisions on the part of wholesale distributors and even end-user health systems may contribute to drug product shortages.

***Industry Consolidations.*** Manufacturer mergers often result in decisions to narrow the focus of product lines or to move a production line to a new facility, resulting in the discontinuation or delayed availability of drug products. Mergers between two companies manufacturing similar product lines typically result in single-source products. As the number of manufacturers of a product decreases, resiliency in the supply chain also decreases, making product supplies more vulnerable. Many vaccines in the United States are single-source products, in part because of discontinuations and consolidations.

***Restricted Drug Product Distribution/Allocation.*** Most hospitals and health systems obtain the majority of their drug products through wholesale distributors. Restricted distribution methods that bypass the normal supply chain can also create shortages. As the result of either market approval requirements or postmarketing surveillance, manufacturers limit the availability of specific drug products. Only selected suppliers and end-users that comply with manufacturer agreements are able to obtain the product. A manufacturer can also place restrictions on available limited supplies, requiring health systems to order direct from the manufacturer or through a specialty distributor to receive an allocation.

***Inventory Practices.*** Communication and transportation efficiencies throughout the supply chain

have allowed inventory reductions at all levels. Most manufacturers, distribution centers, and health systems use just-in-time inventory management to reduce the cost of inventory on hand and to optimize cash flow. For all stakeholders this strategy is recognized as sound business management, but an unexpected shortage at any point in the supply chain can have a significant impact for the end-user and patient. Some manufacturers and distributors use inventory management strategies that minimize end-of-quarter or end-of-year product inventories or limit shipment based on yearly quotas.

Poor ordering practices, stockpiling prior to announced price increases, hoarding caused by rumors of an impending shortage, and unexpected delivery delays may affect inventory levels in individual health systems. In addition, hospitals in rural areas face additional inventory challenges caused by distant distribution centers and the inability to easily borrow an item from a nearby hospital. Drug product shortages may also occur when all hospitals in an area disproportionately use the same wholesaler. Some shortages are wholesaler dependent, as shortages of drugs can occur when contracts with suppliers are delayed.

***Unexpected Increases in Demand/Shifts in Clinical Practice.*** Occasionally, the demand for a drug product unexpectedly increases and exceeds production capacity. This may occur when a new indication is approved for an existing drug product, when usage patterns change in response to new therapeutic guidelines, when a substantial disease outbreak occurs, or when unpredictable factors influence demand. Shortages may be prolonged when the raw materials are limited or manufacturing processes are complex and are dependent on a long lead time. For example, when the Centers for Disease Control and Prevention (CDC) recommended annual influenza vaccination for children ages 6 to 59 months in 2006, only a single product was labeled for children 6 months to 23 months.<sup>17,18</sup>

***Nontraditional Distributors.*** The increased frequency of drug product shortages has precipitated the development of nontraditional distributors, also known as open market, gray market, or alternative distributors. Somehow these specialty, licensed distributors or brokers are able to obtain products in short supply for the purpose of reselling them to end-users unable to obtain them through their normal suppliers. These distributors aggressively market the availability of these products to hospitals, specialty health systems, home care agencies, and physician practices, generally at substantially higher prices. Typically they have only a limited quantity of product, often only enough to supply one or two patients. Many do not offer a return or refund on a product if it expires or is not used. Especially worrisome is the inability to ascertain the product pedigree or ensure the reliability of the source of the product (which could be outside the United States) and proper handling and storage throughout the chain of custody. The extent to which the activities of such nontraditional distributors contribute to shortages is unknown.

Compounding pharmacies have also pursued the production of drugs that are in short supply. Caution is warranted because preparations from these pharmacies may not meet applicable state or federal standards (e.g., *United States Pharmacopeia* Chapter 797 or FDA labeling requirements). The sources of raw materials used by compounding pharmacies have sometimes been questioned, and apparent lapses in quality control have resulted in serious patient injury, including death.<sup>13</sup>

***Natural Disasters.*** Natural disasters can have a profound impact on the availability of drug supplies. Damage to manufacturing facilities, particularly those that are the sole source of a drug product or category of products, are especially likely to cause long-term shortages. Damage to manufacturing facilities in Puerto Rico in 1998 from Hurricane George caused shortages of several drug products. Fires, hurricanes, tornadoes, and floods are examples of disasters that may

compromise drug product supplies on a temporary basis. In some instances, these shortages may be exacerbated by an escalated need for certain classes of drug products to care for victims of the disaster. In 2005, areas affected by Hurricanes Katrina and Rita were affected by both an increased need for medications and an inability to obtain them.

