Szent István University

Doctoral School of Management and Business Administration

Relationship Quality and Related Activities of Pharmaceutical Supply Chain in Iraq

The Ph.D. dissertation

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TABLE OF CONTENTS

ABBREVIATIONS

SCM: Supply Chain Management

SCRQ: Supply Chain Relationship quality

CMS: Central medical stores

DRA: Drug regulatory authority

PPO: pharmaceutical procurement office (ministry of health or other government offices).

SCR: Supply Chain Risks

Ph. SC: Pharmaceutical supply chain

ERP: Enterprise resource planning

RFID: Radio Frequency Identification

VMI*:* Vendor managed inventory

EDI: Electronic Data Interchange

BWE: Bullwhip Effect

1. INTRODUCTION

The pharmaceutical supply chain differs in importance from other supply chains because it is more influential to human life, so it deserves attention to maximize its efficiency by providing medicines and pharmaceutical supplies to customers in the right quantity, with the acceptable quality, to the right place, at the right time and with the optimum cost to be consistent with health systems' objectives and it should make benefits for the stockholders (JABERIDOOST et al., 2013).

The current supply chains, especially, pharmaceutical supply chain have become increasingly complicated due to globalization, crises and catastrophes, increased customer expectations, cost-reduction pressures and environmental volatility, all of which contribute to increasing supply chain risks (NIEKERK et al., 2017). Environmental aspects are also play important role, primarily because of avoiding harmful environmental impacts (MESJASZ-LECH, 2015), sustainability aspects which is a part of competitive business processes (GÁBRIEL, 2016).

The supply chain activities (Demand forecasting / needs estimating, Procurement and Inventory management), and relationship quality with suppliers (Trust, Cooperation, Communication and Commitment) can be considered as a soul of the supply chain. Therefore, the current study tries to clarify the role of supply chain activities and relationship quality on supply chain risks represented by (supply risks, demand risks and inventory risks) which in turn affect the waste in the supply chain such as (Defects, Inventory, Waiting, Extra-processes, Transportation and Energy). These relationships were examined in Iraqi pharmaceutical supply chain represented by the state company for drug marketing and medical appliances (Kimadia) and health institutions. Kimadia is the only company that supplies the Iraqi health sector with medicines and medical appliances, which holds agreements and contracts with local and international pharmaceutical companies for the purpose of sending them to health bureau in the Iraqi provinces which in turn send them to hospitals and health sectors in the provinces. According to the interviews, the company's financial allocations in 2015 amounted to about 1,350,000,000 USD for purchasing medicines and medical appliances. It was noted that there is surplus, shortages, expiration and delay in medicines and medical materials for many reasons which cost millions of dollars (OFS, 2012, 2016). Therefore, the main reasons of adoption this study can be determined as follows:

1. To provide a comprehensive summary about the current situation of supply chain activities and relationships quality dimensions and examine their role in supply chain risks and all types of waste in the pharmaceutical supply chain.

2. The researcher found lack of studies that dealt with the pharmaceutical supply chain in Iraq, and this study tries to find the relationships with current dimensions which has not been studied before.

3. Identifying problems, difficulties, and weaknesses are essential to improve the pharmaceutical supply chain performance by reducing supply chain risks; and waste by excluding activities that do not add value.

1.1. The Study Problem

Since the beginning of the 20th century, there have been trends that seek to reduce risks and all types of waste, which is mean the optimal use of resources. This requires an efficient supply chain to provide the product in right quality, right quantity, right time, right price, right place and right source.

The initial information collected from Diyala health institutions and Kimadia, as well as, from some official websites on the internet has indicated that there is a significant amount of waste due to the surplus of inventory of some medicines and damage the others and expiry date for various reasons which cost millions of dollars. Meanwhile there is a shortage in the other types of medicines; and there are delaying in receiving pharmaceutical materials some time, as well as, inaccurate needs estimates (OFS, 2008; OFS, 2011; ERNST & YOUNG, 2012; OFS, 2014d; AL-ZAIDI, AL-ZUHAIRI and AL-KARAWI, 2018). Regarding the administrative procedures, there is a long series of administrative procedures between different management levels and traditional procurement methods are used which is limited by contract and temporary purchase periods, not long-term partnerships based on trust and cooperation, which takes a long time to conclude the contract, which in turn generate many problems in pharmaceuticals supply chain (AL-ZAIDI et al., 2018).

In general, the contents of the study problem can be identified through the following questions:

1. To what extent the activities of the pharmaceutical supply chain (Needs estimating, Procurement and Inventory system) are efficient?
2. What is the level of supply chain relationship quality in the pharmaceutical supply chain under study?
3. Is there any risk in the pharmaceutical supply chain under study?
4. Is there any kind of waste in the pharmaceutical supply chain under study?

5. Is there any relationship between the supply chain relationship quality and its dimensions, and supply chain risks and its dimensions?
6. Is there any relationship between the dimensions of supply chain risks?
7. Is there any relationship between supply chain risks and wastes?
8. Is the supply chain risks transfer from supplier to customers?

1.2. The Research Scope

Because of the huge numbers of health institutions in the Iraqi health sector – 361 hospitals, 367 public medical clinics and 2890 other health institutions (Central Bureau of Statistics, 2013) – and all of them managed by central system, the health sector in Diyala province is taken as the study population for distribution questionnaires. The official supplier company is Kimadia, which is considered the sole supplier to the government health sector for all Iraqi provinces and ministry of defense. The interviews were conducted with the main directors of health institutions in different Iraqi provinces and Kimadia.

This dissertation will also be restricted to only 4 dimensions in evaluating supply chain relationships quality and their role in supply chain risks represented by supply risk, demand risk, and inventory risk which in their turn affecting different types of waste.

1.3. The Study Importance

The importance of the study comes from the importance of pharmaceutical supply chain and there are limited number of local (Iraqi) studies in this field related to the academic and applied level. Moreover, there are no studies in international scope which discussed supply chain activities and supply chain relationship quality and their role in the supply chain risks and wastes according to researcher's aware. Hence, the importance of this study lies in its attempt to fill the gap in this field.

In addition, medicines are considered as essential commodities that cannot be denied and have to be provided permanently to the patient and taking into account reducing all kind of waste in all activities along the pharmaceutical supply chain. In the same time, any shortages or surplus in medicines will cost the government a lot due to increasing the risk and waste. Therefore, the importance of study can be indicated as follows:

1. Present a theoretical concept through the dialogue of previous literature reviews which is related to pharmaceutical supply chain, supply chain relationship quality, supply chain risks

and waste which can contribute in building a strong base that can be utilized in the practical fields to improve the efficiency of the pharmaceutical supply chain.

2. Measure the extent to which the activities of the pharmaceutical supply chain can be effectively adopted and implemented in order to minimize the supply chain risks and related wastes.
3. Present a guideline for health organizations related to the activities of pharmaceutical supply chain and reducing waste. This may be a worthwhile scientific addition because of rare studies in Iraqi literature in the field of management of pharmaceutical supply chain.
4. Pharmaceutical supply chain helps health institutions to deliver needed medicines as well as reduce medicines waste by enhancing their performance for providing the best service for patients, which is the main aim for health organizations, at the lowest cost.

1.4. The Study Objectives

The study objectives try to construct a theoretical and practical framework for the study variables in a way by that the following can be achieved:

1. Present the perceptions of the researchers in the concept of the pharmaceutical supply chain, supply chain relationship quality, supply chain risks and types of waste in the supply chain.
2. Clarify the importance of supply chain activities (Demand forecasting, Procurement and Inventory management) in the pharmaceutical supply chain and its role in the supply chain.
3. Clarify the importance of supply chain relationship quality in the pharmaceutical supply chain.
4. Identify the supply chain risks and measure to what extent they are in Iraqi pharmaceutical supply chain and its role in waste.
5. Clarify the nature of relationships between the study dimensions which include supply chain activities (demand forecasting, procurement and inventory management); supply chain relationship quality (trust, cooperation, communication and commitment); supply chain risks (supply risks, demand risks and inventory risks); and waste.
6. Building a basis framework in the pharmaceutical supply chain for researchers, in order to develop the Iraqi pharmaceutical supply chain.

1.5. The Study Hypotheses

The following hypotheses are investigated in Iraqi governmental pharmaceutical supply chain represented by Kimadia and health institutions.

H1: There is a significant relationship between supply chain relationship quality (trust, co-operation, communication and commitment) and supply chain risks (supply risks, demand risks and inventory risks) in the pharmaceutical supply chain.

H2: There is a significant relationship between the dimensions of supply chain relationship quality represented by trust, cooperation, communication and commitment in the pharmaceutical supply chain.

H3: There is a significant relationship between the dimensions of supply chain risks (supply risks, demand risks and inventory risks) in the pharmaceutical supply chain.

H4: There is a relationship between supply chain risks and wastes in the pharmaceutical supply chain.

H5: There is a relationship between the pharmaceutical supply chain activities (demand forecasting / needs estimating, procurement and inventory management); and the supply chain risks.

The Figure 1 gives a clear idea about the study processes and its structure.

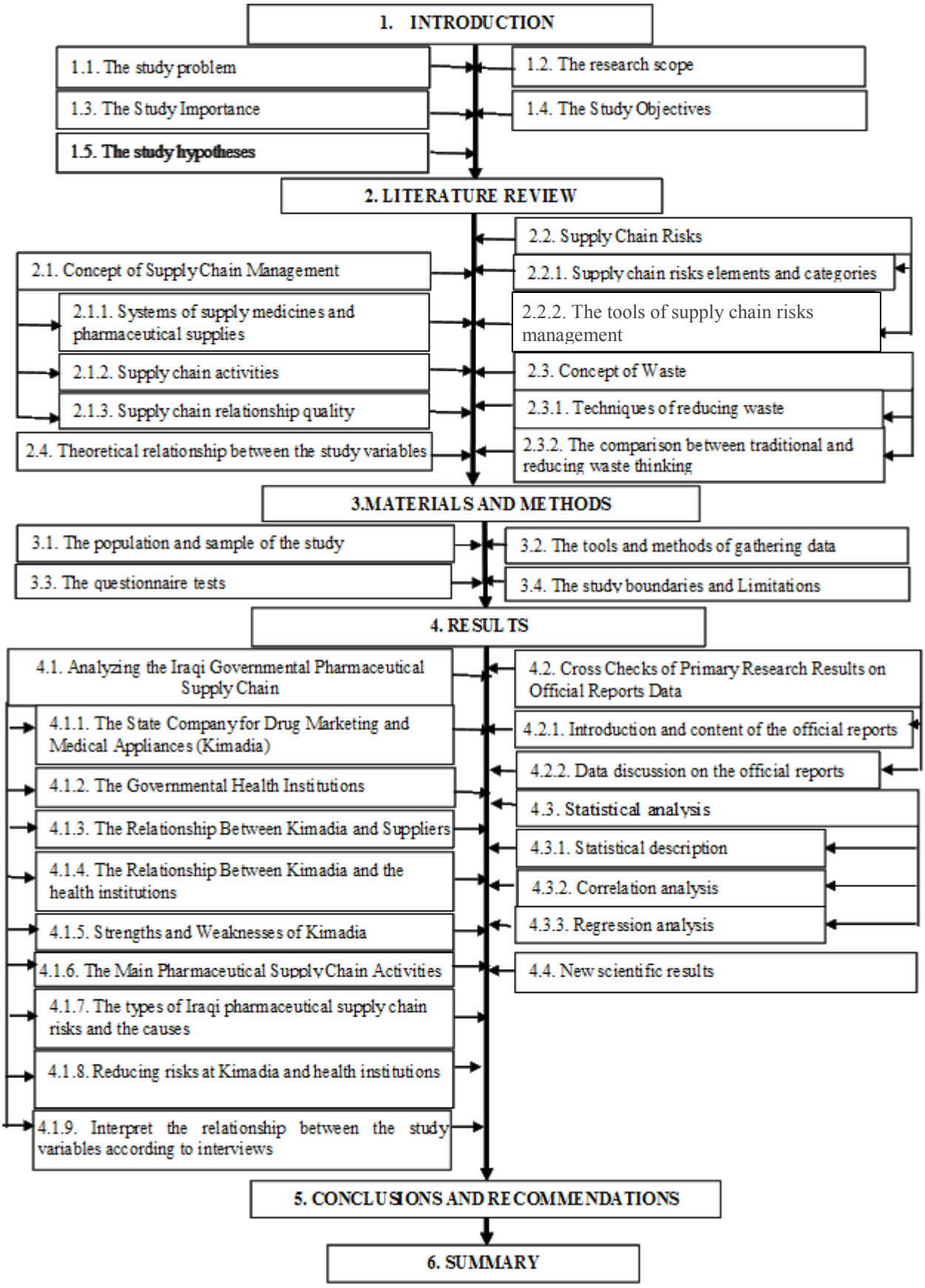

Figure 1. Process model reflecting the structure of the research study

Source: Author's own

2. LITERATURE REVIEW

The importance of the pharmaceutical supply chain lies in providing medicines and pharmaceutical supplies to health institutions in the right time, right place, right quality, right quantity and appropriate price, which is the main objective of health institutions. Therefore, the pharmaceutical supply chain deserves to be studied to clarify its activities, systems and supply chain relationship quality, then determine the main risks which might affect the efficiency of supply chain and select the factors which can play important role to mitigate supply chain risks. As well as, give a short idea about 7 wastes which can be happened in the pharmaceutical supply chain if there are some problems in the management as following:

2.1. Concept of Supply Chain Management

The concept of supply chain was introduced in the early 1980s by Oliver and Webber. The concept primarily focused on a coordinated and comprehensive view of the various sectors in supply chain but the broader focusing was on logistics activities (HAMMER, 2006).

