

Factors Affecting Drug Shortage in Aseer Hospitals

Ali Asiri, Naif Asiri, Ibrahim Asiri, Abdullah Asiri, Ahmed Alshehri, Yahya Albarqi, Majed Alghamri, Ali Hakeem, Hussin Alkhurmani, Abdullah Alzahrani

Ministry of Health, Saudi Arabia

Abstract

Background: drug shortage is a critical with severe negative impacts on patients' outcome. It is a multifactorial problem in the world leading to increased cost of health, poor treatment outcomes and unnecessary patient referrals.

Purpose: this study sought to examined the various causes of drug shortage in Aseer Hospital as a foundational investigation for improvement recommendations.

To explore the factors affecting drug shortage and the magnitude of every factor's influence in drug shortage.

Material and methods: this study applied a cross sectional descriptive research design of the quantitative methodology. A questionnaire was electronically sent to the 177 sample for completion. The data was then analyzed using the descriptive statistics of Statistical Package for Social Services (SPSS), version 26.

Results: a total of 177 questionnaires were completed. Out of the total sample, male gender dominated by 74.6% (n=132) while 25% were females. The dominant age group was (30-39) years old and most of the sampled pharmacists had bachelors in pharmacy 46.9% (n=83). In terms of experience at work, those who had worked for (5-10) years were the majority. Amongst the variables that contribute to drug shortage, this study found regulation and legislative processes (0.80=77.06%) as the major cause while imbalance between the supply and demand was the least cause (64.3%). There were other factors that contributed to drug shortage such as manufacturing problems (69.80%), drug distribution problems (69.0%) and human factor (65.57%).

Conclusion: the study findings are in agreement with most of the previous scholarly findings that cited regulation and legislative process as one of the most causes of drug shortage.

Keywords: *drug shortage, causes of drug shortage, healthcare.*

Introduction

Drug shortage is a major healthcare dilemma affecting most of the countries consequently threatening the realization of the Sustainable Development Goal (SDG) #3 which advocates for a world free of diseases. Additionally, drug shortage could impact directly on the health of patients by increasing the risks of medication errors, prolonging treatment period and length

of hospitalization, referrals to other institutions as well as use of alternative drugs (McLaughlin et al., 2013; Rider et al., 2013; Alruthia et al., 2017). Shukar et al. (2021) states that there is no globally acknowledged definition of drug shortage, however, United States Food and Drug Administration (FDA) defines it as "a situation in which the total supply of all clinically interchangeable versions of an FDA-

regulated drug is inadequate to meet the current or projected demand at the patient level” Shukar et al. (2021) further states that the definition of drug shortage varies across the various drug regulatory bodies. This finding is supported by Videau et al. (2019), who stated that some regulatory bodies define it according to the drug supply chain (supply and demand ratio) while some authorities define it in terms of timeframe (inability to dispense a particular drug to a patient when needed). American Society of Hospital Pharmacists [ASHP] (2020) refers to drug shortage as a supply issue that affects how the pharmacy prepares or dispenses a drug product or influences patient care when prescribers must use an alternate agent (Fox & McLaughlin, 2018).

The world has experienced an increase in drug shortage over a long period of time thus increasing the operating cost of the healthcare institutions. Rinaldi et al. (2017) says that however, many countries experience drug shortages, every country has a unique shortage depending upon the prevailing health conditions. In addition there are certain drugs that are prone to shortage than the rest. These drugs include the emergency and essential drugs. Amongst the classes of drugs, antimicrobial was the most affected class by drug shortage (Mazer-Amirshahi et al., 2014; Hedman, 2016). In 2014, the United States suffered shortage of penicillin G [J01CE08] which was attributed to delay in production. Elsewhere, Setavesh and Mackey (2016) in their study observed a shortage of 73 cancer drugs.

