

Determine types and reasons of waste in Diyala pharmaceutical supply chain-Iraq

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Abstract :

Reducing or removing all kind of wastes, which are defects, inventory, waiting, transportation and extra-processing, are the main aim for organizations in order to minimize cost, so, excluding any activity which cannot add value is required. The main aim of this study is to select the main reasons standing behind any kind of waste in Diyala pharmaceutical supply chain like damage, spoilage, surplus, shortage and expiry date in medicines and pharmaceutical supplies; and administration activities based on the questionnaire prepared for this purpose. The Diyala health sector is one of the Iraqi health sectors linked centrally with the Ministry of Health. The main tool for collecting data was secondary data on website and unstructured interviews with 15 drug store and pharmacy directors; also, a multi-choice questionnaire was distributed to 42 drug stores and pharmacies in Diyala health sector. The main results in this study, there are several reasons behind waste in the Diyala pharmaceutical supply chain. The expiration of medicines and medical materials is the first reason and the storage conditions are the second reason. There are difficulties in reporting surplus medicines and medical materials because of long administrative procedures. The main difficulties to report expired medicines and medical materials is because of fear of accountability.

Keywords: lean, waste, pharmaceutical, supply chain.

Introduction :

The main aim of the pharmaceutical supply chain is to facilitate the provision of medicines to people as a human right, in the right quantity, with the acceptable quality, to the right place and customers, at the right time and with the optimum cost to be consistent with health system's objectives and it also should make benefits for its stockholders (Jaberidoost et al., 2013, 3).

The Iraqi pharmaceutical supply chain has still used traditional system and it has been suffered from many problems in the efficiency like management inventory, reporting, and transportation and warehousing especially in towns and villages. As well as, some problem related to the state company for drug marketing and pharmaceutical appliances. So, the current study tries to highlight the main kind of waste in Diyala health institutions to cover this part of the pharmaceutical supply chain in which there are limited of studies by starting with determining the kind of reasons as the first step in this field to can be possible select the solutions later.

The problem of study :

After making interviews with the responsible employees in the Iraqi health sectors , they emphasized that the pharmaceutical supply chain has been suffered from fluctuations in the provision of medicines and medical supplies, such as a shortage in some medicines and pharmaceutical supplies, whereas, there is a surplus sometimes in other types. Because of existing wastes in Iraqi pharmaceutical supply chain which cost the government millions of dollars and limited studies in the pharmaceutical supply chain. So, the current study seeks to determine the main reasons behind wastes in pharmaceutical supply chain under study through answering the following questions:

Is there any kind of waste in the pharmaceutical supply chain under study?

If there is waste what are the main reasons behind this waste?

The importance of study :

The study importance comes from the importance of pharmaceutical supply chain in health field which seeks to introduce health service in 24 hours

and it has to be ready for any emergency with reducing any activity cannot add value.

The objective of study :

This study tries to determine the main reasons of waste in Diyala pharmaceutical supply chain and introduce recommendations to the concerned authorities.

Research population :

The main drug store in pharmaceutical department in Diyala health directorate, drug stores of hospital, drug stores of sector, pharmacies of hospital, pharmacies in primary health care centers, pharmacies of specialized medical center and pharmacies of public medical clinic in Diyala health sector are taken as a research population which serve people in Diyala province. The number of pharmacies and drug stores are 39 as illustrated in the table 1.

Tab. 1: The number of study population

Main drug store	Hospital drug stores	Sector drug stores	Hospital pharmacies	Primary health care pharmacies	Pharmacies of specialized medical center	Pharmacies of public medical clinic	Others	Total
1	3	2	10	16	2	2	3	39

Source: Author's own

The main reason behind choosing this population because the Iraqi health sector is very huge, and all Iraqi provinces have the same system which centrally connected with ministry of health. As well as, all provinces health sector gets medicines and pharmaceutical supplies from the state company for drug marketing and medical appliances; therefore, the Diyala health sector can be a represented sample for Iraqi health sector regarding to pharmaceutical supply chain system and logistic activities except warehousing which can be different according to the province environment and its situation in terms of services.