There is a difference between the concept of supply chain management and the concept of logistics that the supply chain management refers to many members or companies coordinate their work together, whereas, the logistics concept means all activities such as procurement, distribution, maintenance and inventory management which happen within companies' borders (HUGOS, 2011).

As a result of market globalization, increase competition and focus on customer satisfaction, the concept of supply chain management has been appeared (GUNASEKARAN et al., 2001; WEBSTER, 2002). Therefore, there was a big challenge for companies regarding coordination of material and information flows which depend on their ability to manage complicated relationships with multi suppliers in different countries (CARIDI et al., 2010).

The supply chain is all the processes from getting materials until reaching end user. So, it is necessary to find methods which can manage all activities and processes, which are related to upstream vendors and downstream customers, including relationships management outside as well as inside an organization i.e. throughout all members of supply chain. Supply chain management (SCM) tries to manage all these activities, reduce costs and increase efficiencies of all supply chain activities (McLAUGHLIN and HAYS, 2008). 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 et al., 2016) as illustrated in Figure 2.

Figure 2. Global supply chain

Source: Heaney, 2013: 1

Supply chain management (SCM) is a new powerful source of competitive advantage including all activities from first supplier to final customer such as manufacturing operations, purchasing, transportation, physical distribution, forecasting, production planning and scheduling, order processing and customer service and coordinate them into a unified program with the activities of partners including vendors, carriers, third party companies, and information systems providers, as well as, the departments within the organization (ZIGIARIS, 2000).

There are different definitions for (SCM) depend on author's viewpoint as shown in Table 1.

Table 1. Definitions of supply chain management according to some authors' viewpoint

Authors	Definitions
McCORMACK and JOHNSON, 2001: 34	"SCM is the process of developing decisions and taking actions to direct the activities of people within the supply chain toward common objectives".
VAKHARIA, 2002: 496	"SCM is the art and science of creating and accentuating synergistic relationships among the trading partners in supply and distribution channels with the common shared objective of delivering products and services to the right customer, in the right quantity, and at the right time".
SWAMINATHAN and TAYUR, 2003: 1387-1388	"SCM is the efficient management of the end-to-end process, which starts with the design of the product or service and ends with the time when it has been sold, consumed, and finally, discarded by the consumer. This complete process includes product design, procurement, planning and forecasting, production, distribution, fulfillment, after-sales support, and end-of-life disposal".
CHRISTOPHER, 2005: 5	"SCM is the management of upstream and downstream relationships with suppliers and customers to deliver superior customer value at less cost to the supply chain as a whole".
LU, 2011: 13	"SCM is simply and ultimately the business management, whatever it may be in its specific context, which is perceived and enacted from the relevant supply chain perspective."
JABERIDOOST et al., 2013: 3	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.
HEIZER et al., 2017: 444	SCM describes the coordination of all supply chain activities, starting with raw materials and ending with a satisfied customer. Thus, a supply chain includes suppliers; manufacturers and/or service providers; and distributors, wholesalers, and/or retailers who deliver the product and/or service to the final customer.

Source: Author's own based on literature review

According to the definitions above that, the supply chain members should have high coordination and close relationship in order to achieve efficient management through supply chain starting from supplier ending with final customers.

Due to the high interconnectedness of supply chain members, any problem faced by one member can cripple the entire supply chain (LI, 2014: 283). So, the instant corrective action is necessary to mitigate all negative effects as mentioned. In order to ease execution of these corrective measures, the company will need to be aware of, and oriented to, supply chain risk management and security (HISHAMUDDIN et al., 2013: 552). The supply chain management aims to optimize all activities in supply chain and solves the obstacles wherever it is in the continuously changing environment (JUTTNER et al., 2007). These problems and challenges may occur as bottlenecks, material flow and transportation (SOUSA et al., 2011), manufacturing flow, select

the location of factories and warehouses, analyses vehicle route, dynamic programming and efficient capacities use, inventories, and labors (NARAHARISETTI and KARIMI, 2010).

2.1.1. The systems of supply medicines and pharmaceutical supplies

There are five kinds of pharmaceutical supply system, which aim to provide needed medicines and supplies to governmental and nongovernmental health institutions, enhance the rational use of medicines, and ensure the quality, safety, and efficacy of medicines. There is a considerable variation in these systems based on the government role, private sector role, and incentives for efficiency. The countries that take advantage of the capacities in both the public and private sectors usually have systems that are more effective; they also tend to be more resistant to shock from disaster events. These systems are illustrated as follows: (BENNETT et al., 1997: 45)

1. *Central medical stores (CMS):* It is a traditional system in which a centralized government unit is responsible for procurement and distribution. Decentralization is possible in this system by establishing pharmaceutical stores at provincial or state level. In this system, the government is responsible for managing the whole system and, financing, procuring and distributing medicines by a unit related to the ministry of health.
2. *Autonomous supply agency:* This system is managed by an autonomous or semi-autonomous pharmaceutical supply agency. It can be an alternative to the central medical stores (CMS)
3. *Direct delivery system:* This system is a decentralized which different from CMS. In this system, the medicines are delivered by suppliers to districts and major facilities directly. The government pharmaceutical procurement office chooses the suppliers and establishes the price for each item, but the government does not store and distribute medicines. The direct delivery system requires a sole-source commitment.
4. *Primary distributor (or prime vendor) system:* it is similar to the direct delivery system in which the government pharmaceutical procurement office makes a contract with one or more primary distributors as well as separated contracts with pharmaceutical suppliers. The primary distributor receives medicines from the suppliers and then stores and distributes them to districts and major facilities.
5. *Fully private supply:* This system is used in some countries that allows private pharmacies in or near government health facilities to provide medicines for public-sector patients. With such a system, measures are required to ensure equity of access for the medically needy, poor, and other targeted people.

The key advantages and disadvantages, and the comparison of supply systems for government and institutional health services in Table 2.

Table 2. Comparison of basic pharmaceutical supply systems

Systems	Responsibilities			Advantages	Disadvantages
	Contracting suppliers	Storage & delivery	Monitoring drug quality		
Central medical stores	CMS	CMS	CMS, DRA	•Maintains government control over entire system •It is easy to monitor	• High capital cost for offices, storage, and transport facilities • Recurrent cost of staff, transport, other operating costs • Limited incentive for efficiency • Open to political and other interference
Auto-nomous supply agency	Auto-nomous agency	Auto-nomous agency	PPO, auto-nomous agency, DRA	•Maintains advantages of centralized system •Flexibility in personnel and management systems may improve efficiency • Less open to interference •Separate finances facilitate revolving drug funds	•Cost and effort of establishing supply agency •May retain some constraints of CMS •Limited competitive pressure for efficiency if operated as a monopoly
Direct delivery system	PPO	Suppliers	PPO, DRA	•Eliminates cost of government-operated storage and distribution •Decentralized order quantities and delivery help adjust to variations in seasonal and local demand •Maintains price benefits of centralized tendering •Reduces inventory costs and expiration for high-cost, low-volume medicines	•Coordination and monitoring of deliveries, payments, and quality are demanding •Feasible only where adequate private infrastructure exists •Suppliers limited to those able to ensure local distribution (may reduce competition, increase cost) •Direct delivery by multiple suppliers (especially to remote areas) is inefficient, may raise costs
Primary distributor (or prime vendor) system	PPO	Primary distri-butor	PPO and Primary distributor	•Maintains advantages of single distribution system •Potential primary distributors compete on service level and cost	•Monitoring of service level and pharmaceutical quality is demanding •Competition depends on well-developed private
Fully private supply	Procurement and distribution by private enterprises		DRA	•Least demanding and least costly for the government	•Does not ensure equity of access for poor, medically needy, or other target groups •Medicine quality is more difficult to monitor
CMS: Central medical stores; **DRA:** Drug regulatory authority; **PPO:** pharmaceutical procurement office (ministry of health or other government offices).					

Source: Author's own based on DIAS, 2012: 138

2.1.2. The Activities of supply chain

A supply chain is the sequence of organizations, which their facilities, functions, and activities, are involved in producing and delivering a product or service. The sequence begins with basic suppliers of raw materials and extends all the way to the final customer. Facilities include warehouses, factories, processing centers, distribution centers, retail outlets, and offices. Functions and activities include forecasting, procurement, inventory management, information management, quality assurance, scheduling, production, distribution, delivery, and customer service (STEVENSON, 2012: 4).

In this part, we are focusing on three supply chain activities which are important in this study to understand their role in the supply chain namely (Demand forecasting, Procurement and Inventory management) as illustrated following:

2.1.2.1. Demand Forecasting/ Needs Estimating

One of the most important keys to succeeding in supply chain management is demand forecasting or needs estimating. If the demand forecasting is incorrect, there will be many problems may happen throughout the entire supply chain (CHENT et al., 1999; BALTZAN and PHILLIPS, 2009; BALASUBRAMANIAN et al.; RAHMAN et al., 2014). Demand forecasting can be defined as an attempt to estimate the need for a particular good or service or a combination of goods over a future period of time. As well as, it can be defined as an art and science to expect events in the future. Forecasting may depend on historical data (such as past sales or consume) and use a mathematical model to expect needs or sales into the future (HEIZER et al., 2017).

Forecasting is "one of the most important business functions because all other business decisions are based on a forecast of the future". Poor forecasting can be very costly due to incorrect decisions related to manpower plan, carrying inventory, production plan and choosing the market. Because of the forecasting importance, the companies have been investing billions of dollars in state-of-the-art technologies to achieve accurate forecasting (REID and SANDERS, 2011).

The forecasting is also different from pattern products to non-pattern products which are suitable for one can be unsuitable for another. Companies are able to predict the demand for pattern products individually as they are limited in quantity. For non-pattern products, the prediction for each item requires large financial costs, especially when the number of products is enormous, so it is best to predict them in similar groups (HEIZER et al., 2017).

Because of today's changeable environment, therefore, it is hard to give a high accuracy of forecasting for individual items (CHRISTOPHER, 2011). The demand forecasting has a significant role in bullwhip effect (BWE) in the supply chain. The bullwhip effect (BWE) might be occurred when the members of supply chain do not expect their needs precisely which affect the manufacturers' product scheduling, capacity planning, inventory management, and part procurement multiplies leading to multiple changes in all the supply chain (CHENT et al., 1999; BALTZAN and PHILLIPS, 2009; RAHMAN et al., 2014; WANG and DISNEY, 2016; CAO et al., 2016). The problems in the supply chain will be less if the demand forecasting period is short (DIAS, 2012).

There are three types of forecasting used by companies to plan their operation in future including economic forecasting, technological forecasting, and demand forecasting. In this study, demand forecasting is taken into account. Demand forecasts estimate demand for a company's products or services. Forecasts also very important to make decisions, therefore decision makers need immediate and precise information about real demand. There are seven basic steps for forecasting:

1. Determine the use of the forecast.
2. Select the items to be forecasted.
3. Determine the time horizon of the forecast.
4. Select the forecasting model(s).
5. Gather the data needed to make the forecast.
6. Make the forecast.
7. Validate and implement the results (HEIZER et al., 2017).

Although there are several types of forecasting models which are different in complexity, the amount of data, and the way of generating the forecast, there are some common features for all forecasting models as the following (REID and SANDERS, 2011, 266):

1. Forecasts are rarely perfect.
2. Forecasts are more accurate for groups or families of items rather than for individual items.
3. Forecasts are more accurate for shorter than longer time horizons.