There are quite a number of factors contributing to shortage of drugs in various countries as per previous studies. These factors can be categorized into three main groups such as supply issues for example, manufacturing issues, unavailability of raw materials, business issues and logistical issues (De Weerd et al., 2015; Shukar et al., 2021). Secondly, demand issues, which encompasses just –in- time, increasing marketing and tendering system as well as the government regulatory issues causes serious bureaucratic challenges on the availability (Dill and Ahn, 2014; Bogaert et al., 2015; Alsheikh et al., 2016; Phuong et al.,

2019). A study conducted by American Society of Health-System Pharmacists [ASHP]/University of Utah Health Care (UUHC) found out that 23% of the causes of drug shortage is due to manufacturing problems, demand and supply accounted for 13% whereas more than half of the causes (55%) were unknown (American Society of Health-System Pharmacists, 2011).

The level of drug shortage in various countries vary, for example, in the United States, it suffered an increase in drug shortage from 60 in 2005 to 200 in 2010. In a similar survey by the European Association of Hospital Pharmacist (EAHP) conducted in 2012 revealed that almost all the participating hospitals (99%) at least suffered drug shortages at some time. In Saudi Arabia, in a study conducted in the city of Riyadh, up to 9% of the patients to whom the drug prescription were offered failed to get their medicines at an outpatient pharmacy due to drug shortage (Al-Aqeel et al., 2010). In yet another study carried out in one of the tertiary healthcare in the city of Riyadh, the dispensing pharmacists admitted to only knowing the shortage of a particular drug at the time of its demand something that could be avoided if proper interdepartmental communication is improved (Al-Aqeel et al., 2010). Of notable interest is the fact that drug shortage does not only affect the hospitals but the community pharmacies too. A staggering 240 community pharmacies in the city of Riyadh reported drug shortage (Alshehri et al., 2016). Hence, the need to examine the persistent factors affecting drug shortages in Aseer Hospitals in Saudi Arabia.

Methodology

This study applied a cross sectional descriptive research design of the quantitative methodology. The study targeted pharmacists working at Aseer Hospital between the period of September, 2021 and October, 2021. A random sampling technique was used to recruit the sample participants, which comprised of the pharmacists working at Aseer Hospital. A total of 177 subjects were randomly sampled to take

part in the study. The data was collected electronically by the use of an adopted self-administered questionnaire sent through a link in the google website. The questionnaire contained a set of 24 questions about the prevalence and duration of drug shortages, the classes of drugs in shortage, the impact of drug shortages on patient safety and care, and the possible causes of drug shortages. Additionally, it contained sociodemographic information such as age, education, gender, and years of experience. This instrument was first assessed for reliability using the Cronbach's alpha (range between 0.513 and 0.891) before being administered. Prior to collection of data, this study was approved by the Ethical Committee of Aseer Hospital (Number REC 19-09-2021 H-06-B-091). Statistical analysis was performed using the descriptive statistical tools of Statistical Package for Social Science (SPSS) version 26.

Results

To examine the factors affecting drug shortage in order of their scope of effect. Data was collected in one phase by electronically sending questionnaires to pharmacist working at Aseer hospital between the period of September, 2021 and October, 2021. In this study, a total of 177 pharmacists filled the questionnaires out of which 74% are males and 25.4% are females. The leading age bracket comprising of pharmacists between the age of 30 and 39 were 24.3%. In terms of level of education, the

pharmacists who graduated with Bachelor in Pharmacy are the majority (46.9%) while in terms of experience, 53.7% of the pharmacists serving (5-10) years were the majority (Table 1).

Table 1. Participants' sociodemographic features

Variables	Frequency	Percentages
Gender		
Female	45	25.4
Male	132	74.6
Ages		
From 18-29 years	26	14.7
From 30-39 years	108	61.0
From 40-49 years	43	24.3
More than 50 years		
Education level		
Bachelor	83	46.9
Diploma	58	32.8
Postgraduate	36	20.3
Years of experience		
From 0-5 years	26	14.7
From 5-10 years	95	53.7
From 10-15 years	56	31.6
More than 15 years		

From the statistical analysis, increase in product recall [83%] was the leading cause of drug shortage in Aseer hospital whereas more stringent regulatory requirements that delay production was least with 72.6% (Table 4.2).