### **Phased Approach to Planning for Drug Product Shortages**

The discovery of a shortage initiates a cascade of events surrounding drug procurement and therapeutic decision-making (Figure 1). Drug procurement considerations include validating the shortage and its anticipated duration, determining the availability of supplies from alternative sources, locating and procuring alternative supplies (if available), investigating the implications of compounding the product, and researching and providing education about alternative agents and the cost implications of all scenarios. The outcome of this process may then prompt evaluation of the shortage's potential impact on patient care and development of a strategy for effectively communicating the needed information to all professionals involved and to affected patients when warranted.

In an ideal world, there would be a system for warning providers in advance of impending drug product shortages; this would give them ample opportunity to proactively address and manage all aspects and implications of the shortage. In lieu of this ideal, pharmacists, when confronted with the unavailability of a drug product, want information on which to base decisions about meeting patient needs for the product. Segments of the supply chain, especially manufacturers and distributors, have been inconsistent in providing information and assistance to health systems. The difficulty in obtaining information is exacerbated by the many players, complexities, and uncertainties in the supply chain.

The pharmacy department must take a leadership role in managing shortages by

developing and implementing appropriate strategies and processes for optimizing safe and effective use of therapeutic alternatives. Health systems should develop a contingency planning strategy to prepare for the possibility of a prolonged drug product shortage.<sup>19</sup> Although it often is not possible to predict when shortages will occur, the process for dealing with them can be defined in advance. The health system should identify a point person to implement and monitor this process and establish an organizational approach to decision-making and communication. The institution should determine committee structures and responsibilities for decision-making during each phase of the process (e.g., pharmacy and therapeutics committee, medical executive committee).

Planning can be divided into three phases: identification/assessment, preparation, and contingency. Assessment requires a critical evaluation of the current situation and the potential impact of the shortage on the health system. An effective evaluation examines the reason for the shortage and an estimated release/end date; both internal and external supply availability are assessed.

The preparation phase consists of all activities that can be performed before the actual effects of the shortage are felt. Depending on the health system's inventory, when a back order or other notice is received, there is often lead time before actual stock depletion. All patients whose treatment depends on the unavailable drug product and alternative therapies should be identified. Since many drug products have limited therapeutic alternatives, outages can have significant patient care and cost consequences. Health systems need to gauge the impact of those consequences on their system. Preparation should also include the development of methods for implementation and communication.

The contingency phase involves operations and circumstances for which preparation is

limited because of incomplete information, financial constraints, or circumstances beyond the health system's control. For example, biological products are available only in increments and at a very high cost when no therapeutic alternatives are readily available or when shortages are longer than anticipated. Since direct control over availability is not possible, health systems must prepare for the product's unavailability.

### **Identification/Assessment Phase**

The purchasing agent is often the person who identifies a shortage and may be the point person responsible for managing drug product shortages. This person must be cognizant of aberrant fluctuations in the health system's supply chain that may indicate a potential shortage (e.g., partial orders filled, one strength difficult to obtain, most manufacturers out of stock). If the purchasing agent is not a pharmacist, he or she must work with a designated pharmacist.

When a shortage is identified, the point person or their designee should conduct an assessment to evaluate its impact. A threat analysis using the shortage's expected duration and an assessment of the current inventory and usage patterns can be used to determine the potential impact.

***Details and Duration of Shortage.*** Pharmacists can contact product manufacturers, distributors, FDA, CDC, and other sources to determine the reason for the shortage and its expected duration. This information may already be available on the ASHP Drug Shortage Resource Center Web site (<http://www.ashp.org/shortages>). If it is not, visitors to the site can report a shortage online. Predictions of when the product will be available help determine the health system's ability to endure the shortage and guide its short- and long-term strategies.

Although the end result is the same, the time to impact and duration of impact vary according to the reason for the shortage and where in the supply chain problems occur—from

raw materials to manufacturer, manufacturer to wholesaler, or wholesaler to health system. The lack of raw material may affect several manufacturers of the finished drug product. A manufacturer's problems may affect only its product. Effects on distributors are dependent on their inventory levels.

***Inventory on Hand.*** Once a shortage is confirmed, the pharmacy should count the inventory on hand and estimate the time period it will cover. Available inventory includes all supplies of the drug product within the health system, including the pharmacies, inpatient units and ambulatory care clinics, automated medication storage and distribution devices, floor stock, code carts, and prepared trays.

On the basis of available quantities and historical usage, the pharmacy should estimate how long the health system can endure a shortage. Usage history can be obtained from procurement and issue records held by distributors, the purchasing department, and the pharmacy department. Billing and automated medication storage and dispensing device records assist in determining actual usage within the system.

Inventory counts of all alternative drug products should be converted into common measurement units to augment estimates of use. Both the current use rates and reduced rates after conservation measures are implemented should be included in the assessment of how long the available inventory of the shortage drug product and possible alternative products will last.