According to McLAUGHLIN and HAYS, 2008; SLACK et al., 2010; REID and SANDERS, 2011; HEIZER et al., 2017, the methods used in demand forecasting of goods and services divided in to two collections, the first collection is Qualitative Method which include Sales estimates, Panel of experts method, Market Research and Delphi method, and the second

collection is Quantitative Demand Forecasting Methods which includes two methods, the first method is Time Series Analysis which includes the following methods:

1. Simple moving average method
2. Simple exponential smoothing method
3. Trend adjusted exponential smoothing method
4. Trend line method
5. Seasonal adjusted trend line method

The second method is Causal Method which includes two methods:

1. Linear regression
2. Multiple regression.

There is no forecasting method can be very precise, so, forecast error measurement, which is the difference between the actual and the forecast demand, is necessary. The companies have to make a review for demand forecasting to reduce forecasting error at a minimum level. The forecast error is easy if we deal with two or three products, but the task will be complicated if we deal with a huge number of products, therefore, using computer and software is important. There are three common methods to calculate the forecast error as following:

1. Mean absolute deviation (*MAD*)
2. Mean Squared Error (*MSE*)
3. Tracking signal.

Although no approach will result in a precise forecast, a combination of qualitative and quantitative methods can be used to great effect by bringing together expert judgments and predictive models (SLACK et al., 2010).

The main solution to get accurate demand by making demand data at a downstream site available to the upstream site through supply chain which means information sharing by using electronic data interchange (EDI), and build a partnership with suppliers with using vendor-managed inventory (VMI) or a continuous replenishment program (CRP) policy. Many companies such as Campbell Soup, Nestle, Quaker Oats, Nabisco, Procter & Gamble (P&G), and Scott Paper use CRP with some or most of their customers (LEE et al., 1997).

2.1.2.2. Procurement

Procurement is the function that ensures identification, sourcing, access, and management of the external resources that an organization needs or may need to fulfill its strategic objectives

(KIDD, 2005: 5). According to (The Global Fund to Fight AIDS, Tuberculosis and Malaria, 2009: 5) the term procurement refers to all activities required to ensure the continuous and reliable availability of sufficient quantities of quality-assured, effective products to end-users, procured at the lowest possible prices in accordance with national and international laws.

The procurement activity has several benefits according to (CIPSA) namely

1. security of supply,
2. lower costs,
3. reduced risk,
4. improved quality,
5. greater added value,
6. increased efficiency, and
7. innovation

The activities and events before and after the signing of a contract as well as the general management activities associated with a range of contracts are included in procurement activity which are:

1. pre-contract activities such as planning, needs identification and analysis, and sourcing,
2. post-contract activities such as contract management, supply chain management and disposal, and
3. general activities such as corporate governance, supplier relationship management, risk management and regulatory compliance (KIDD, 2005: 5).

The relationship with suppliers and risk management are one of the main tasks for the procurement, therefore, emphasis will be placed on the relationship quality with the suppliers as an independent variable and its impact on the supply chain risks as will be mentioned later.

2.1.2.3. Inventory Management

According to (DIAS, 2012: 451) inventory management is an extremely important in pharmaceutical supply system so that without healthy inventory system, the pharmaceutical supply system will not be viable. In fact, the task of inventory management is rather hard, and poor management of inventory in pharmaceutical supply system for example order frequency and quantity, inaccurate stock records and a lack of systematic performance monitoring can cause waste in financial resources, lack important medicines or surplus in others can lead to expiration and poor quality of patient care. These problems occur because of lack of knowledge

and appreciation of what inventory management means, and in many cases, there are no systematic procedures and roles to guide the employees (SZEGEDI and ILLÉS, 2007). The problem will be exacerbated if the managers have a lack of understanding of the basic issues of proper inventory management (WILLIAMS and TOKAR, 2008).

There are several advantages and disadvantages of maintaining inventory as shown in Table 3.

Table 3. Advantages and disadvantages of maintaining inventory

Advantages	Disadvantages
• Minimize life-threatening shortages • Facilitate bulk purchasing • Increase transportation efficiency • Protect against seasonal fluctuations	• Capital cost • Expiration • Spoilage • Obsolescence • Storage costs • Pilferage costs

Source: Author's own based on DIAS, 2012: 451 (published also in AL-ZAIDI et al., 2018)

Inventory management focuses primarily on activities related to planning and control inventory to ensure achieving a set of objectives to meet the needs of companies and customers as efficiently as possible for improving revenues; reducing degradation and obsolescence; improving warehouse utilization; and lower utility, labor and capital costs. Therefore, it is tied both directly and indirectly to huge financial gains (AMJED and HARRISON, 2012). Thus, from materials management perspective, an apt definition of inventory is "a usable but idle resource having some economic value." Physical inventory is essential for the continuity of production and services provided. However, keeping stocks is not free because there are opportunity costs of holding in companies. Accordingly, the paradox is that inventory is needed, but it is not desired which makes inventory management a complicated area in materials management. It also makes a high inventory turnover ratio as a good performance indicator.

There are several kinds of inventory including raw materials; bought-out-parts (BOP) which go to the product assembly directly as it is; work-in-progress (WIP) or pipeline inventory; finished goods inventory to support the distribution to the customers and maintenance, repair, and operating (MRO) supplies (VRAT, 2014).

Inventory is one of the most important cost elements and must be managed well to minimize costs. Therefore, because of the high cost of keeping inventory, the companies try to reduce inventory levels which can be achieved by focusing on raising supply chain efficiency, quality management and reducing uncertainty at various points along the supply chain (SZEGEDI and ILLÉS, 2006). According to The U.S. Department of Commerce estimates, the inventory of U.S.

companies cost a huge amount of money. Therefore, because of the high cost of keeping inventory, the companies try to reduce inventory levels which can be achieved by focusing on raising supply chain efficiency, quality management and reducing uncertainty at various points along the supply chain. In fact, uncertainty is created by low-quality weather from the part of the company or its suppliers or both. This can be represented by variations in delivery times, large fluctuations in customer demand, or poor forecasts of customer demand. Therefore, the inventory management takes suitable lot size into account to determine how frequently and in what quantity the inventory should be ordered (RUSSELL and TAYLOR, 2011: 554).

One of the most successful solutions to reduce the amount of inventory is frequent small lot-size which also contribute to reducing carrying costs, space requirements, and clutter in the workplace. As well as, small lots also permit greater flexibility in scheduling, in addition, inspection and rework costs are less when problems with quality occur because there are fewer items in a lot to inspect and rework by enhancing quality at source when the supplier and customer have high-quality relationships (STEVENSON, 2012: 625).

There are several models clarify inventory priorities including ABC analysis, HML analysis, VED analysis, FSN analysis, SDE analysis, GOLF analysis and SOS analysis. The ABC model is the widest use among all type of models. Each type of these models is defined briefly as follows:

1. *ABC analysis:* the classification of inventory in this analysis is based on annual consumption and the annual value of the items (KUMAR and SURESH, 2009: 177). High usage value items should be carefully controlled, whereas those with low usage values need not be controlled quite so vigorously (SLACK et al., 2010: 363).
2. *High-Medium and Low Price (HML) analysis:* this classification based on cost per unit criterion is used. This classification divides items to three groups High, Medium and low price.
3. *VED analysis:* this type of classification is dividing it into three categories vital, essential and desirable items.
4. *FSN analysis:* In this classification, the inventory items are classified based on consumption (*fast moving, slow moving and non-moving items*) (CHITALE and GUPTA, 2014: 203).
5. *SDE analysis:* In this analysis (analyzing according to *Scarce, Difficult and Easiness*), items are classified based on availability which is Non- availability, Scarcity, Longer lead-time, Geographically scattered and unreliable sources or supply.

6. *GOLF analysis*: it is based upon nature of sources or suppliers of the items and type of market from where. The suppliers can be classified to four categories which are *Government supply, ordinarily available, local availability and foreign supplier* to provide items.
7. *SOS analysis:* In this analysis, the seasonal classification is considered including two categories which are *seasonal and off-seasonal* items (BRINDHA, 2014).

Mixing these classifications is the optimal solution for inventory management (KUMAR and SURESH, 2009, 177).

The other type of models is represented by models of controlling the amount of inventory in the warehouses and reorder frequency systems. These models and systems are very important to maximize the inventory efficiency as the illustrated following:

1. *Economic order quantity (EOQ):* It is one of the most important models to manage inventory under certainty situations. It is used to determine the quantity required to minimize total cost and balance between procurement and holding costs. The economic order quantity is called economic lot size as well. There are two methods by which economic order quantity can be calculated which are (Tabulation and Algebraic methods) (McLAUGHLIN and HAYS 2008; KUMAR and SURESH, 2009; BRINDHA, 2014).
2. *Continuous review (Q):* Continuous review or perpetual inventory one of the most common in pharmaceutical supply chain designed to track stock units continuously to determine the quantity, at which an order must be placed, and time of reordering. Sometimes, it is called reorder point system or fixed quantity system. Depending on continuous review models, it is possible to place order at any time when the inventory reach at the minimum level, therefore, it has been used in developed countries in which manufacturers are located close to customers and use advanced information technology system such as USA (BUFFA and SARIN, 1990; DIAS, 2012). The Continuous review is more sophisticated and efficient than periodic review when precise information is available at real-time and use computer systems or detailed records are maintained (ÇAKICI et al., 2011; ACCOUNT TOOLS, 2013).
3. *Periodic review (P):* In the pharmaceutical supply chain, there are two models as a periodic review model. The first model is Annual purchasing model used to purchase items at once a year. Annual purchasing can be suitable for countries which new programs, which have no system for inventory management. Annual purchasing might be compulsory in countries that have limited local sources and lead times of importing from foreign suppliers needs months for arriving. Although using scheduled or continue purchasing by some systems, some items might be purchased annually. There are several disadvantages related to this

model like surpluses, shortages and expensive emergency orders, high stock levels and cost of inventory-holding, providing a huge single delivery is hard, large storage space, difficulties to pay funds and workload in the main receiving points and procurement office. The second model is schedule purchasing in which orders are placed at a selected time such as (weekly, monthly, quarterly, biannually). Orders are placed at the scheduled order date for suitable quantity to meet average needs until the next order. Schedule purchasing have to take into account stock needed during the lead time for that order (plus replenishment of safety stock, if needed). In most supply systems, new orders are placed only after receiving the previous one. However, there are some systems use tandem ordering, with overlapping orders and various expected times of arrival, if the reliability of estimated lead time is high. In the scheduled purchasing, supply contracts can be renewed at each interval or can be negotiated at the beginning of the year, with the condition that orders will be placed when needed at the identified ordering intervals. Although there are several benefits for the schedule purchasing model like bullwhip effect is less than annual purchasing model, bullwhip effect can still occur with scheduled review periods in three to six months, as shown in Figure 3, and the cost of inventory-holding is directly proportional to the interval of material supply (DIAS, 2012).

Figure 3. Impact of reorder interval on average inventory

Source: DIAS, 2012: 460

According to ACCOUNT TOOLS (2013) and BUSINESS FINANCE (2017), the review system is superior to the periodic review system. The case, which periodic system may make sense, is when the inventory amount is very small, and it is easy to review it visually without

any specific need for more detailed inventory records. The periodic system can be also used well when the workers of warehouses are weakly trained in the uses of continues review system.

4. *Hybrid system:* The hybrid inventory control systems combine some but not all the features of the periodic (P) and continuous (Q) systems. This system can be based on the importance of medicine by using suitable classification such as (ABC) or others (DIAS, 2012, KRAJEWSKI et al., 2016).
5. *Vendor managed inventory (VMI):* It is a method of inventory control, the supplier (vendor) monitors and maintains the quantity of commodities at the customers' location (the customer is the custodian of the inventory). VMI is opposite of the methods used by many organizations which the custodian calculates the needed quantities and places an order with their supplier when commodities are needed, whereas, with VMI, the supplier or vendor, at the custodian's location, manages the timing and quantity of inventory to be replenished (USAID, 2012). Figure 4 shows two types of benefits for using VMI system in public health supply chain which including immediate benefits, that result directly from the changes introduced by VMI, and contingent benefits that will come after additional efforts.