Sample of study :

The sample of study is represented by the directors of main store in directorate, drug stores and pharmacies because they are responsible for managing these facilities and they have information about their pharmaceutical supply chain. 46 questionnaires were distributed to the directors, but 42 questionnaires were returned which means that the response rate about 91%. The table 2 shows the demographic information for responders.

Tab. 2: Describe the study sample

Education qualification																															
High school and below				Technical Diploma				Bachelor		Higher Diploma		Master		PhD		Others															
No.		%		No.		%		No.		%		No.		%		No.		%													
				18		42.9		24		57.1																					
experience years																															
Less than 2				2-5		5-8		8-11		11-15		More than 15																			
No.		%		No.		%		No.		%		No.		%		No.		%													
5		11.9		10		23.8		9		21.4		3		7.1		4		9.5		11		26.2									
Place of work																															
Main drug store		Hospital drug stores		Sector drug stores		Hospital pharmacies		Primary health care pharmacies		Pharmacies of specialized medical center		Pharmacies of public clinic		Others																	
No.		%		No.		%		No.		%		No.		%		No.		%		No.		%									
4		9.5		3		7.1		2		4.8		10		23.8		16		38.1		2		4.8		2		4.8		3		7.1	
Geographic place																															
City				Town								Village																			
No.		%		No.				%				No.				%															
25		59.5		12				28.6				5				11.9															

Source: Author's own

The table (5) above shows that the sample of the study is distributed from the last pharmacy in the pharmaceutical supply chain until the main store in the Diyala health sector which give clear perception about the pharmaceutical supply chain under study. All employees who work in pharmacies and drug stores have medical qualification according to government regulations. As well as, the study sample includes different levels (main drug store and pharmacies and drug stores in hospitals, sectors, primary health care,

specialized medical centers, public clinics and others which mean medical detachment which is located in remote villages) geographical areas (cities, towns and village) which help to understand pharmaceutical supply chain in different conditions. There are 64.2% of directors who work more than 5 years which mean that they have enough experience to deal with questionnaire.

Theoretical background

The concept of supply chain and waste

Supply chain is a set of players, processes, information, and resources which transfers raw materials, and components to finished products or services and delivers them to the customers. It includes suppliers, intermediaries, third-party service providers and customers. It also includes all the logistics activities, manufacturing operations and activities with and across marketing, sales, product design, finance and information technology. Supply chain management (SCM) is defined as the integration of key business processes across the supply chain for the purpose of creating value for customers and stakeholders (Jaberidoost et al., 2013, 3).

According to Lee (2002) management of supply chains is a complex and challenging task, because of the changing trends in expanding variety of products, short product life cycles, increased outsourcing, continuous advances in information technology, and globalization of businesses. It also includes expenditure of high cost and time in conducting clinical trials with low success rate in product discovery and clinical development, generic competition at the end of product patent life followed by high uncertainties in demands and capacity planning (Singh, Kumar and Kumar, 2016, 2).

The organizations management has been paying attention towards reducing waste policy in all its activities and remove any kind of act does not add any value. This policy was first applied by Japanese Toyota Company as a lean manufacturing in 1970 and achieved excellent results. In the 1980s, the policy of reducing waste was used by American and European companies (Al-Rawi, 2013, 88). According to (Womack et al., 1991), The "lean" term was used the first time by professors of MIT " Massachusetts Institute of Technology" to interpret Japan's new production system that is far away from mass production (Bin Daud, 2010, 31).