***Threat to Patient Care and Costs.*** A threat analysis evaluates all factors relevant to the shortage (e.g., duration, current inventory, medical necessity, and alternative sources or therapies) to determine the shortage's potential impact on patient care and costs. Shortages affect safe medication practices throughout the medication distribution and administration process within a health system. When considering alternative dosage forms or therapies, pharmacists must

consider changes in look-alike/sound-alike procedures, bar coding, distribution paths, and the impact on automation, contract compliance, and final product preparation.<sup>20</sup> The extent to which a health system will be affected by a given shortage depends on the health system's scope and level of services and its service population.

### **Preparation Phase**

Once an imminent shortage is confirmed, the health system should take steps to prepare for known and potential problems in maintaining patient care and controlling costs.

***Therapeutic Alternatives.*** The first step in the preparation phase is to identify therapeutic alternatives to the unavailable drug product. A formal process for identifying and approving therapeutic alternatives for the health system should be established. The health system should make decisions about alternative agents in collaboration with medical, nursing, and pharmacy representatives and obtain approval of the appropriate medical committee(s). Therapeutic alternatives should be inventoried to ensure adequate supplies to meet new demand. In many cases, supplies of the best alternative agent may be affected by the current shortage.

***Communication and Patient Safety.*** Information about the drug product shortage, alternative therapies, temporary therapeutic guidelines, and implementation plans should be communicated to clinical staff by the most effective means available within the health system. Communication of this information is essential for ensuring patient safety and preventing medication errors caused by confusion over differences between drug products' dosages, onset, duration, and other factors. Automated systems and order entry systems must be updated with changes. Pharmacy department staff responsible for assisting prescribers with medication orders and aiding nursing staff with administration should be thoroughly informed about the alternative therapy decisions and implementation plans. Sustained communication is necessary to reach medical, nursing, and

pharmacy staffs working varied shifts or services.

***External Relationships with Other Health Systems.*** The preparation phase includes, when applicable, the establishment of collaborative arrangements with other institutions within a regional network or system. Available supplies of a potentially unavailable product and information about alternative therapies should be shared among the facilities. This option is limited for rural hospitals and for area hospitals served by a single wholesaler.

***Patient Prioritization.*** When a limited supply of a drug remains available and alternatives for specific patient groups are undesirable, a health system may prioritize the drug for specific patient groups. National organizations (e.g., CDC or a physician organization) may provide guidance on setting patient priorities. Medication-use evaluation data on prescribing and utilization trends, if available for the drug in question, may be useful in developing prioritization criteria to guide appropriate drug use. Such criteria are particularly helpful in dealing with long-term shortages, such as with intravenous immune globulin. To limit product use for select patients or services in the health system, criteria should be developed by a multidisciplinary team. Communication is essential to ensure that adequate supplies are available to complete courses of therapy. Clear guidelines for prioritization must be provided to assist pharmacists in evaluating the appropriateness of medication orders.

Consultation with risk management and ethics staff members or committees may be useful when supplies are severely limited. For example, during the influenza vaccine shortage of 2004–2005, many health systems did not have sufficient product to follow recommended CDC guidelines and further restricted product to specific patient groups.

***Stockpiling Restraint.*** Inventory management is a challenge in the face of a shortage. Despite pressure to do otherwise, stockpiling (hoarding) in advance of a feared shortage can occur; this

can exacerbate the shortage and divert unneeded supplies away from other health systems with patients in need.<sup>21</sup> Health systems should refrain from stockpiling, which causes two distinct problems:

1. Stockpiling can cause artificial shortages when health systems drain the supply chain and exceed manufacturing capacities, and
2. Increased inventory is costly and may not be absorbed by normal usage if shortages do not occur as anticipated.

Speculative purchasing in response to a potential shortage has drawbacks, depending on the likely cause of the shortage and where it might occur in the supply chain. Problems may arise that pose threats to, but do not reach, end-users. This happens when the supply chain, from raw material to finished product, contains several months' supply; that long lead time allows corrections that avert a shortage.

During shortages, manufacturers and distributors often allocate product on the basis of past usage. An initial stockpile order generally has no impact on increasing an allocation.

### **Contingency Phase**

Health systems must establish clear guidelines for dealing with situations in which a product is available only from a compounding source or nontraditional source or when a critical drug is not available at all.

***Risk Management and Liability.*** One potential complication of a shortage is litigation by patients who feel that they have received improper care or suffered unanticipated adverse drug effects as a result of delays, prioritization, alternative therapy, or nontraditional drug product sources. This situation is most likely with agents for which no alternatives are available. Even though risk management and legal representatives may have participated in earlier phases of the

process, they should be notified immediately when all options for obtaining either the drug product or acceptable alternatives have been exhausted.