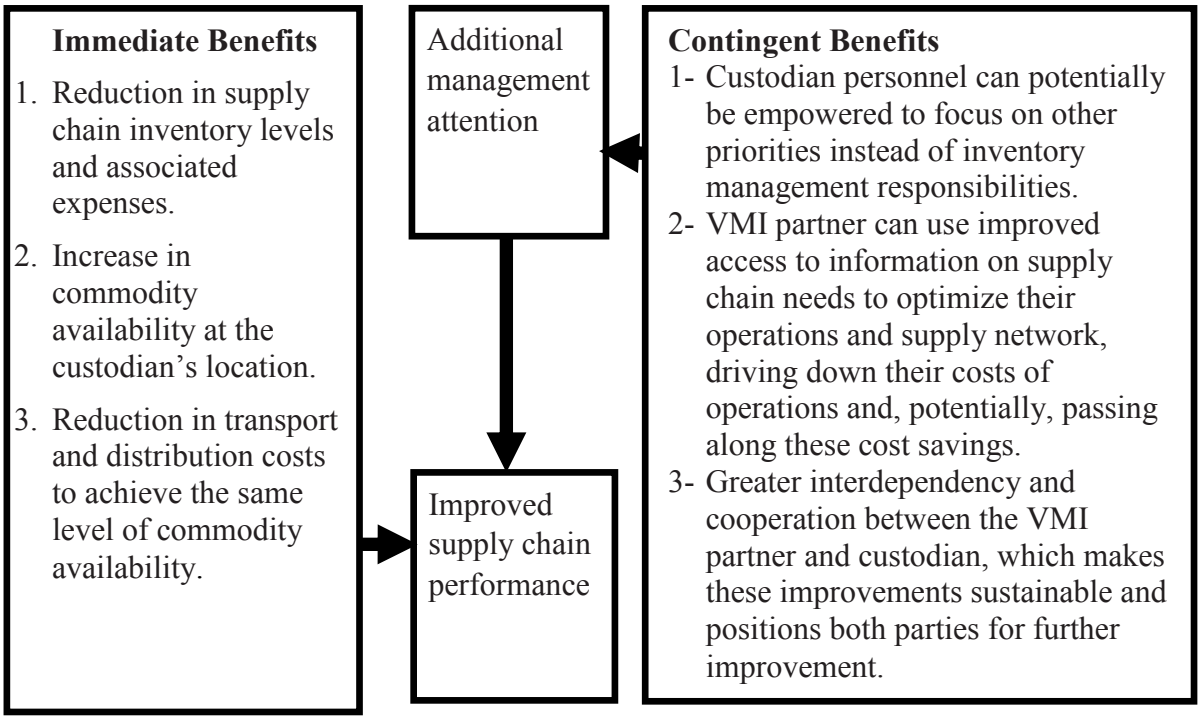

Figure 4. Benefits of using Vendor managed inventory (VMI) system

Source: USAID, 2012: 6.

2.1.3. Supply chain relationship quality (SCRQ)

Relationship Quality is defined by CROSBY et al., (1990) as "the customer is able to rely on the salesperson's integrity and has confidence in the salesperson's future performance because the level of past performance has been consistently satisfactory". SKARMEAS and ROBSON (2008) define relationship quality as less conflict, higher trust, commitment to achieving the aim and greater partner satisfaction.

The supply chain has witnessed three changes in the nature of relationships. These changes have been shifted from cooperation (visibility on essential information and long-term contracts) to coordination (implementation of visibility mechanisms such as EDI and JIT) and full collaboration (which also includes a high level of trust and a common vision of the future) (CARIDI et al., 2014). Relationships have a significant role in supply chains and if companies do not have good relationships with the members of the supply chain, they will be confused all the way from suppliers to customers (BIFM, 2015).

Building relationships quality in the supply chain should not be focused on first-tier suppliers and first tier customers but should extend to involve all supply chain members. There are two types of relationships arm's length and close partnership. The arm's length relationship is clarified when the supply chain members focus only on the volume and price of the transaction; whereas, the close partnership relationship is clarified when the supply chain members exchanged their vision, new product introduction (NPI), investment planning process and detailed financial information (LU, 2011).

As previously indicated, supply chain relationship occurs when two parties in supply chain interact which include short-term exchanges and long-term relationship behaviors. The supply chain relationships tend to be considered as a long-term relationship which ensures long-term cooperation (RAZAVI et al., 2016). According to (SAAD et al., 2002; KELLER, 2002; FYNES et al., 2004; LAGES et al., 2005) that the long-term relationship is the soul of relationship quality. The long-term relationship helps to reduce behavioral uncertainty, which includes opportunism and bounded rationality. As well as, the close long-term relationships among parties are a powerful barrier to the entry of another company (FYNES et al., 2004). There is an increasing interest in relationships through supply chain especially the companies which try to reduce inventory and raise the supply chain efficiency. This can happen by improving communication and cooperation between all parties which can help to reduce total cost and improve profit margins (KRAJEWSKI et al., 2016: 211). The supply chain relationship quality is

important to enhance supply chain performance (FYNES et al., 2005a; MOHAGHAR et al., 2011).

Regarding material flow and strong relationships, it is necessary to strengthen the relationships with few numbers of suppliers and make sure that their location in close geographic proximity. Long-term relationships among customers and suppliers can enhance providing quality goods and services, thereby eliminating the need to inspect deliveries from suppliers because of the supplier as a partner, in this case, can help to adopt the strategy of quality at the source (KRAJEWSKI et al., 2013: 298-299).

Small and medium-sized Romanian companies realized that a one-time relationship with the suppliers could cause more losses due to defects in the quality of received products. After that, the companies sought to establish long-term mutually beneficial relationships with their suppliers to reduce procurement problems (PLAIAS and MURESAN, 2007). The supply chain relationships can enhance customer service quality (AL-ZAIDI et al., 2017). Supply chain requires close collaboration, cooperation, and communication among all members to be effective. All members through supply chain including suppliers and customers must share information which characterizes today's supply chain management. Suppliers and customers must also have the same goals and mutual trust between suppliers and customer is also very important. Therefore, suppliers and customers must work together in order to design the supply chain for achieving their common goals and to facilitate communication and the flow of information (RUSSELL and TAYLOR, 2011: 68-69).

In Table 4, the supply chain relationship quality dimensions are illustrated based on several authors' perspective.

Table 4. The supply chain relationship quality dimensions

Authors	Dimensions
SKJOETT-LARSEN (2000)	Co-operation, Coordination, Joint planning, Joint product development.
WALTER et al. (2003)	Trust, Commitment, satisfaction.
WOO and ENNEW (2004)	Adaptation, Co-operation, atmosphere.
LOURENÇO, (2005)	Communication, Co-operation, Coordination, Integration, Share information.
LAGES et al. (2005)	Communication quality Share information, long-term relationship oriented, satisfaction.
FYNES et al. (2005a)	Trust, Commitment, Adaptation, Communication, Co-operation, Interdependence.
FYNES et al. (2005b)	Communication, co-operation, commitment, and adaptation
HUNTLEY (2006)	Communication, trust, co-operation/ Institutionalization, adaptation, and atmosphere
RAUYRUEN and MILLER (2007)	Trust, Commitment, satisfaction, Service quality.
SKARMEAS et al. (2008)	Trust, Commitment, satisfaction.
PAYAN et al. (2010)	Trust, Commitment, Co-operation, Coordination, satisfaction. Specific assets
MOHAGHAR and GHASEMI (2011)	Trust, Commitment, Adaptation, Communication, Co-operation, Interdependence, atmosphere,
RAZAVI et al. (2016)	Trust, Commitment, Adaptation, Communication, Co-operation, Interdependence, Atmosphere
AL-ANI and AL-OMARI (2016)	Trust, Communication, Commitment, Co-operation.
AL-ZAIDI et al. (2017)	Trust, Co-operation, Communication, Commitment.

Source: Author's own based on literature review

In this research, definitions and clarification for four main sub-dimensions trust, co-operation, communication, and commitment, which are used by most authors and taken as an independnt dimensions in this research, are presented as the following:

2.1.3.1. Trust

It is one of the most frequent dimensions in the literature of supply chain relationship quality (SCRQ) which has been defined as "the firm's belief that that another company will perform actions that will result in positive actions for the firm, as well as not take unexpected actions that would result in negative outcomes for the firm" (ANDERSON and NARUS, 1990: 45). IK-WHAN and TAEWON, (2005) defined trust as a willingness to take a risk and depend on an exchange partner in whom one has confidence. ROBBINS and JUDGE (2009) mentioned that the trust concept in relationships means a positive expectation that the other party does not engage in any act of opportunism through words, actions, and decisions. there are dimensions to the concept of trust including Integrity (credibility, honesty), competency (Skills and knowledge

owned by the other party), and consistency which refers to what extent the company can rely on the other party), loyalty which means the desire to maintain the relationship with the other party), and openness and frankness. Therefore, high level of trust within and among companies and people lead to manage supply chain with fewer resources and clear decisions (PALA et al., 2012).

HA et al. (2011) mentioned that suppliers feel more comfortable when they have an effective trust with their partners to frequent contact and greater information sharing. Customers' participation does not necessarily mean joining decision processes of suppliers. Partners, who have enough technical knowledge to contribute to the performance, must be involved in making valuable decisions, especially strategic ones. Therefore, the trust competence is extremely important in joint strategic decision-making because incorrect decisions lead to costs increasing and a drop in performance.

Building trust between the partners means a cost management strategy due to the consistency of companies which can generate a conviction for partners to obtain free defects goods, facilitates long steps of legal contracts and conditions, excessive quality control and assurance, time of communication and recurrence of effort in planning, forecasting, and replenishment. Consequently, several advantages can happen such as improving quality and efficiency, reducing cost and responding time to a customer request.

There are three steps of trust. The first step is the calculative trust which involves that gaining benefits from the high trust is more than lack trust. The second step is the cognitive trust which means understanding the collective benefits including success, achievement of goals and solving problems. Finally, the bonding step is a more intimate step which means that the companies have built a strong relationship between each other which now goes beyond just relating and partner companies have a common ground in terms of shared values, code of conduct, obligations and emotional connection (STUART et al., 2011).

With regard to medicines, building trust with suppliers is more important than the other goods because the medicines are related to human life, so it is better to buy medicines from highly reliable suppliers especially medicins related to critical illness and not to risk buying from unknown suppliers (DIAS, 2012).

2.1.3.2. Co-operation

As mentioned before, the supply chain relationship has been shifted from cooperation (visibility on essential information and long-term contracts) to coordination (implementation of visibility

mechanisms such as EDI and JIT) and full collaboration (which also includes a high level of trust and a common vision of the future) (CARIDI et al., 2014).

An efficient co-operation between partners in the supply chain can happen by information sharing on production schedules, new products or processes and value analysis will help companies to learn more about partners' needs, eliminate product costs and enhance product or process innovations (LANDEROS and MONCZKA, 1989).

According to (SIMATUPANG and SRIDHARAN, 2002; WHIPPLE and RUSSELL, 2007) collaboration in supply chain can be defined as two or more chain members work together on quality and service or product designs, as well as plan and execute supply chain operations for achieving greater success through information sharing, benefits and risk and making joint decisions which lead to increase profitability and meeting end customer needs than acting alone. The benefits of collaboration can be indicated according to viewpoint of different authors which include: increase revenue, reduce cost, production flexibility to deal with demand uncertainty (FISHER, 1997; SIMATUPANG et al., 2002); increment in sales, efficient forecasts, information sharing is more precise, reduce cost, less inventory, high customer service, (BARRATT and OLIVEIRA, 2001; WHIPPLE and RUSSELL, 2007). As well as, In the cooperative approach, the buyer may not need to inspect incoming materials (KAČ et al., 2015).

There are advantages and disadvantages for both competitive and cooperative orientation. So, some companies use a mixed strategy, utilizing a competitive orientation for their commodities like supplies and a cooperative orientation for high-valued or high-volume services and materials. The companies can choose the best orientation which serves their goals. Close cooperation between supply chain parties can be a win-win situation for everyone. In collaborative efforts, there must be willing from customer part which allows supplier access to their inventory information but supported by forecasting information, sales promotions, and other demand-related data. Therefore, trust and accountability are required in this kind of relationship (KRAJEWSKI et al., 2013).

2.1.3.3. Communication

There is the same meaning for communication and visibility according to their definitions. Visibility is the access to accurate, timely information throughout the supply chain processes and networks, allowing organizations to make decisions quicker and with more accuracy (BICHANGA and MWANGI, 2014), whereas, communication is a vital link among companies' logistics processes, as well as, among all partners which can be defined as "the formal as well as

informal sharing of meaningful and timely information between firms" (ANDERSON and NARUS, 1990: 44). Therefore, we conclude that the visibility and communication depend on information sharing through supply chain members, so, in this dimension, Therefore, communication are been used in this part.

High communication is the cornerstone of supply chain successful. It is also a major indicator of whether the relationship among the partners is vital and energetic. (LAMBERT and STOCK, 2001; TSAI and HUNG, 2016). LAGES et al., (2005) mentioned that keeping long-standing partnership and building long-term customer satisfaction depend on efficient communication. Three aspects of communication have great importance in relationships, the first is the quality of information, including accuracy and timing relevance and credibility; secondly, how information is shared or how relevant and relevant information exchange is, and thirdly is the participation degree to which the parties share the planning and setting goals (FYNES et al., 2005a).