Table 2. Causes of drug shortages

Items	Mean	Standard deviation	Weight mean	p-value	Rank
Stringent regulatory requirements	3.63	1.19	72.60	0.000	4
Problems with manufacturing processes	4.07	1.08	81.40	0.000	2
Product recalls in Saudi Arabia	4.18	0.94	83.60	0.000	1
Shortage of packaging materials	3.71	1.09	74.20	0.000	3
Total	3.90	0.69	77.91	0.000	

Regarding regulatory and legislative process, the shortages in drugs were hugely due to failure by the companies to give periodical reports that informs policy implementations (80.4%), whereas failure by manufacturing companies to predict shortages was least by

73.0% (Table 4.2). Additionally, concerning issues related to manufacturing, the highest number of respondents reiterated that failure by the manufacturers to notify the health care institutions about disruption in manufacturing of certain drugs could acutely increase drug

shortage problems (72.2%). Failure by the manufacturers to establish a contingency plan in event of drug manufacturing disruption was fourth position in order of causes (67.2%).

The results further showed that even though poor distribution of drugs could contribute to shortages of drugs, in this sub-division, the distribution was largely affected by unclear medicine procurement procedures and the

protocols (73.60%). Also, 62.8% of the respondents stated that lack of incentives to produce less profitable drugs contributed the least to drug shortage whereas 67.4% attributed the increase in shortages of drugs to low competencies amongst the pharmacists. All these causes were statistically significant contributors to drug shortages ($p < .01$) (Table 3).

Table 3 Sub-divisions of causes of drug shortages.

Items	mean	Standard deviation	Weight mean	p-value	Rank
<i>Regulatory and Legislative process by pharmaceutical companies and their affect to drug shortages</i>					
Provision of reports to authorities	3.74	1.19	74.80	0.000	3
New innovations to address drug shortages	4.02	1.01	80.40	0.000	1
Predicting shortage of drugs	3.65	1.24	73.00	0.000	4
Contingencies to deal with drugs shortage	4.00	1.06	80.00	0.000	2
The whole first field	3.85	.80	77.06	0.000	1
issues related to manufacturing					
Early notification to hospitals about potential discontinuation in drug supply	3.36	1.18	67.20	0.000	4
Provision of information about possible causes of drug shortages	3.42	1.17	68.40	0.000	3
Early notification about an interruption in drug supply	3.61	1.12	72.20	0.000	1
Contingency plans to maintain supply of a drug in case of disruption.	3.57	1.05	71.40	0.000	2
The whole second field	3.49	.84	69.80	0.000	2
Factors of distribution					
Restrictions by Just-In-Time inventory	3.65	1.10	73.00	0.000	2
Dependence on one source and forcing bundled purchasing.	3.19	1.16	63.80	0.000	4
Contractual agreements at the local, regional, and global levels	3.28	1.15	65.60	0.000	3
Unclear drug procurement procedures and protocols	3.68	1.23	73.60	0.000	1
The whole third field	3.45	.83	69.01	0.000	3
Imbalance of supply and demand					
Lack of Incentives to Produce Less Profitable Drugs.	3.14	1.24	62.80	0.000	4
Lack of market reinforcement of effective quality management maturity.	3.25	1.12	65.00	0.000	2
Political instability in the region that contributes to increased demand.	3.14	1.17	62.80	0.000	3
Pandemic diseases leading to unexpected demand.	3.34	1.11	66.80	0.000	1
The whole fourth field	3.22	.99	64.35	0.000	5
Human Factors					
Lack of skilled laborers	3.25	1.13	65.00	0.000	3
Low competencies among pharmacists	3.37	1.07	67.40	0.000	1
Lack of knowledge/ fear of shortages	3.25	1.09	65.00	0.000	2

Lack of cooperation amongst stakeholders (manufacturers, pharmacies, patients)	3.24	1.06	64.80	0.000	4
The whole fifth field	3.28	0.92	65.57	0.000	4
The whole second Axis	3.46	0.66	69.15	0.000	

Discussion

This study identified a number of significant contributors to drug shortages in Aseer Hospitals. Nevertheless, there are numerous causes of drug shortages all over the world in both developed and developing nations and this is dependent upon the type/class of drug (Mazer-Amirshahi et al., 2014). There are multifactorial causes of drug shortages that this study sought to explore; regulatory and legislative processes, manufacturing problems, human factors, and the imbalance in the supply and demand as well as problems of drug distribution. These factors are in line with the findings reported by the previous researchers who categorized the causes of drug shortages in three groups; supply issues, demand issues and regulatory issues (Hedman, 2016; Schwartzberg et al., 2017; Jenzer et al., 2019).