Each health system must determine its philosophy on purchasing drugs from the gray market or compounding pharmacies and on compounding agents in-house. These decisions should be made before the pressure and emotion of a specific shortage occur. Each option and its potential effect on patient risk should be evaluated. Nontraditional drug product sources (e.g., secondary wholesalers) have extremely limited supplies, and the quality of these products may be questionable because the provenance of the medication may be unknown. Compounding pharmacies may also present patient risks; several deaths have been associated with improperly sterilized compounded products.<sup>9</sup> Health systems may choose to compound products if they can meet the necessary guidelines, although obtaining raw materials may be difficult in some cases.

***Budget Considerations.*** In the event that the drug product is available only from noncontracted manufacturers or through nontraditional distributors, the increased costs of using these sources should be estimated. Using alternative therapies may also increase costs. The financial implications should be presented through budget channels, with a request and justification for contingency funds. Additional expenditures caused by drug product shortages (e.g., overtime spent in locating product, extra or priority deliveries, in-house compounding or packaging) must be documented to explain budget variances and to support future budget proposals.

***Information Coordination and Communication.*** Clear communication with all affected clinicians about the status of a shortage is vital. Some health systems may designate a specific department to manage communications; others may find that a collaborative strategy involving various organizational departments and committees works best. Patients or family members should be counseled when a drug product shortage will delay or compromise care, especially

when patients have been stabilized on the drug product and alternatives may not be as effective (e.g., pain or blood pressure medications). The Joint Commission requires that prescribers potentially affected by drug product shortages be actively alerted.<sup>10</sup>

### **Strategies for Prevention**

Communication with the media, national professional or patient organizations, and government agencies can raise awareness of the shortage and its potential consequences. Notifying ASHP or FDA about a drug product shortage can initiate these efforts. Drawing attention to the shortage may encourage production by other manufacturers, collaborative efforts to develop alternative therapies, and ad hoc training opportunities on the safe and effective use of alternatives.

**Government Intervention.** FDA is responsible for assisting with drug product shortages to the extent of its authority.<sup>11</sup> Its responsibilities are dispersed among several components of CDER. The limits on FDA's activities depend on whether a shortage meets "medical necessity" criteria. FDA will attempt to prevent or alleviate shortages of medically necessary products. A product is considered to be "medically necessary," or a "medical necessity," if it "is used to treat or prevent a serious disease or medical condition, and there is no other available source of that product or alternative drug that is judged by medical staff to be an adequate substitute."<sup>12</sup> Inconvenience to the patient and cost to the patient, institution, and manufacturer are insufficient bases for classifying a product as a medical necessity.

A determination of medical necessity involves a risk–benefit evaluation of the compromising issue with the product versus the medical need. When FDA has determined that a shortage of a medically necessary product exists, the agency will act within its authority; actions may include discussions with pharmaceutical manufacturers to encourage additional sources, technical assistance to manufacturers experiencing CGMP difficulties, or expedited reviews of

drug product marketing applications or CGMP-related improvements. FDA may take these actions whether the cause of the shortage involves business decisions to stop manufacturing the product, voluntary recalls, FDA enforcement actions, or other factors. Information on the availability of medically necessary drug products is posted on the FDA/CDER Web site, and information regarding the availability of blood and vaccine products regulated by FDA's Center for Biologics Evaluation and Research (CBER) is posted on the CBER Web site. FDA encourages consumers and health care professionals and organizations to report product shortages. Reports of drug product shortages can be made by e-mail via FDA's CDER Drug Shortages Web site ([www.fda.gov/cder/drug/shortages/default.htm](http://www.fda.gov/cder/drug/shortages/default.htm)), and reports on vaccine and blood product shortages via the FDA CBER Biological Products Shortage Web site ([www.fda.gov/cber/shortage/shortage.htm](http://www.fda.gov/cber/shortage/shortage.htm)). The FDA shortage team will obtain information about availability and will work cooperatively with the ASHP drug product shortage team.

### **Conclusion**

Drug product supply issues are becoming more frequent, whether they result from manufacturing difficulties or natural disasters that affect production, reductions in the supply of raw materials, voluntary recalls, manufacturer business decisions, FDA enforcement actions to ensure public safety, or stockpiling that leads to artificial shortages. Although it is impractical to prepare for every potential shortage, proper planning can minimize adverse effects on patient care and health-system costs and prevent problems from escalating into crises. The key to success will undoubtedly be found in the effectiveness of information gathering, teamwork to assess options, and communication with providers, patients, and administrators.

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