Lean philosophy aims to eliminate all kinds of waste, continuous improvement for systems and processes, respect and preserve all workers, eliminate all activities that have non-value added to products and use pull products by customers instead of push products i.e. producing what customers want (Heizer & Render, 2011,654; Meredith & Shafer, 2010, 176). Waste is any activity dose not add any value, and it is not only important to reduce waste in the process but to reduce costs and improve the long-term performance of the process by increasing focus on staff and management then enabling them to add value (Mehta & Shah, 2005, 15). To avoid waste, companies have to focus on only value-added activities i.e. no bad parts and no inventory. So, any activity that does not add value in the eyes of the customer is a waste. Taiichi Ohno, noted for his work on the Toyota Production System, identified seven categories of waste which are very popular in lean organizations. Ohno's seven wastes as following: (Heizer et al. 2017, 638)

- ❖ *"Overproduction: Producing more than the customer orders or producing early (before it is demanded) is waste.*
- ❖ *Queues / waiting: Idle time, storage, and waiting are wastes (they add no value).*
- ❖ *Transportation: Moving material between plants or between work centers and handling it more than once is waste.*
- ❖ *Inventory: Unnecessary raw material, work-in-process (WIP), finished goods, and excess operating supplies add no value and are wastes.*
- ❖ *Motion: Movement of equipment or people that adds no value is waste.*
- ❖ *Over-processing: Work performed on the product that adds no value is waste.*
- ❖ *Defective product: Returns, warranty claims, rework, and scrap are wastes"*

Another view point takes into account energy, water, and air as other types of waste which should be avoided because the main aim of lean philosophy is minimizing inputs and maximizing outputs, wasting nothing.

Inventory is the main cause of waste, which can occur as a result of inefficient supply chain as mentioned in (Kachwee and Hartmann, 2013, 1). Bullwhip effect is one of the main reasons for inventory fluctuation which can be defined as a phenomenon which can emerge in both inventory levels and replenishment orders (Goodarzi et al. 2017, 1). Inventory fluctuation or bullwhip effect through supply chain can be happened due to five factors including demand signal processing, non-zero lead time, order batching, supply shortages, and price fluctuations (Cao et al. 2017, 3-4); also lack of information sharing among supply chain members (Goodarzi et al. 2017, 1); whereas (Li et al. 2017, 5420) add that lead time can cause amplification effect in supply chain. Information sharing among supply chain members can improve inventory holding efficiency by better demand forecasting; while, lacking or limiting in sharing information may lead to the bullwhip effect (Huang et al. 2017, 1) (Jeong and Hong 2017, 1) and taking into considerations the quality of information because the value of information sharing is more significant than when there are no information errors (Lu et al. 2017, 1) Therefore, using vendor managed inventory (VMI) and Joint managed inventory management can play main role to solve the problem of forecasting demand, inventory management and mitigate bullwhip effect through supply chain (Dai et al. 2017, 1230). One of the main important solutions is a multiple order-up-to policy based inventory replenishment scheme to mitigate the bullwhip effect in a multi-stage supply chain scenario, where various transportation modes are available between the supply chain (SC) participants (Keshari et al. 2017, 1) As well as, trust and collaboration in supply chain contribute to mitigate bullwhip effect in supply chain (Mizue et al. 2017, 1) (Augusto et al. 2014, 1).

According to Manrodt et al., (2008) the implementation of lean philosophies in various industries has enabled organizations to become more customer-focused, flexible and profitable (Kachwee and Hartmann, 2013, 4). Building high quality relationship within supply chain such as (trust, collaboration, communication and commitment) can help to reduce various forms of waste in supply chain as well (AL-Zaidi et al. 2017, 196-197).

Methodology and research design

The researchers depended on several methods to collect data. The theoretical part is depended on the previous studies and books which are related to current study to cover the theoretical part and support the practical part, whereas, the practical part depends on secondary data and primary data. The secondary data include reports on website and records of health facilities. The multi-choice questionnaire and interviews are used to collect primary data.