As mentioned by MIN et al. (2005) that information sharing represents the heart of supply chain collaboration, so, more attention towards information sharing should be given. LEE and WHANG (2004) represented many benefits for information sharing including inventory reduction and efficient inventory management, cost reduction, increasing visibility (significant reduction of uncertainties), organizational efficiency and improved services, significant reduction or complete elimination of bullwhip effect, quick response, improved resource utilization, building and strengthening social bonds, increased productivity, early problem detection, earlier time to market, expanded network and optimized capacity utilization. BAGCHI and SKJØTT-LARSEN, (2004) add reduce cycle time from the order placement to delivery and better tracing and tracking.

Lack of information sharing among supply chain members causes low visibility, inaccurate forecasting demand and bullwhip effect along supply chain such as surplus or shortage inventory (AGRAWAl et al., 2009; BHATTACHARYA and BANDYOPADHYAY, 2011; RAHMAN et al., 2014; AUGUSTO et al., 2014; GOODARZI et al., 2017), as shown in Figure 5.

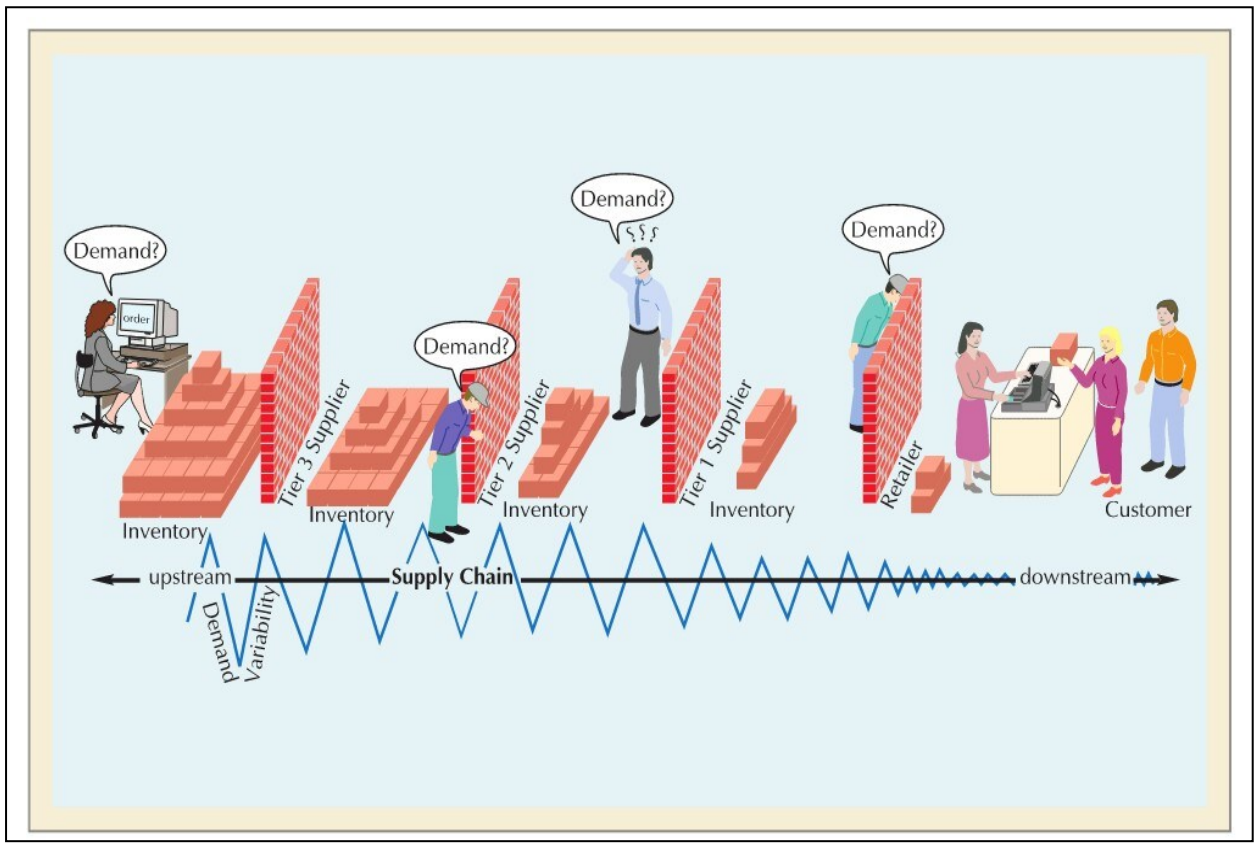

Figure 5. The Bullwhip Effect

Source: RUSSELL and TAYLOR, 2011: 426

Several technologies and systems are used to facilitate information gathering and sharing among all members of supply chain such as Radio frequency identification data (RFID), electronic data interchange (EDI), point of sales (POS), vendor-managed inventories (VMI), barcode and enterprise resource planning (ERP) (see LAMBERT and STOCK 2001; KRAJEWSKI et al., 2016). The advantages of using information technologies in the supply chain are to reduce overall operational costs, operational performance improvements such as improving shipment accuracy (reduction of shipping errors) and customer satisfaction; inventory levels, lead time, purchase order cost and administrative cost and procedures. Another main important impact of information technology is to achieve integration among supply chain members which help to enhance supply chain relationships throughout coordination, trust and commitment between supply chain members. As a result, information technologies have a positive impact on the performance of the entire supply chain (KRAMAC, 2005).

Many kinds of information can be shared within a supply chain such as inventory information, sales data, sales forecasting, order information, product ability information, exploitation information of new products (LOTFI et al., 2013).

2.1.3.4. Commitment

One of the most important dimensions in supply chain relationship quality (SCRQ) is a commitment which is considered the core of the relational exchanges between the companies and its partners (IK-WHAN and TAEWON, 2005) and it is necessary for long-term success because of willingness of partners, who believe in commitment, through supply chain to share advantages and disadvantages for long-term success (MENTZER et al., 2000). According to FYNES et al. (2005a) that the commitment and trust are the main requirements in the supply chain relationship quality which encourage the committed parties to get common investments, reduce uncertainty and contribute to make companies more stability. As well as, there is a strong correlation between commitment and successful partnership. AL-ANI and AL-OMARI (2016) mentioned that the commitment is a long-term relationship among all partners and maintain this relationship to counter all expected challenges.

2.2. Supply Chain Risks

The top priority for any health system is to provide medicines for patients. The pharmaceutical supply chain like any supply chains can exposure to many risks and it is more sensitive than the other supply chain because it is related to human life. These risks affect supply medicines or waste the resources but also can threaten the peoples' life by impeding access to medicines, therefore, the factors which affect supply chain should be selected and find appropriate solutions to treat the risks (JABERIDOOST et al., 2013).

2.2.1. Supply chain risks elements and categories

The supply chain risk is defined by many authors by definitions from various point of view. The supply chain risk defined by focusing on information, material and products flow risks by JÜTTNER et al. (2003: 200), which is any risk related to information, material and products flow from original suppliers to the delivery of the final product to the end user. The supply chain risk defined as "the potential variation of outcomes that influence the decrease of value added at any activity cell in a chain" (BOGATAJ and BOGATAJ, 2007: 291). According to HO et al. (2015: 5035) supply chain risk is "the likelihood and impact of unexpected macro and/or micro level events or conditions that adversely influence any part of a supply chain leading to operational, tactical, or strategic level failures or irregularities".

The concept of supply chain risk is a multi-faceted which differs according to industry or service type, for instance, aerospace firms understand supply risk in terms of threats to customers' life

and safety (PABLO, 1999). To provide all kinds of medicines and pharmaceutical supplies by pharmaceutical companies, it should be depended on outsourcing. Although the companies recognize the importance of global supply chain, they are also finding that the global supply chains have extra complexities which were either slight or nonexistent in a local supply chain. These complexities include cultural differences and language, currency fluctuations, armed conflicts, increased transportation costs and lead times. In addition, the factors which can affect the supply chain success, including local capabilities; transportation, financial, and communication infrastructures; governmental, environmental and regulatory issues; and political issues must be analyzed and identified by managers to avoid risks. The risks can relate to supply such as (supplier failure, sustainability issues, quality issues, transportation issues, pirates, terrorism), costs (e.g., increasing commodity costs), and demand (e.g., decreasing demand, demand volatility, and transportation issues). Still, other risks can involve intellectual rights issues, contract compliance issues, forecasting errors, competitive pressure, and inventory management (STEVENSON, 2012: 669). There are many other authors classified the type of risks, according to JABERIDOOST et al., (2013) there are about 50 elements which pose a risk on pharmaceutical supply chain were extracted based on previous articles. The elements were divided into 7 main categories which contain sub-elements as appeared in Table 5.

Table 5. Description of the elements of pharmaceutical supply chain risks

No.	Category	Risks
1	Supply & Suppliers issues	Supply and supplier issue, partnership with supplier, raw material quality, ordering cycle time, contract & agreements, customization of supplier, certificate of good manufacturing practice (GMP), flexibility of supplier, fragmentation, delivery reliability, environmental assessment, technology level, information systems, good will, technology development, flexibility in delivering, flexible quantities, flexibility in product variety, timely delivery, quality management system and customer services disruption.
2	Organization & strategies issues	Inventory management, operation issues, research and development R&D, skill of workers, strategy, planning issues, information flow, visibility on stock, organization & process, mergers and acquisition, time to market and waste management.
3	Financial	Production cost, tax payable change, currency rate, financial risks, tariff policies changes, costs related to supply, cash flow and interest rate
4	Logistics	Counterfeit and transportation
5	Market	Market, consumers taste and demand
6	Political	Natural disasters &terrorism, political issues and sanction
7	Regulatory	Regulation

Source: JABERIDOOST et al., 2013: 6-7

GUPTA and GUPTA (2016) classified the pharmaceutical supply chain risks in to 2 main factors which are:

1. External supply chain risks: demand risks, stock risks, environmental risks, corporate risks and physical plant risks.
2. Inside supply chain risks: manufacturing risks, corporate risks, planning and control risks, mitigation and contingency risks and cultural risks.

According to HASIJA et al. (2017) there are four kinds of risk affecting the pharmaceutical supply chain are identified as regulatory risk, counterfeit risk, inventory risk and financial risk.

The categories of supply chain risks in general determined by many authors most of them focus on supply and demand as illustrated in Table 6.

Table 6. Determining supply chain risk types according to researchers

Authors	Risk types
HARLAND et al., 2003	Strategic, operations, supply, customer, asset impairment, competitive, reputation, financial, fiscal, regulatory and legal risks
CHRISTOPHER and PECK, 2004	Process, control, demand, supply, and the environmental
WU et al., 2006	• Internal risks: internal controllable, internal partially controllable, internal uncontrollable • External risks: external controllable, external partially controllable, external uncontrollable
SODHI and LEE, 2007	supply, demand, and contextual risks requiring both strategic and operational decisions
BLACKHURST et al., 2008	Disruptions or disasters, logistics, supplier dependence, quality, information systems, forecast, legal, intellectual property, procurement, receivables (accounting), inventory, management and security risks, capacity
OKE and GOPALAKRISHNAN, 2009	Consider low-impact-high-frequency and high-impact-low-frequency risks in three major categories: demand, supply, and miscellaneous
TRKMAN and McCORMACK, 2009	•Endogenous risks: market and technology turbulence •Exogenous risks: discrete events (e.g. contagious diseases, terrorist attacks, workers' strikes) and continuous risks (e.g., consumer price index changes, inflation rate)
OLSON and WU, 2010	• Internal risks: available capacity, internal operation, information system risks • External risks: nature, political system, competitor and market risks
TANG et al., 2012	Material flow, information flow risks and financial flow
SAMVEDI et al., 2013	Supply, demand, process and environmental risks
HO et al., 2015	• Macro risk factors: which are natural disaster, war and terrorism, fire accidents, political instability, economic downturns, external legal issues, sovereign risk, regional instability, government regulations and social and cultural grievances. • Micro risk factors: which are demand risk factors, manufacturing risk factors, supply risk factors and infrastructural risk factors including information risk factors, transportation risk factors and financial risk factors
RAJAGOPAL et al., 2017	Operational supply chain risks: quality risk, capacity/inventory risk, supply risk, demand risk, information flow risk, transportation risk, commodity price fluctuation risk, exchange rate risk, credit risk, environment risk and reputation risk.

Source: Author's own based on literature review

MANUJ and MENTZER (2008) classified the supply chain risks factors and selected the sources of risks for each factor as shown in Table 7.

