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Assess Drug Shortages' Effects on Health System Pharmacies

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ABSTRACT

Background: Drug shortages have become a significant issue globally, with the number of drugs in short supply rising dramatically over the past two decades. These shortages affect essential medications, including chemotherapy agents, anesthetics, and antibiotics, and are attributed to factors such as production disruptions and supply chain issues. The consequences of shortages impact patient care, clinical outcomes, and healthcare costs, placing additional strain on pharmacy personnel and healthcare systems.

Methods: A 34-question electronic survey was distributed to pharmacy directors across multiple states to assess the impact of drug shortages in hospitals and health systems. The survey collected data on strategies for managing shortages, communication methods, staffing needs, and medication errors associated with shortages. A total of 219 responses were received, yielding a 40% response rate.

Results: The survey revealed that 51% of hospitals monitored drug shortages, with significant price increases noted by 84% of respondents due to supply shortages. The average additional staff hours required to manage shortages ranged from 10 to 20 hours per week. A majority of respondents (76%) reported preapproval for auto-substitution of drugs in short supply, and 60% agreed that shortages created unsafe conditions for patients and staff. Respondents estimated an average of 1% to 5% medication errors due to shortages.

Conclusion: Drug shortages continue to pose a major challenge for hospitals, requiring significant pharmacy resources and negatively affecting patient care. Pharmacists play a critical role in mitigating the impact of shortages through strategies such as auto-substitution, managing expiring medications, and coordinating with manufacturers. To address the ongoing issue, hospitals should consider adopting these strategies, and pharmacy education should include formal training on managing drug shortages. Collaboration between healthcare professionals, manufacturers, government agencies, and patients is essential to advocate for solutions to the drug shortage crisis.

Keywords: chemotherapy agents, anesthetics, antibiotics, shortages.

INTRODUCTION

The growing prevalence of drug shortages has become a significant global issue, with the number of medications listed as in shortage rising dramatically over the past two decades. Between 2005 and 2010, the number of drugs on shortage lists surged from 61 to 178, reaching over 200 in 2012 alone. As of March 2014, 754 drug products were reported to be in shortage by the U.S. Food and Drug Administration (FDA) (2). Shortages commonly affect essential drugs, including chemotherapy agents, pain relievers, injectable nutritional supplements, anesthetics, anti-infectives, and cardiovascular medications (3-6). Contributing factors to these shortages include insufficient raw materials, reduced manufacturing capacity, and production disruptions (7,8). Furthermore, communication delays or failures between the FDA, manufacturers, and healthcare providers often exacerbate the problem by hindering proper planning and response (1).

The consequences of these shortages are widespread, with over half of healthcare professionals reporting that these shortages have negatively impacted their practice and led to substandard patient care (9). A study from Canada revealed that anesthesiologists linked drug shortages to extended recovery times, delays in scheduling surgeries, and increased costs of recovery. Nearly 50% also believed that shortages led to the use of less effective anesthetics (6). Vulnerable groups such as cancer patients and neonates are especially affected, as few

alternative treatments are available for certain drugs, leading to serious clinical complications, as seen in the case of selenium shortages (10-13). In addition, shortages often force healthcare providers to prescribe less commonly used medications, increasing the risk of medication errors, as demonstrated during previous shortages of fentanyl (6). Beyond patient care, drug shortages have had societal impacts, including delays in legal executions due to a lack of available drugs (14).

Financially, drug shortages are estimated to cost the U.S. healthcare system $99 million annually, just in acquisition costs (9). Many of the drugs affected are generics, which hospitals and insurance providers rely on for affordable alternatives to branded medications (1,7). Shortages not only increase the price of drugs but also decrease productivity and efficiency within the healthcare system. Pharmacists and other staff spend additional time sourcing medications, exploring alternative treatments, and coordinating with manufacturers. As a result, many healthcare facilities have employed specialized staff dedicated to managing shortages (9,15).