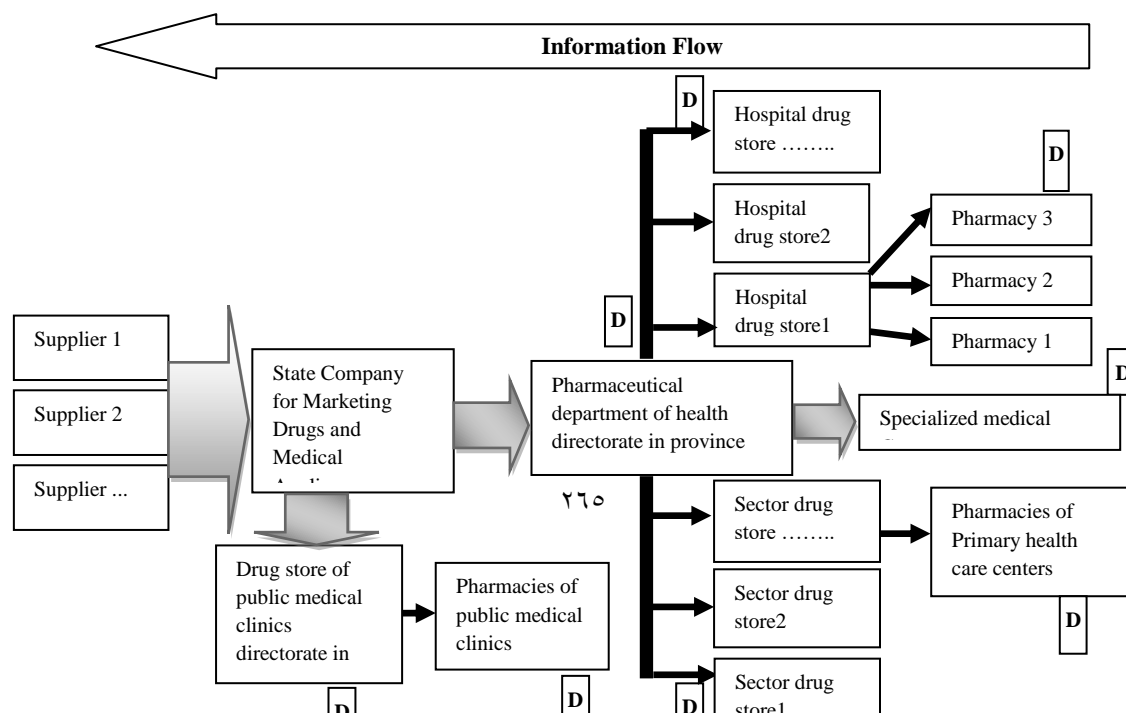
The problem of study was diagnosed after knowing that there are some problems in pharmaceutical supply chain such as expiration, delay, surplus and shortage; therefore, the researchers were motivated to determine the main reasons behind these problems. Unstructured interviews were conducted with 7 directors of drug stores and pharmacies in the pharmaceutical supply chain under study as shown in the table (4) in order to understand the system of health sector deeply.

Tab. 4: Interviews and meetings with the directors in Diyala health sector

Main drug store in the directorate	Hospital drug store	Sector drug store	Public clinic drug store
2	2	2	1

Source: Author's own

Unstructured interviews are one of the most important methods to collect general data about studies (Sekaran, 2003, 245); so, the medicines and pharmaceutical materials follow are described by directors through unstructured interviews as shown in Fig. 1 and distributed questionnaires are illustrated through pharmaceutical supply chain as well.



Multi-choice questioner of reasons behind waste	D
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Fig. 1: Pharmaceuticals Supply Chain in Diyala Health Sector and distributed questionnaires

Source: Author's own

The multi-choice questionnaires were formed based on (USAID, 2005; USAID, 2011) to determine exact reasons behind waste as illustrated in appendix 1. The options of questions also selected based on primary data collected by interviews. The Q2, Q4, Q5, Q6, Q7 and Q8 have options and their answer was just tick the right reason and do not tick if there is no reason; whereas, Q1 and Q3 have options as well and their answer were by ordering the reasons by putting number 1 for the first reason then number 2 for the second reason, number 3 for third reason and putting zero if there is no reason. There is open option in each main question to write if there are other reasons do not mention in the questionnaire. IBM SPSS statistics version 21 has been used to analyze data and find out the frequencies and percentage rates for each reason.

Data Analysis and Discussion

The table (5) shows the percentage rates of reasons behind waste in Diyala pharmaceutical supply chain.