Table 7. Supply chain risks classification

Type of risk	Source
Supply Risks	Disruption of supply, inventory, schedules, and technology access; price escalation; quality issues; technology uncertainty; product complexity; frequency of material design changes
Operational Risks	Breakdown of operations; inadequate manufacturing or processing capability; high levels of process variations; changes in technology; changes in operating exposure
Demand Risks	New product introductions; variations in demand (fads, seasonality, and new product introductions by competitors); chaos in the system (the Bullwhip Effect on demand distortion and amplification)
Security Risks	Information systems security; infrastructure security; freight breaches from terrorism, vandalism, crime, and sabotage
Macro Risks	Economic shifts in wage rates, interest rates, exchange rates, and prices
Policy Risks	Actions of national governments such as quota restrictions or sanctions
Competitive Risks	Lack of history about competitor activities and moves
Resource Risks	Unanticipated resource requirements

Source: MANUJ and MENTZER, 2008: 138

This topic focuses on supply, inventory and demand risks; therefore, the short idea is given about these two factors. ZSIDISIN (2003: 222) defined the supply risks as the probability of an incident associated with inbound supply from individual supplier failures or the supply market occurring, in which its outcomes result in the inability of the purchasing firm to meet customer demand or cause threats to customer life and safety".

The concept of risk cannot be accurately identified as mentioned before by PABLO (1999) which depend on the type of industry or service. According to HO et al. (2015) and HASIJA et al. (2017) the supply, demand and inventory risk factors described as following:

1. *Supply risk factors:* Inability to handle volume demand changes, Failures to make delivery requirements, Cannot provide competitive pricing, Technologically behind competitors, Inability to meet quality requirements, Supplier bankruptcy, Single supply sourcing, Small supply base, Suppliers' dependency, Supply responsiveness, High capacity utilization of supply source, Global outsourcing, Narrow number of intermediate suppliers, Lack of integration with suppliers, Lack of suppliers' visibility, Supplier management, Supplier market strength, Supplier opportunism, Monopoly, Selection of wrong partner, Transit time variability, Contractual agreements, Low technical reliability, Supplier fulfilment errors and Sudden hike in costs.

2. *Demand risks factors:* Inaccurate demand forecasts, Serious forecasting errors, Bullwhip effect or information distortion, Demand uncertainty, Sudden shoot-up demand, Demand variability, Customer fragmentation, High level of service required by customers, Customer dependency, Deficient or missing customer relation management function, Short lead times, Short products' life cycle, Competitor moves, Competition changes, Market changes, High competition in the market, Low in-house production and Order fulfilment errors (HO et al., 2015).

According to HASIJA et al. (2017), the inventory risks can be happening due to lack of inventory planning and inaccurate demand forecasting. Inventory control might be a challenge for companies and the way by which inventory managed can affect the performance of a company. Increasing the level of inventory in warehouses means extra cost and having low inventory level leads to reduce service quality. Despite inventory is considered to have a negative effect on companies' performance because of large proportion of the total expenses is generated, but having inventory is still important for many kinds of products.

Any risk might happen with supply or demand will affect inventory, Therefor, inventory problems and solution should be given extra clarification.

The bullwhip effects which means, a common phenomenon in supply chain which is a kind of distortion occurring in the process of transmitting order information upstream, is a bigger fluctuation in upstream order quantity caused by the fluctuation of downstream demands (DAI et al., 2017), one of the main risks in supply chain with respect of inventory fluctuation. The bullwhip effect has several consequences which are: LEE et al. (1997), CARLSSON and FULLER (2000), NIENHAUS et al., (2006), and WANG and DISNEY (2016)**:**

1. Variation in inventory levels through supply chain members;
2. Minimizing the agility of supply chain;
3. Low customer service because of run out of some products due to insufficient means for coping with the variations;
4. Variations in the logistics chain due to unexpected demand;
5. Missed production schedules because of demand fluctuations;
6. Lost revenues due to shortages;
7. High possibility to make misguided decisions because of fluctuations in demand;
8. High level of safety stock.

The inventory variability in the supply chain can be happened due to various reasons. Five factors have more impact on inventory fluctuation in supply chain including demand signal

processing, non-zero lead time, order batching, supply shortages, and price fluctuations (CAO et al., 2016); also lack of information sharing among supply chain members (GOODARZI et al., 2017); whereas (LI et al., 2017) add that lead time can cause amplification effect in supply chain. Table 8 illustrates more main causes for inventory fluctuation from the different viewpoint of different authors.

Table 8. The reasons of inventory fluctuation according to authors' opinion

Authors	Causes of inventory fluctuation
LEE et al. 1997	Demand Forecast Updating, order batching, price fluctuation rationing and shortage gaming
CHENT et al., 1999	Demand Forecast, lead time, order batching, price fluctuation and supply shortage
CARLSSON and FULLER, 2000	Demand signal processing, rationing game, order batching and price variations
NIENHAUS et al., 2006	Lead time of information and material, demand forecast based on orders of the succeeding tier, historically oriented-techniques for demand forecast, batch ordering, price fluctuation and exaggerated order quantity in case of delivery bottlenecks
ALONY and ANEIROS, 2007	Demand forecast updating, order batching, price fluctuation rationing, shortage gaming, machine breakdown, capacity limit, number of echelons, lead time variability and workloads
AGRAWAL et al., 2009	Information sharing and lead time
BHATTACHARYA and BANDYOPADHYAY, 2011	Demand forecasting, order batching, price fluctuation, rationing and shortage gaming, lead time, inventory policy, replenishment policy, improper control system, lack of transparency, number of echelons, multiplier effect, lack of synchronization, misperception of feedback, local optimization without global vision, company processes, capacity limits, neglecting time delays, lack of learning and/or training, fear of empty stock
RAHMAN et al., 2014	Demand forecasting, order batching, price fluctuation, rationing and shortage gaming, local optimization without global vision, lead time, information sharing, exaggerated order quantity in case of delivery bottlenecks, machine breakdown, capacity limit, number of echelons, workloads and lack of supply chain coordination
WANG and DISNEY, 2016	Demand, forecasting, time delay, information sharing and ordering policies
CAO et al., 2016	Variability in supply and demand

Source: Author's own based on literature review

2.2.2. The tools of supply chain risk management (SCRM)

There are many authors define the supply chain management as illustrated in Table 9. All authors agree that reducing or managing risk in the supply chain can be efficient by enhancing coordination or collaboration among the supply chain partners (JÜTTNER et al.,2003;

NORRMAN and JANSSON, 2004; TANG, 2006; GOH et al., 2007; WIELAND and WALLENBURG, 2012; KILUBI and HAASIS, 2015), through using adequate tools, techniques, and strategies to mitigate or eliminate risk exposure (KILUBI and HAASIS, 2015).

Table 9. Definitions of supply chain risk Management given by researchers

Authors	Definitions
JÜTTNER et al., (2003: 202)	"The identification and management of risks for the supply chain, through a coordinated approach amongst supply chain members, to reduce supply chain vulnerability as a whole"
NORRMAN and JANSSON, (2004: 436)	To collaborate with partners in a supply chain apply risk management process tools to deal with risks and uncertainties caused by, or impacting on, logistics related activities or resources
TANG, (2006: 453)	The management of supply chain risks through coordination or collaboration among the supply chain partners so as to ensure profitability and continuity
GOH et al., (2007: 164–165)	The identification and management of risks within the supply network and externally through a coordinated approach amongst supply chain members to reduce supply chain vulnerability as a whole
WIELAND and WALLENBURG (2012:890-891)	"SCRM is defined as the implementation of strategies to manage both every day and exceptional risks along the supply chain based on continuous risk assessment with the objective of reducing vulnerability and ensuring continuity."
KILUBI and HAASIS (2015: 46)	"SCRM implies the identification, assessment, monitoring and evaluation of risks and potential threats within and outside supply chain networks with all members and entities involved. It supports cooperative and collaborative management of supply chain risks with the aid of adequate tools, techniques, and strategies as to mitigate or eliminate risk exposure. SCRM, therefore, aims at ensuring flexibility and agility to deliver operational excellence and to achieve superior performance and customer value."

Source: Author's own based on literature review

Plentiful studies have been published on supply chain risk management and in related fields in previous time. One key element to mitigate supply chain risk is improved 'end-to-end' visibility, it is argued that supply chain 'confidence' will increase in proportion to the quality of supply chain information and information should be accuracy, visibility and accessibility (CHRISTOPHER and LEE, 2004).

Proper coordination is the key to mitigate Bullwhip Effect (BWE). In case of demand forecasting as a reason of BWE, one of the main remedies is information availability and flow downstream upstream supply chain partners.

Using channel alignment strategies to mitigate BWE by the application of VMI such as Procter & Gamble (P&G), Apple, HP, Motorola, and Texas Instruments companies, the application of Continuous Replenishment Policies (CRP), Consumer Direct Programs, and offering a discount

for information sharing. Reducing the number of supply chain echelons also mitigate BWE through ease the coordination.

In case of order batching that the small and frequent order batches are a good solution to reduce the BWE, but the problem is that the cost of placing an order and replenishing it becomes higher in two cases decreasing order size and/or increasing order frequency. The remedies are using Electronic Data Interchange (EDI) and order full truckloads of various products instead of just one product. As a result, for each product, the order efficiency and transport efficiency are preserved. "Procter & Gamble (P&G) has encouraged its distributors by offering discounts for ordering in mixed Stock Keeping Units. The use of "Composite Distribution" is another concept in the industry for food products or products which need different temperatures to be stored.

This can be made possible by making separate compartments in a truck, each having a different temperature suitable for particular products. Since small order batches minimize BWE and increases ordering costs at the same time, using Third-party logistics (3PL) is thus observed in the industry, as well as, using information technology system can enhance systems and facilitate coordination and information sharing among supply chain members (BHATTACHARYA and BANDYOPADHYAY, 2011).

Using Third-party logistics (3PL) has several advantages such as small batch replenishments become economical, allows economies of scale and full truckloads of products from different suppliers (LEE et al., 1997).

MOHAGHAR et al. (2011), found the supply chain relationship quality represented by trust, commitment, adaptation, communication, collaboration, interdependence, atmosphere is important to enhance supply chain performance.

AUGUSTO et al. (2014), ALMEIDA et al. (2015) and ALMEIDA et al. (2017) studied the role of trust and collaboration to mitigate the bullwhip effect in supply chain management indicate that the behavioral aspects are important to mitigating the bullwhip effect such as trust and collaboration among those members in the supply chain and it needs more studies on that.

Information sharing has a significant impact on the reduction of inventory level and total costs of the suppliers. In other words, the information sharing is highly valuable on successive demand increases and support better coordination and collaboration in a supply chain (HUANG et al., 2016; JEONG and HONG, 2017), whereas, LU et al., (2017) added that information sharing is important, but information quality is the main important in this case.

One of the main important solutions to reduce supply chain risks is multiple order-up-to policies-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).

PEREIRA (2009) focused on information management by supporting information technology as a tool to reduce supply chain risk. KILUBI and HAASIS (2015) collected 12 factors which can protect or manage supply chain risk by analyzing previous studies from 2000 to the beginning 2015. These factors included visibility, flexibility, relationships, redundancy, coordination, postponement, multiple sourcing, collaboration, risk awareness, agility, avoidance, contingency planning, risk monitoring, transferring and sharing risks; whereas he suggested five enablers for effective SCRM, namely visibility, flexibility, multiple sourcing, redundancy, and coordination.

After the long discussion about the tools of supply chain risk management, there are controversy and disproportion that surrounds the tools of supply chain risk management (SCRM). A good example of the differences in expression is that some researchers referred to information sharing and information technology system as the tools of supply chain risk management, whereas the other such as JOHANSSON and MELIN (2008) mentioned visibility as a tool for reducing risk which can be achieved by (relationship and information sharing). Whereas according to BARRATT and OKE (2007, in JOHANSSON and MELIN, 2008: 15, 21) information sharing enablers are (communication, collaboration, trust, commitment, and technology), and some of them talked about coordination and collaboration. Therefore, this research aims to study to what extent supply chain relationship quality dimensions represented by (Trust; Co-operation; Communication and Commitment), as well as, inventory management system contributes to supply chain risks including (Supply risk, Demand risk and Inventory risk) and their role in wastes.