The rising costs and scarcity of medications have led healthcare providers to adopt strategies aimed at reducing waste and finding alternative sources. For example, Pharma Tech has developed software solutions to help institutions efficiently manage expired drugs in automated storage machines, minimizing waste and ensuring safety (16). In cases where medications are in short supply, some institutions turn to compounding, though this practice carries risks due to potential inexperience with certain compounds and the danger of contamination (17,18). A tragic example of the risks associated with compounding occurred during an amino-acid shortage, where nine deaths resulted from a lapse in the sterile process (19,20). Another high-risk strategy is sourcing medications from the "grey market," where intermediaries purchase scarce drugs at inflated prices. These drugs often come with uncertain quality, as some may be stolen or counterfeit (21).

To address these challenges, the Accreditation Council for Pharmacy Education (ACPE) recommends that hospital and health system pharmacists develop competencies in drug procurement, medication safety, and managing shortages. These competencies include understanding the basic processes of drug selection, inventory management, handling back orders and recalls, minimizing drug waste, and ensuring that shortages do not compromise patient care (22). With the ongoing issue of drug shortages, this study aims to highlight the challenges faced by health system pharmacies, outline necessary responses to manage these shortages, and propose strategies to prevent future shortages.

METHODS

An electronic survey comprising 34 questions was distributed via SurveyMonkey to pharmacy directors or their designated representatives across several states. The distribution list of pharmacy directors was obtained through collaboration with the state boards of pharmacy. A total of 549 pharmacy directors were given a two-week period to complete the survey, with a follow-up reminder sent to non-respondents after one week. The survey was not anonymous, as respondents were asked to provide contact information for follow-up inquiries. However, all responses were kept confidential and reviewed solely by a designated investigator.

The survey was developed by the study team with contributions from members of a professional pharmacy association. The survey collected demographic data, including the respondent's title and the name of their facility. Respondents were asked questions related to drug shortages if relevant data were available. Most questions were multiple choice, allowing participants to select from predetermined options. Topics covered included: 5 questions on alternative product preparations, 6 on drug expiration, 2 on additional staffing requirements, 2 regarding hard-to-find suppliers, 4 on internal communication about shortages, 3 on medication errors, 1 related to purchase orders, and 1 regarding pharmacy and therapeutics (P&T) committees. Additionally, one question asked respondents to rate the severity of unsafe conditions caused by medication shortages on a scale from 0 to 10. All collected data were organized into a Microsoft Excel database for descriptive analysis.

RESULTS

A total of 549 surveys were distributed to hospital pharmacy directors, with 219 responses received, resulting in a 40% response rate. The highest response rate was from South Carolina at 81.8%, while Florida had a response rate of 28.6%, North Carolina had 41.9%, and Georgia had 35.9%. Fifty-one percent of the hospitals reported monitoring drug shortages. A significant portion of respondents indicated that alternative suppliers were marking up prices by 300% to 500% for hard-to-find medications due to shortages, citing examples such as furosemide, succinylcholine, metoclopramide, azithromycin injection, suxamethonium chloride, and ketorolac. Price gouging was noted, with 84% of respondents advocating for government intervention to regulate these price increases.

Effective communication of drug shortages to physicians and hospital staff is critical. The most common methods reported for communicating shortages were through Pharmacy and Therapeutics (P&T) committee meetings and email. Respondents indicated that an additional 2 to 5 staff hours per week were required for communicating drug shortage information to hospital staff, while an average of 10 additional staff hours per week were necessary to update hospital information systems with this data. It was not specified whether non-

pharmacy staff hours were included in this time.

Seventy-six percent of institutions had P&T committee preapproval for pharmacists to perform autosubstitution for drugs in short supply. A majority of respondents reported that drug shortages caused an error rate of 1% to 5% due to the additional manipulation required by pharmacists to ensure patients received the appropriate drug. In each state surveyed, 60% of respondents agreed that drug shortages created unsafe conditions for patients and staff. Respondents ranked the severity of unsafe conditions caused by shortages at an average of 5 on a scale of 0 to 10.