The findings of this study shows that amongst the parameters which were tested, regulation and legislature process proven to be the major cause of drug shortage, followed closely by issues related to manufacturing. Human factors, such as low competencies among pharmacists and the imbalance between the supply and demand least contributed to high prevalence of drug shortages at 65.57% and 64.35% respectively. This study finding is contrary to the findings of a similar study carried in United States that suggests that the impact of regulation is nearly negligible (~1%) (American Society of Health-System Pharmacists, 2011). However, Fox et al. (2019), reveals that the United States Food and Drug Administration [USFDA] can impact largely on the rising drug shortage if there is delay in timely inspection and recertification of manufacturing sites after a noncompliance shutdown.

Further analysis of the causes of drug shortage revealed that the regulation and legislative process is worsened by the failure of the

manufacturing companies to submit periodic reports that informs proper regulations by the authorities. These could arise from the bureaucratic issues that change with the microeconomic policies in the region (Alruthia et al., 2018). A study conducted at University of Utah Drug Information Service in 2011 by Fox et al. (2011) linked the impact of manufacturing issues to drug shortages at 23.0% which is in line with this study findings. However, similar study by the same university in 2020 revealed a sharp drop in the contributions made by manufacturing process to a low of 8% (American Society of Health System Pharmacists, 2020). Amongst the issues about manufacturing that impact on drug shortages, lack of contingency plan by the manufacturers took a lead. The ASHP/UUHC reported the problem of supply and demand at 13%, as the third most common cause of drug shortage across US (American Society of Health-System Pharmacists, 2011). This observation is in agreement with the findings of this study that puts distribution issues at third most popular cause after regulatory and legislative, and manufacturing issues. ASHP Expert Panel on Drug Product Shortages et al. (2009) states that the business decisions made by the stake holders (wholesalers, group purchasing organizations and prime vendors) about the distribution of drugs can impact hugely on drug supply leading to shortages.

Overall, there are quite a number of practices that could lead to restricted supply of drugs to health care system (Fox, 2011) consequently leading to drug shortage; health care systems ordering drugs direct from the manufacturers, stringent market approval requirements and drug distribution methods that are prohibitive. Pharmacists are the first victims to face the challenges due to drug shortages (Pauwels et al., 2015). However, they may also contribute to the shortage if professionalism is not upheld in their day-to-day practice. In a survey of

hospital pharmacist carried out in Europe by Pauwel et al (2015), 28% of the respondents indicated that they only know about drug shortages at the time of delivery. In this study the issues of lack of cooperation between the stakeholders [1.06=64.80%] could be the leading factor to breakdown in communication amongst the various stakeholders thus crippling the availability of drugs when needed.

Conclusion

Drug shortage remain a constant problem in the health care system all over the world hence compromising the quality of healthcare service delivered. This study has established various causes of drug shortage, such as regulatory and legislative process, manufacturing problems, problems with distribution, the human factors as well as imbalance in supply and demand. This study has also found out that ambiguous regulation and legislative processes largely contribute to the shortage of drugs while the least contributing factor is the imbalance in supply and demand.

Recommendation

This study findings may be used to inform a number of recommendations. First, the government of Saudi Arabia should adopt a national reporting system in liaison with the healthcare sector to curb drug shortages and that the pharmacists working in various hospitals across the country should be educated on way of giving real time reports. Additionally, there should be enhanced cooperation amongst the stakeholders (the manufacturers, Joint Procurement Department and health care facilities) to provide proactive solutions to drug shortages. The Health System Management teams should also adopt the use of automated inventory for stakeholders in order to quickly track the manufacturing, distribution and consumption of drugs.

Limitations

Although this study highlighted on key issues affecting the drug shortage in Aseer Hospitals,

the findings may not be replicated across other hospitals in the county since collection of data was restricted to only one hospital. Nevertheless, the study applied quantitative approach primed on the positivism paradigm, which empowers the generalizability of the outcomes.