Tab. 5: Percentage rates of reason behind waste in Diyala pharmaceutical supply chain

<div>Main Q</div> <div>Options</div>	Q1				Q3			
	First %	Second %	Third %	No reason %	First %	Second %	Third %	No reason %
A	76.2	16.7	7.1	0	81	0	0	19
B	23.8	66.7	0	9.5	0	23	2.4	73.8
C	2.4	7.1	57.1	33.3	-	-	-	-
<div>Main Q</div> <div>Options</div>	Q2	Q4	Q5	Q6	Q7	Q8		
A	42.9%	66.7%	31%	19%	54.8%	40.5%		
B	52.4%	11.9%	66.7%	88.1%	35.7%	76.2%		
C	14.3%	-	-	-	26.2%	-		

Source: Author's own

Selecting main reasons behind damaged medicine in Q1 is by order the reasons as a first, second, third or choosing no reason if it is not happened; the highest reason behind the damaged medicine is because of expiration (A) 76.2% of responders selected it as a first reason, after that the storage condition (B) 66, 7% of responders selected it as a second reason; whereas, the third one is transportation condition (C) 57.1% of responders but 33.3 of responders selected the damaged medicines and medical materials because of transportation condition has not happened with them. The main reason behind of expiration mentioned in Q2 because of receiving huge amount of medicines and pharmaceutical supplies from the supplier and the date is close to expiration (B) 52.4% of responders selected it; whereas the second reason is receive large quantity and cannot be easy to finish (A) was chosen by 42.9% of responders which meaning there are incorrect way to estimate needs of medicines and medical materials as mentioned by Bhattacharya &

Bandyopadhyay, (2011) and Cao et al. (2017) that the demand forecasting and order batching can be the main reason for over-stock.

The Q3 refers to the main reason behind storage condition, the temperature degree (A) selected as a main reason behind storage condition because of the oscillating electricity power as the responders said in interviews. Although, the percentage of damaged medicines by transportation conditions are very low as shown in the Q1 option (C), There are 66.7% of responders said that the main reason behind damaged medicines by transport conditions because of temperature and conditions of transport means are not suitable for medicines and pharmaceutical supplies as shown in Q4 option (A). Improper transportation might lead to damage medicines and medical materials, as a result, affect patient health.

There are surplus in medicines and medical materials, especially, before 2016 as the directors mentioned in the interviews and the main reasons behind surplus Q5 is option (C) which is send medicines without needing for it 66.7% of responders but some of them add the surplus happen because of security situation because they estimate their needs for next two years e.g. they estimate their needs for 2015 in the 2013 and there are some security problems or changes happened during two years, like these cases was mentioned by several authors like Alony & Aneiros, (2007); Rahman et al. (2014); Li et al. (2017); Cao et al. (2017) that the long led time cause problem in inventory. The other reason has been added by some responders in open option are because of the quality or brand of medicines are not suitable for patient which cause the reluctance of patients to receive the medicine or there is no specialist doctor to dispense a medication. The surplus means high level of inventory, more consumed energy, extra-process for redistributing it and more likely to be spoilage or expired.

The reason of shortage in medicines and medical materials because of sending small amount of medicine from top authorities as shows in Q6 option (B) 88.1% of responders selected it. The shortage of medicines and medical materials one of the main kind of waste in supply chain because in this case the health foundation has to wait and order new amount of medical material which mean new long procedures, especially in government health sector.

One of the main reasons behind the difficulties to report a surplus medicines and medical materials is the long administration procedures as shown in Q7 option (A), there are 54.8% of responders select that choice. The reason is because of don not using modern information technology in administration procedures which can cause fluctuations in inventory as well (Lee et al. 1997); Huang et al. (2017); Jeong and Hong (2017); Lu et al. (2017).

The main reason for not reporting expired medicines and medical materials (Q8) is fear of accountability (A) chosen by 76.2% of responders which mean keep lots of mistakes hidden without informing the management to put suitable solutions for the reasons behind expiration. In the same time, this index that they use traditional management in Diyala pharmaceutical supply chain and Iraqi pharmaceutical supply chain because of the pharmaceutical supply chain system the same in all Iraqi provinces. The fear of accountability can be happened in the traditional management as mentioned in study of Liker (2004) and Kotter (2007) to clarify the differences between traditional and reducing waste thinking (Al-Rawi, 2013, 106-107).