Regarding the additional staff hours required to manage drug shortages, most respondents estimated the need for 0.5 full-time equivalents (FTE), followed by 1.0 FTE. This increase was mainly attributed to managing orders and preparing syringes, with more than five different products being reconstituted or prepared in alternative dosage forms. On average, over 400 extra syringes were prepared per month due to drug shortages, with a $2 additional cost per prepackaged syringe for supplies, excluding the drug cost. The survey found that, on average, 10 additional pharmacy personnel hours per week were needed to prepare these syringes, with one state reporting 20 additional hours.

Approximately 90% of respondents confirmed that expiration dates of drugs in automated storage machines (ASMs) were tracked, and expired medications were removed from the machines weekly (48%) or monthly (46%)

DISCUSSION

Drug shortages have become a widespread issue in healthcare, necessitating collaboration between pharmacists, manufacturers, the government, and the public to address this ongoing crisis. The findings of this survey align with previous studies, demonstrating the significant impact shortages have on hospital pharmacies and the delivery of high-quality patient care (9,23).

When a healthcare institution faces a drug shortage, a structured approach is required to manage the situation. Actions such as contacting manufacturers for direct orders and consolidating stock, which according to our survey demands an additional 0.5 to 1 FTE, can help mitigate the impact until regular supplies are restored. When these basic steps are insufficient, identifying therapeutic alternatives becomes crucial. These alternatives must be quickly sourced through literature and shared with healthcare teams to prevent delays in patient care and ensure the continuity of appropriate treatments. A practical example of this occurred at our facility when etomidate injection was unavailable. In advance of the product depletion, alternative medications were identified and communicated to pharmacy staff and key physicians, ensuring a seamless transition during emergency intubation procedures. This process also involved collaboration with departments such as information technology and communications.

Health systems have a significant role in preventing shortages by minimizing the gap between a medication's expiration date and its removal from inventory, as well as by establishing a critical medication list that allows for less stringent inventory turnover controls. According to our survey, institutions are pulling medications nearing expiration on a weekly or monthly basis. Weekly removal of soon-to-expire medications helps reduce waste, limits the amount of expired stock returned, and makes better use of available inventory, particularly during shortages. Additionally, maintaining a critical medication list and delaying the removal of these medications until closer to their expiration can help mitigate the effects of shortages. Effective inventory management, with reduced overstock, has become crucial in distinguishing between a true shortage and a manageable inventory challenge. Having a list of essential medications, with a buffer stock for must-have drugs, can be pivotal in maintaining optimal patient care during a shortage.

Drug shortages have led to several medication errors and adverse clinical outcomes, often due to the use of compounded drugs or alternative formulations (15). Examples of this include substituting sodium acetate with potassium acetate in sodium bicarbonate solutions, or errors in heparin drip preparations during a shortage of premixed heparin. Shortages in chemotherapy drugs have also contributed to increased morbidity and mortality (24). Over 60% of respondents in our survey indicated that drug shortages created unsafe conditions, and additional hours were required to update hospital information systems. Issues such as sound-alike/look-alike drugs (SALAD), lack of familiarity with alternative medications, improper dilution of concentrated alternatives, expired drugs in automated storage, and adjustments to expiration dates for USP <797> compliance have been identified in the literature (25). Addressing these challenges requires better education, improved communication, and robust system checks. Negative clinical outcomes have included issues like nutrient deficiencies in neonates during selenium shortages and respiratory arrests from the use of larger fentanyl vials during shortages of smaller ampoules (7,15,26–29). A recent critical shortage of intravenous fluids, including normal saline, has further strained healthcare systems (2).

The Institute for Safe Medication Practices (ISMP) has emphasized the need to evaluate the impact of alternative drugs on prescribing practices, drug storage, final product preparation (including admixture directions), drug administration procedures, SALAD issues, and the use of technology such as electronic prescribing, barcoding systems, automated dispensing cabinets, and smart pump libraries (25,30). Our survey

indicates that addressing the safety concerns related to shortages involves additional FTE hours: 0.5 to 1 FTE for ordering, 10 hours per week for syringe preparation, 10 hours per week for hospital system updates, and 2 to 5 hours per week for communicating with physicians and staff. These findings are consistent with those of other surveys (31). Table 1 includes examples of steps taken at our institution to prevent medication errors resulting from drug shortages.