Reference

- [1] Al-Aqeel, S. A., Al-Salloum, H. F., Abanmy, N. O., & Al-Shamrani, A. A. (2010). Undispensed prescriptions due to drug unavailability at a teaching hospital in Saudi Arabia. *International Journal of Health Research*, 3(4), 213-216.
- [2] AlRuthia, Y. S., AlKofide, H., AlAjmi, R., Balkhi, B., Alghamdi, A., AlNasser, A., Alayed, A., Alshammari, M., Alsuhaibani, D., & Alathbah, A. (2017). Drug shortages in large hospitals in Riyadh: a cross-sectional study. *Annals of Saudi medicine*, 37(5), 375–385. <https://doi.org/10.5144/0256-4947.2017.375>
- [3] Alruthia, Y. S., Alwhaibi, M., Alotaibi, M. F., Asiri, S. A., Alghamdi, B. M., Almuaythir, G. S., ... & Alshamsan, A. (2018). Drug shortages in Saudi Arabia: Root causes and recommendations. *Saudi Pharmaceutical Journal*, 26(7), 947-951.
- [4] Alruthia, Y. S., Alwhaibi, M., Alotaibi, M. F., Asiri, S. A., Alghamdi, B. M., Almuaythir, G. S., Alsharif, W. R., Alrasheed, H. H., Alswayeh, Y. A., Alotaibi, A. J., Almeshal, M., Aldekhail, S. N., Alhusaini, A., Alrashed, S. A., Alrumaih, A. M., Dahhas, M. A., Alghamdi, M. A., Aleheidib, M. S., Alhaidari, M. H., Alharbi, J. A., ... Alshamsan, A. (2018). Drug shortages in Saudi Arabia: Root causes and recommendations. *Saudi pharmaceutical journal : SPJ : the official publication of the Saudi Pharmaceutical Society*, 26(7), 947–951. <https://doi.org/10.1016/j.jsps.2018.05.002>
- [5] Alsheikh, M., Seoane-Vazquez, E., Rittenhouse, B., Fox, E. R., & Fanikos, J. (2016). A Comparison of Drug Shortages

- in the Hospital Setting in the United States and Saudi Arabia: An Exploratory Analysis. *Hospital pharmacy*, 51(5), 370–375. <https://doi.org/10.1310/hpj5105-370>
- [6] American Society of Health System Pharmacists (2020). Drug Shortages Statistics. <https://www.ashp.org/Drug-Shortages/Shortage-Resources/Drug-Shortages-Statistics?loginreturnUrl=SSOCheckOnly>.
- [7] American Society of Health-System Pharmacists (2011). Drug Shortages Summit Report. Available at: www.ashp.org/drugshortages/summitreport.
- [8] ASHP Expert Panel on Drug Product Shortages, Fox, E. R., Birt, A., James, K. B., Kokko, H., Salverson, S., & Soflin, D. L. (2009). ASHP Guidelines on Managing Drug Product: *AJHP* : official journal of the American Society of Health-System Pharmacists, 66(15), 1399–1406. <https://doi.org/10.2146/ajhp090026>
- [9] Bogaert, P., Bochenek, T., Prokop, A., & Pilc, A. (2015). A Qualitative Approach to a Better Understanding of the Problems Underlying Drug Shortages, as Viewed from Belgian, French and the European Union's Perspectives. *PloS one*, 10(5), e0125691. <https://doi.org/10.1371/journal.pone.0125691>
- [10] De Weerd, E., Simoens, S., Hombroeckx, L., Casteels, M., & Huys, I. (2015). Causes of drug shortages in the legal pharmaceutical framework. *Regulatory toxicology and pharmacology* : RTP, 71(2), 251–258. <https://doi.org/10.1016/j.yrtph.2015.01.005>
- [11] Dill, S., & Ahn, J. (2014). Drug shortages in developed countries--reasons, therapeutic consequences, and handling. *European journal of clinical pharmacology*, 70(12), 1405–1412. <https://doi.org/10.1007/s00228-014-1747-1>
- [12] Fox, E. R., & McLaughlin, M. M. (2018). ASHP guidelines on managing drug product shortages. *American Journal of Health-System Pharmacy*, 75(21), 1742–1750.
- [13] Hedman L. (2016). Global Approaches to Addressing Shortages of Essential Medicines in Health Systems. *WHO Drug Inf.* 30, 180.
- [14] Jenzer, H., Sadeghi, L., Maag, P., Scheidegger-Balmer, F., Uhlmann, K., & Groesser, S. (2019). The European medicines shortages research network and its mission to strategically debug disrupted pharmaceutical supply chains. *Pharmaceutical Supply Chains-Medicines Shortages*, 1-22.
- [15] Mazer-Amirshahi, M., Pourmand, A., Singer, S., Pines, J. M., & van den Anker, J. (2014). Critical drug shortages: implications for emergency medicine. *Academic Emergency Medicine*, 21(6), 704-711. <https://doi.org/10.1111/acem.12389>
- [16] McLaughlin, M. M., Sutton, S. H., Jensen, A. O., & Esterly, J. S. (2017). Use of High-Dose Oral Valacyclovir During an Intravenous Acyclovir Shortage: A Retrospective Analysis of Tolerability and Drug Shortage Management. *Infectious diseases and therapy*, 6(2), 259–264. <https://doi.org/10.1007/s40121-017-0157-y>
- [17] Pauwels, K., Simoens, S., Casteels, M., & Huys, I. (2015). Insights into European drug shortages: a survey of hospital pharmacists. *PloS one*, 10(3), e0119322. <https://doi.org/10.1371/journal.pone.0119322>
- [18] Phuong, J. M., Penm, J., Chaar, B., Oldfield, L. D., & Moles, R. (2019). The impacts of medication shortages on patient outcomes: A scoping review. *PloS one*, 14(5), e0215837. <https://doi.org/10.1371/journal.pone.0215837>
- [19] Rider, A. E., Templet, D. J., Daley, M. J., Shuman, C., & Smith, L. V. (2013). Clinical dilemmas and a review of strategies to manage drug shortages. *Journal of pharmacy practice*, 26(3), 183–191. <https://doi.org/10.1177/0897190013482332>