Conclusions and recommendations

The pharmaceutical supply chain in Diyala-Iraq follow centralized system and use traditional management methods with regarding inventory management methods, need estimate and information system which cause problems throughout supply chain such as surplus, expiration, shortage and difficulties in administration reporting, as well as, warehousing condition is weak especially in the towns and villages. The main problems in pharmaceutical supply chain are surplus in some kind of medicines and shortage in others. The highest rate of damaged medicines is because of expiration and storage conditions. There are difficulties in reporting surplus medicines because of using long procedures which need long time; as well as, difficulties in reporting expiration medicines because of fear of accountability. The results can describe all Iraqi pharmaceutical supply chain because they use the same system of Diyala health sector and all province health sectors are linked centrally with ministry of health.

The main recommendations are paying attention towards warehousing system, estimating the need precisely, use visible management by using information technology system to ease information sharing in whole supply chain and build quality relationships with the supplier by enhancing trust, collaborative, commitment and communication with them.

Study limitations and future studies

The limitations associated with this study was that we could not get real data about the amount of damaged, surplus, shortage and expired medicines and medical materials because the director were hesitated to give real data.

The future studies should focus on measure the reasons of waste to what extent they are critical in supply chain. As well as, study logistics activities in Diyala pharmaceutical supply chain to what extent they are efficient.

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Appendixes

Appendix 1. Questionnaire of Reasons of Waste in Pharmaceutical Supply Chain

Q1	Order the main causes of damage of medicines and pharmaceutical supplies by importance by putting number 1 for the first reason then number 2 for the second reason, number 3 for third reason. Please put zero if there is no reason.	
A	Expiry of the validity period	
B	Storage conditions	
C	Transportation conditions	
D	Are there any other reasons, please, mention kindly	

Q2	What is the reason for expiry of the validity of drugs and pharmaceutical supplies without being able to spend (Please, tick the correct reasons and you can choose more than one reason)	
A	Receive large quantity and cannot be easy to finish	
B	Receive medicines and pharmaceutical supplies from the supplier and the date is close to expiration	
C	Lack of knowledge or mixed with different medicines difficult to see	
D	Are there any other reasons Please, mention it kindly	

Q3	Order the main reasons of spoilage of some medicines due to storage condition by putting number 1 for the first reason then number 2 for the second reason, number 3 for third reason. Please put zero if there is no reason.	
A	Temperature	
B	Light	
C	Are there other reasons I mention kindly	

Q4	What are the main causes of damaged medicines due to transport conditions? (Please, tick the correct reasons and you can choose more than one reason)	
A	Temperature and conditions of transport means are not suitable for medicines and pharmaceutical supplies	
B	The roughness of the road	
C	Are there other reasons, please, mention kindly.	

Q5	What are the reasons of surplus in some medicines and pharmaceutical supplies? (Please, tick the correct reasons and you can choose more than one reason)	
A	Because the request has large quantity	
B	Sending medicines without needing for it	
C	Are there other reasons, please, mention kindly.	

Q6	What are the reasons for the shortage in some medicines and supplies medicine? (Please, tick the correct reasons and you can choose more than one reason)	
A	Because of the request of a small quantity	
B	Sending small amount of medicine from top authorities	
C	are there other reasons, please, mention kindly	

Q7	What are the difficulties you face in reporting the surplus medicines?	
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	(Please, tick the correct reasons and you can choose more than one reason)	
A	Length of administrative procedures	
B	Fear of accountability	
C	Do not accept the higher authorities to return surplus medicines	
D	are there other reasons, please mention kindly	

Q8	What are the difficulties you face in reporting the damaged medicines? (Please, tick the correct reasons and you can choose more than one reason)	
A	Length of administrative procedures	
B	Fear of accountability	
C	are there other reasons, please mention kindly	