2.3. Concept of Waste

Waste means any activity that does not add value to company and product, finally customers (HEIZER and RENDER, 2011). Eliminating waste 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). It is called lean philosophy, according to WOMACK et JONES (2003), "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). Other authors

mentioned that according to Japanese companies lean thinking is the best solution for solve the waste problem and the concept can be used with different supply chains (VAJNA and TANGL, 2017; DUNAY and SHABAN, 2017a). SLACK et al. (2010) and also TANGL and VAJNA (2016) stated that the concepts, thoughts and techniques of lean management can be applied not only for individual activities, but for also all components of supply chain. To avoid waste, companies have to focus on only value-added activities e.g. try to remove or reduce inventory as much as possible and the other types of waste. Reducing waste may increase the performance of products and may reduce costs by more effective use of resources (NOWAKOWSKA-GRUNT and MOROZ, 2013; SEROKA-STOLKA, 2016). It provides better service to customers in economic and environmental aspects (SKOWRON-GRABOWSKA and OSYRA, 2013) and finally may increase business performance (SKOWRON-GRABOWSKA, 2008). Lean supply chain management means supply chain management focusing on reducing or eliminating waste (GÁBRIEL, 2014). Taiichi Ohno, the father of Toyota Production system noted seven categories of waste which are used in lean organizations (OHNO, 1988):

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

Another viewpoint considers 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 (HEIZER et al., 2017: 638). ILLÉS et al. (2017) discussed lean concepts as a part of quality management tools and highlighted that lean thinking and quality assurance should be applied by all members of the organization, from the top managers to the front line. Lean thinking is the best solution to solve the problem of waste, and this concept can be used with different supply chains (DUNAY and SHABAN, 2017b).

In current study, the surplus and shortage in inventory, as well as, damaged medicines due to expiry date and storage conditions are taken as variables to measure waste.

2.3.1. Techniques of reducing waste

According to AL-NIMA (2007) there are several terms belong to the foundations of applying reducing waste, such as Tools, Techniques, Methods and Fundamentals. In this study, the term of (techniques) will be used. So, the term of techniques are used in this part and each technique is clarified shortly.

1. *The 5Ss to Organize Workplace*

Takashi Osada in 1991 coined the original concept of 5s in the early 1980s. 5s is the acronym for five Japanese words Seiri (organizing), Seiton (neatness), Seiso (cleanliness), Seiketsu (standardization) and Shitsuke (discipline); they introduced in Japan mainly in the manufacturing and service industries (GUPTA et al., 2015). 5S try to improve information stream, materials and reduce the time of looking for things that form waste by having a dedicated place for things in order to increase efficiency (VAJNA and TANGL, 2013).

2. *Just in Time (JIT)*

JIT is one of the most important techniques to reduce waste in organizations. It aims to solve problems by focusing on outcomes, reduce inventory (HEIZER and RENDER, 2011: 654). In JIT system, the customer is considered as a start point to manage inventory. The system aims to achieve zero defects, zero inventories, zero set-up time, zero lead time, zero break down and zero-handling (CHASE and AQUILANO, 1995: 242), Whereas (KRAJEWSKI et al., 2013) mentioned that the JIT focuses on removing waste by eliminating excess productivity energy or inventory and removing the activities that don't add-value.

3. *Value Stream Mapping (VSM)*

Value stream is analyzed and mapped in order to reduce the waste in processes (VAJNA TANGL and VAJNA, 2014), to enable flow, and provide the ideal quick response to customer pull (McMANUS and MILLARD, 2002). The value stream extends along supply chain from raw materials until deliver final products to customers; besides, it helps to create a clear image which helps managers to identify non-value-added activities (AL-OBAIDY, 2014: 55). Figure 6 as an example to illustrate the Value Stream Mapping in supply chain.

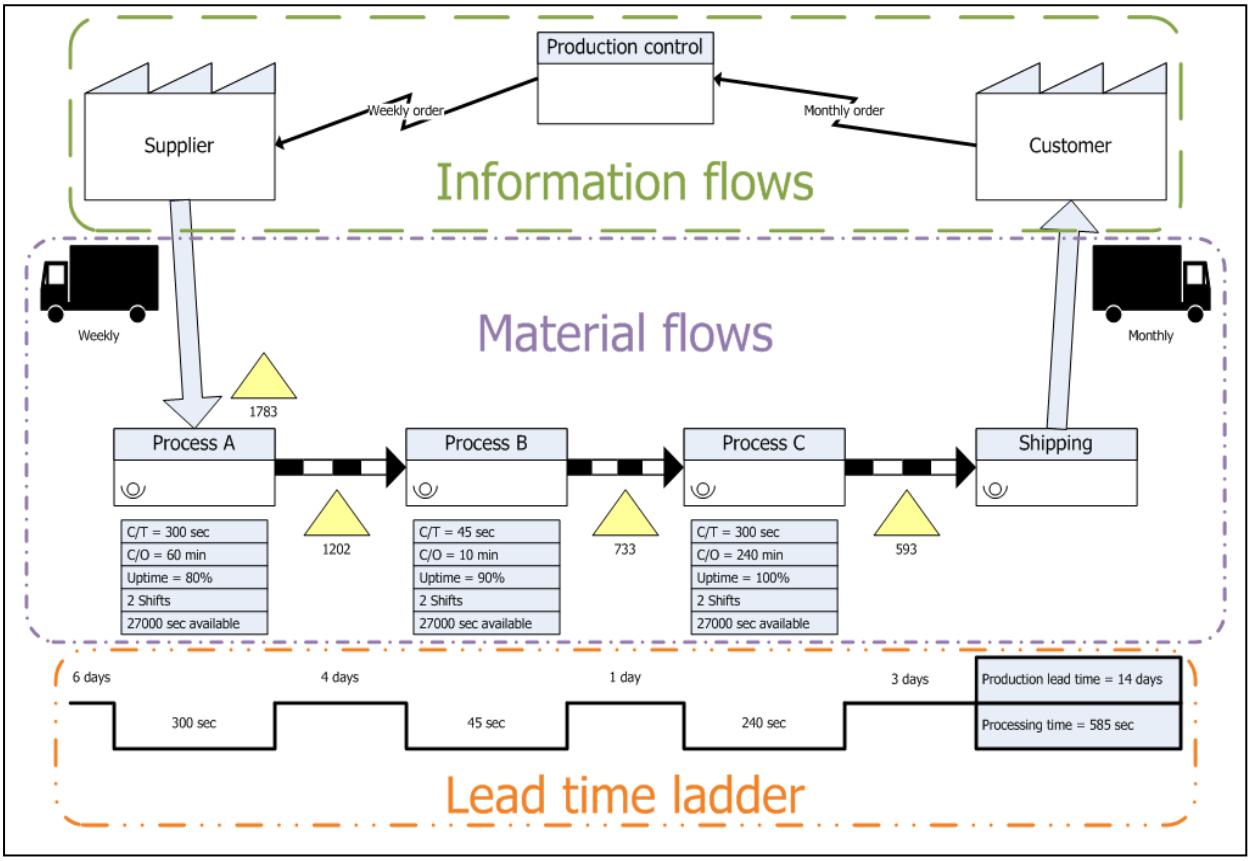

Figure 6. Value stream mapping (VSM) in the supply chain

Source: https://www.plant.ca/features/map-your-future/

4. *Improvement Continuous (Kaizen)*

According to (IMAI, 1986) Kaizen means improvement, continuous improvement involving everyone in the organization from top management, managers, supervisors, to worker. Also, it is applied in processes, such as purchasing and logistics that cross organizational boundaries of supply chain (SINGH and SINGH, 2009, 53).

5. *Total Quality Management (TQM)*

Total Quality Management (TQM) means "quality management throughout an organization at all management levels and across all areas" (RUSSEL and TAYLOR, 2011, 99), whereas, KRAJEWSKI et al. (2013: 180) mentioned that (TQM) "a philosophy that stresses three principles for achieving high levels of process performance and quality customer satisfaction, employee involvement, and continuous improvement in performance".

6. *Close supplier ties*

In the pharmaceutical supply chain, it is necessary to build a strong relationship with suppliers through mutual trust and long-term relations with a few suppliers who have superior performance that meets quality standards by their ability on repeated delivery and small lot-size daily; characterized by high quality, suitable cost and their ability to change their systems according to customers' desires (HEIZER and RENDER, 2017: 645).

7. *Quality at the Resource*

High quality along supply chain is extremely required due to lack of inventories to compensate defective products. Therefore, workers have to be very precise that they do not receive any defective unit from previous station (RUSSELL and TAYLOR, 2011: 735).

8. *Small Lot Size*

The waste can be reduced by cutting the investment in inventory. A main key to minimize inventory is to produce good product in small lot sizes. Small lot size can be a major reason to reduce inventory and inventory costs (HEIZER et al. 2017: 644).

2.3.2. The comparison between traditional and reducing waste thinking

LIKER (2004) and KOTTER (2007) mentioned to the differences between traditional and reducing waste thinking. AL-RAWI (2013: 106-107) clarified the two solutions, i.e. how to deal with problems in traditional and waster reducing way of thinking, as it is summarized in Table 10.

Table 10. Clarify the main differences between traditional and reducing waste thinking

Traditional Thinking	Reducing Waste Thinking
Try to access the cause quickly	Try to study the problem deeply instead of rushing to reach the cause
The procedures followed when the worker made a mistake is he has to be punished and warned not to make mistakes again.	The procedures followed when the worker made a mistake are: 1- Why he makes a mistake 2- Are the instructions clear? 3- Has the worker seen the instructions? If the worker was new in his job the procedures are: • Has the worker taken training courses that qualify him? Or he took training courses, but he has not focused on this point? After discussion with workers and directors, they try to solve the problem then correct and clarify how can avoid this problem next time.
We have considerable experience in identifying the problem through available means of communication or reports.	Visit the work site and discuss the problem directly there and find out the causes and solutions.
When the mistake occurs, the person who is responsible is afraid even if he is not related to the problem.	When the error occurs, all workers cooperate to reach the cause to prevent recurrence.
The phrase that is usually repeated: the inefficient worker, the engineer does not realize anything; the manager failed and predicted that this will happen.	The phrase that is repeated is why the process needs to be modified, the worker needs help tools, and the machine needs to be developed.
The leader or manager the only person who reaches to the cause quickly.	The cause of the fundamental problem is discovered by teamwork after discussion among the members of the team.
The real causes cannot be determined, because the worker who has information about the truth takes into account social relations and nepotism and fears for himself primarily.	There is no objection to clarifying the truth, it is the main means to prevent the problem, it is possible to make mistakes by workers and the organization and workers are responsible to help worker to avoid mistakes.
They try to fix the problem after occurring	They try to avoid problem by using Total productive maintenance (TPM)
They rely on oral discussions, assessment and absence of numbers and facts.	Reliance on reports with facts, figures, charts, date of occurrence of problem and previous solutions.
Study method is not necessary to study the problem, they consider the problem is very clear	brainstorming, fishbone diagram, and information gathering meetings are used to study the problems
Only the head of organization and departments are responsible about problem study.	All people related to problem have a role to solve it whether they are workers or directors.
Problems occur frequently and are handled each time	Problems are not repeated but are fundamentally solved
Work is annoying and boring	Work is a place for enjoyment and solving problems
Many problems are covered so as not to punish any of the workers	Everyone is happy to talk about problems and mistakes as they lead to improvement and development of work not to punish employees
Workers in place and management elsewhere, and information are not shared among them.	Management and employees have the same information and exchange ideas and information.

Source: AL-RAWI, 2013: 106-107

2.4. Theoretical Relationship between the Study Variables

This part tries to clarify the nature of the theoretical relationship among the study variables (supply chain activities, supply chain relationship quality, supply chain risks, and waste). After long discussion for study variables, it is concluded that the pharmaceutical supply chain activities (demand forecasting/needs estimating, procurement and inventory management) the supply chain relationship quality represented by trust, cooperation, communication, and commitment. It has an important role in raising the efficiency along the supply chain and thus reducing supply chain risks, especially, supply risks, demand risks and inventory risks which in its turn reduce the waste such as inventory, waiting, transportation, motion, over-process and defects. In other words, the efficient supply chain activities and the higher supply chain relationship quality, the lower risks, will reduce waste and vice versa. For example, if the supply chain relationship quality was weak i.e. if there is no trust, cooperation, communication and/or commitment between supply chain members, the supply chain risk will increase, i.e. delays in receiving the materials, extra-inventories will appear, urgent orders will be costlier, etc. This will increase again the waste in transportation, waiting, inventory, over-process and defects. The research will clarify in the practical part through interviews, questionnaire and secondary data of official reports. In addition, if there is inaccurate needs forecasting, long procurement procedures or unsuitable inventory management system, they will lead to increasing the risks in the pharmaceutical supply chain and waste as well as shown in Figure 7.