Table 1. Actions Taken to Prevent Medication Errors Due to Drug Shortages

Drug/Agent Affected	Action Taken
Dobutamine vials	Use of dobutamine premix bags during vial shortage; education on SALAD risks with dopamine premix bags
TPN Software Template	Staff education on parenteral nutrition preparation changes
Multitrace-4 (parenteral nutrition)	Substitution of Addamel N for Multitrace-4, with education on dosing differences (10 mL vs. 1 mL for adult TPN preparation)
Epinephrine Abboject	Preparation of "epinephrine kits" for emergency boxes, containing appropriate supplies and preparation instructions during the epinephrine Abboject shortage

Note: SALAD = sound-alike/look-alike drugs; TPN = total parenteral nutrition.

Over 80% of survey participants believe that government intervention is necessary to regulate price gouging. It is crucial for healthcare providers to report any concerns regarding price increases to the Federal Trade Commission, alert the FDA about drug shortages, and notify the FDA Office of Criminal Investigations regarding grey market activities. These agencies are designed to handle such issues, but they rely on healthcare professionals to report these problems. Additionally, pharmacists have an ethical responsibility to complete shortage surveys when requested, as this data is vital for lobbying and legislative actions.

In 2011 and 2013, two bills were introduced in both the Senate and House of Representatives to address drug shortages (32). The proposed legislation would require manufacturers to notify the FDA if there is any disruption, discontinuation, or modification in the production of a drug that might cause a shortage. Another suggested measure is for the FDA to implement a grading system for plant inspections, as the current pass/fail system does not allow manufacturers to correct minor issues without risking plant shutdowns. A grading system, similar to those used in the food industry, would motivate manufacturers to maintain high standards, knowing that the results would be shared with consumers (1). While FDA regulation is critical for ensuring safe medication delivery, the US House of Representatives Oversight Committee suggests that these actions should be taken with consideration for their potential effects on the supply of essential medications (33).

There are still unresolved questions, such as whether group purchasing organizations have exacerbated the shortage crisis by contracting single-source manufacturers for specific drugs. Could these exclusive contracts place an undue burden on one manufacturer, or would contracting multiple suppliers help prevent shortages? Additionally, future research should examine whether automatic substitutions during shortages impact costs to pharmacies or patients, or if they delay patient outcomes or lengthen hospital stays.

Several limitations of the survey should be noted. The response rate was 40%, with many participants citing time constraints, lack of interest, the survey's length, or simply ignoring the request. We suspect that only one survey per institution was completed, as there was only one point of contact for each pharmacy director or designee. The highest response rate came from South Carolina, likely due to the research team's location there. The responses may have varied based on hospital patient demographics and drug suppliers. Although open-ended responses were not allowed, there were no specific complaints about this limitation. We also did not assess the additional hours required from staff outside of the pharmacy team. While the survey was conducted in four southeastern states, we believe the findings can be generalized to other regions in the United States.

CONCLUSION

Drug shortages have become a persistent challenge, requiring significant pharmacy resources to manage within hospitals and health systems. These shortages also negatively affect the clinical outcomes of many vulnerable patients. Pharmacists are essential in leading efforts to mitigate the impact of shortages on patient care. Educating hospital staff, physicians, pharmacists, and other healthcare personnel is crucial. Based on the survey results, hospitals should consider adopting strategies such as allowing automatic substitutions, pulling soon-to-expire medications, ordering directly from manufacturers, and assigning additional FTE hours to manage shortages. Developing a critical medication list with elevated par levels could also help prevent shortages. Pharmacy schools should consider formally teaching students about drug shortages and strategies to address them as part of their curriculum. Patients, in addition to healthcare professionals, manufacturers, and government bodies, play an important role in advocating for solutions to the drug shortage crisis.

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