- [20] Rinaldi, F., de Denus, S., Nguyen, A., Nattel, S., & Bussi eres, J. F. (2017). Drug Shortages: Patients and Health Care Providers Are All Drawing the Short Straw. *The Canadian journal of cardiology*, 33(2), 283–286. <https://doi.org/10.1016/j.cjca.2016.08.010>
- [21] Schwartzberg, E., Ainbinder, D., Vishkauzan, A., & Gamzu, R. (2017). Drug shortages in Israel: regulatory perspectives, challenges and solutions. *Israel journal of health policy research*, 6, 17. <https://doi.org/10.1186/s13584-017-0140-9>
- [22] Setayesh, S., & Mackey, T. K. (2016). Addressing the impact of economic sanctions on Iranian drug shortages in the joint comprehensive plan of action: promoting access to medicines and health diplomacy. *Globalization and health*, 12(1), 31. <https://doi.org/10.1186/s12992-016-0168-6>
- [23] Shukar, S., Zahoor, F., Hayat, K., Saeed, A., Gillani, A. H., Omer, S., Hu, S., Babar, Z. U., Fang, Y., & Yang, C. (2021). Drug Shortage: Causes, Impact, and Mitigation Strategies. *Frontiers in pharmacology*, 12, 693426. <https://doi.org/10.3389/fphar.2021.693426>
- [24] Shukar, S., Zahoor, F., Hayat, K., Saeed, A., Gillani, A. H., Omer, S., Hu, S., Babar, Z. U., Fang, Y., & Yang, C. (2021). Drug Shortage: Causes, Impact, and Mitigation Strategies. *Frontiers in pharmacology*, 12, 693426. <https://doi.org/10.3389/fphar.2021.693426>
- [25] Videau, M., Chemali, L., Stucki, C., Saavedra-Mitjans, M., Largana, S., Guerin, A., Bonnabry, P., Delhauteur, B., Van Hees, T., Lebel, D., & Bussi eres, J. F. (2019). Drug Shortages in Canada and Selected European Countries: A Cross-Sectional, Institution-Level Comparison. *The Canadian journal of hospital pharmacy*, 72(1), 7–15.