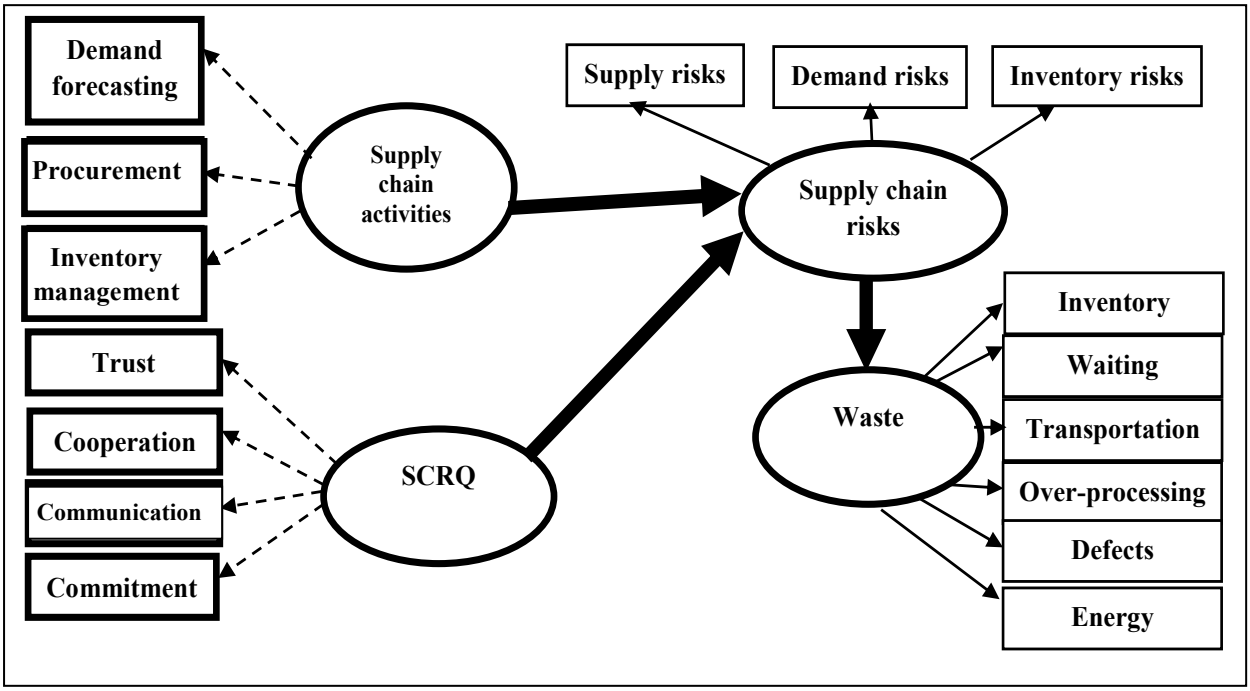

Figure 7. The theoretical relationship between the study dimensions
Source: Author's own

3. MATERIALS AND METHODS

In order to test and answer the hypotheses and questions of the study, the researcher depended on the analytical and descriptive methods by studying the correlation and effect between the main and secondary variables by collecting the data related to the study variables and analyzing them. In addition, secondary data were also used which were collected from reports belong to different years which are prepared by Office of Financial Supervision. In this part the population and the sample of the study, the tools and methods of data collection, the type of questionnaire tests, the study boundaries and the study limitations are clarified.

3.1. The Population and Sample of the Study

The study population is represented by Kimadia and government health sector in Iraq. The main aim to choose this population is to investigate the main reasons behind the essential problems such as surplus, shortages, delay, quality, etc. in the medicines and pharmaceutical supplies in Iraqi pharmaceutical supply chain which has no enough studies to cover the current problems.

The study sample has included the directors or managers who work in the surveyed company (Kimadia) and health institutions who have responsibilities and information about the Iraqi pharmaceutical supply chain.

The researcher distributed 48 questionnaires to the directors and their assistants in Kimadia but the number of returned questionnaires, which were suitable for statistical analysis, were 42 which mean that the response rate was 88% which is a high rate. In addition, the number of questionnaires which distributed to the Diyala health institutions was 50 and the returned questionnaires which valid for statistical analysis were 42 which represent 84% which is can also be considered as a high rate see Table 11.

The questionnaire distribution process was required more time and efforts from the researcher because of depending on the interviewing method to clarify the questionnaires, thus providing sufficient time and atmosphere for responders for freedom of expression about their opinion. As well as, unstructured interviews were made by the 19 directors in different positions and health institutions in various provinces to describe and diagnoses the main risks and waste in the pharmaceutical supply chain, as shown in Table 14. It shows the interviewers according to health institutions in detail and Appendix 5 which clarify the interview questions.

Table 11. The number and rate of distributed and received questionnaires in Kimadia and health institutions

Name of institution	Distributed questionnaires	Received questionnaires	Response rate
Kimadia	48	42	88%
Diyala health institutions	50	42	84%

Source: Author's own

Tables 12, 13 and 14 describe the respondents in Kimadia and health institutions in details.

Table 12. Respondents of questionnaire in Kimadia

Education qualification													
High school and below		Technical Diploma		Bachelor		Higher Diploma		Master		PhD		Others	
No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
1	2.4	6	14.3	32	76.2	1	2.4	2	4.8	-	-	-	-
Field of qualification													
Medical		Biology		Managerial		Chemistry		Physics		Others		Missing	
No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
17	40.5	2	4.8	12	28.6	2	4.8	-	-	8	19	1	2.4
Experience years													
Less than 2		2-5		5-8		8-11		11-15		More than 15			
No.	%	No.	%	No.	%	No.	%	No.	%	No.	%		
1	2.4	1	2.4	4	9.5	8	19	4	9.5	24	57.1		

Source: Author's own

Table 12 above shows that there are high qualifications in Kimadia in different fields with long experience years.

Table 13. Main features of the respondents of questionnaire in health institutions

Education qualification													
High school and below		Technical Diploma		Bachelor		Higher Diploma		Master		PhD		Others	
No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
		18	42.9	24	57.1								
Field of qualification													
Medical		Biology		Management		Chemistry		Physics		Others			
No.	%	No.	%	No.	%	No.	%	No.	%	No.	%		
42	100												
Experience years													
Less than 2		2-5		5-8		8-11		11-15		More than 15			
No.	%	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.	%	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

Table 13 above shows that the sample of the study is distributed from the last pharmacy in Diyala 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 have years' experience more than 5 years which mean that they have enough experience to deal with the questionnaire.

Table 14. Sample of interviewed persons according to health institutions in details

Name of health institution	Head of department	Director of main store in the province	Hospital drug store	Sector drug store	Public clinic drug store	Total
Kimadia	3					3
Diyala		2	2	2	1	7
Kirkuk		1		1		2
Baghdad			1	1		2
Babylon			1			1
Salah Al-Deen		1		1		2
Al-Anbar		1	1			2
Total	**3**	**5**	**5**	**5**	**1**	**19**

Source: Author's own

Table 14 above shows that the interviews which conducted with the directors in Kimadia, which is the main company that provides the Iraqi health institutions with medicines and

pharmaceutical supplies, and in 6 provinces health institutions out 18 provinces. There were some difficulties to make the interviews in all 18 provinces because it is not easy to visit all provinces health institutions with the current hard situation in Iraq. In the same time, all health institutions follow the central government health system, so, the researcher saw that these provinces are enough to be represented sample to understand the nature of the system and diagnose main problems.

3.2. The Tools and Methods of Gathering Data

The purpose of obtaining the necessary data is to achieve and examine the objectives and hypotheses of the study, so the researcher depended on books, scientific papers and conferences, reports, theses etc. to cover the literature review; and three methods have been used to cover the practical part as illustrated in Figure 8.

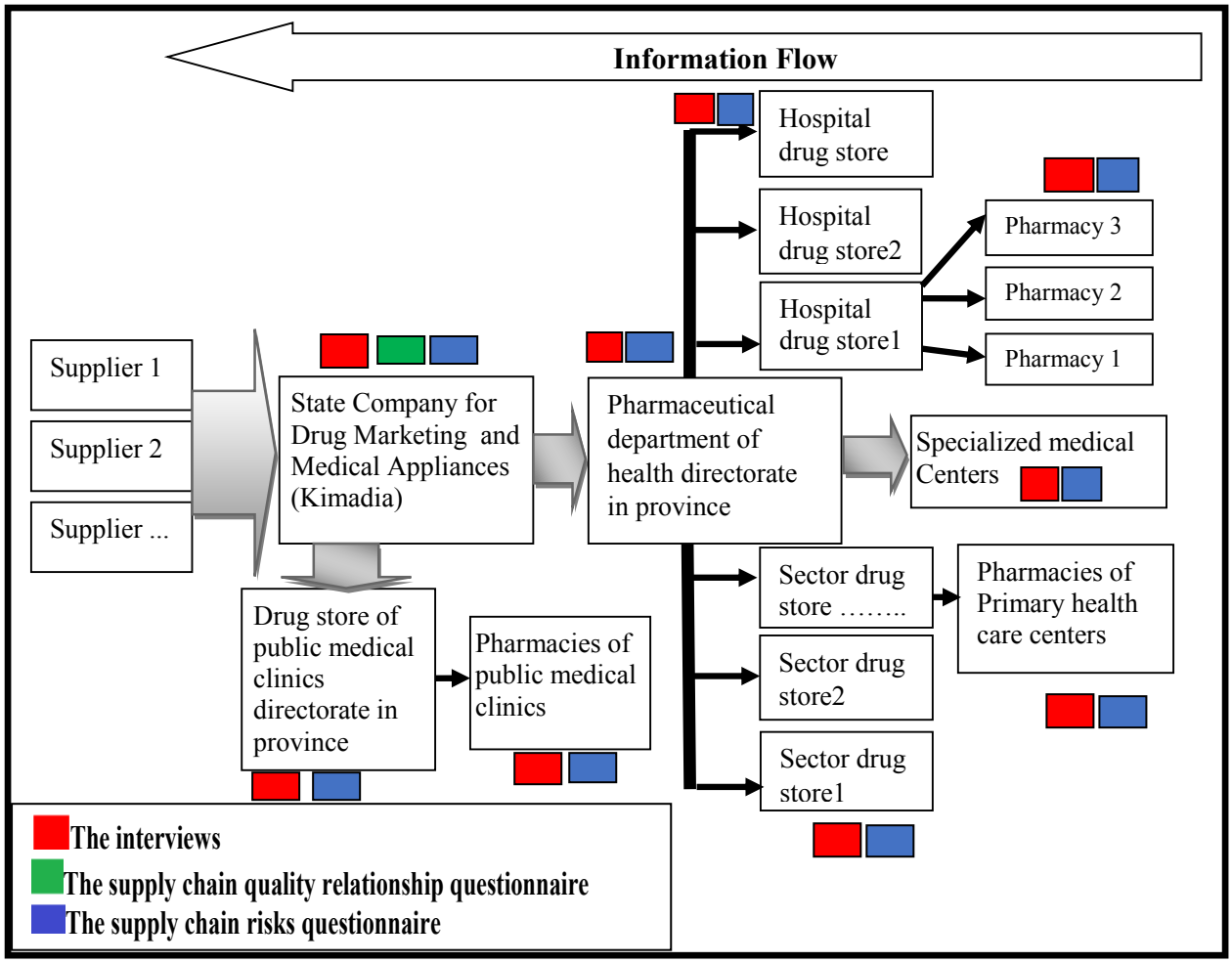

Figure 8. Illustration of the pharmaceutical supply chain of Iraq

Source: Author's own

The methods that were used to collect the data in the practical part of the study are clarified in detail as follows:

1. Unstructured interviews with the main directors in Kimadia and health institutions as mentioned in Table 14 and Appendix 5 to collect general data about the governmental supply chain in Iraq and diagnose the main weaknesses and problems in the Iraqi pharmaceutical supply chain and find suitable solutions. The interviews lasted for a long time during the study period, conducted through face-to-face interviews and through using social media for video call. The main aim of using this method is to allow the interviewers to express about there all problems which might not appear before the interview to the researcher which means collect a huge detailed amount of information related to the Iraqi pharmaceutical system in the state sector and give the interviewers enough time to talk about the problems and the main reasons behind them. This was a huge help the researcher for deeper understanding and use the interviews information to interpret the secondary data that collected from the previous reports or official websites concerned of Iraqi pharmaceutical supply chain.

2. Using some quantitative data about the surplus, shortages, delay and quality of products problems which are published in the annual and quarterly reports of the Office of Financial Supervision and official website of Kimadia. The data are not regular data because the Office of Financial Supervision cannot find all the problems in the pharmaceutical supply chain, however, these data can support the result of interviews and questionnaires. The analysis and interpretation of this data are depended on the information which collected from the interviewers to clarify the main reasons behind selected problems in Iraqi pharmaceutical supply chain, for example, the surplus of medicines has been diagnosed in the reports, but they did not mention the reasons behind that in the reports, so, the researcher depended on the interviews information to interpret this case and the other cases.

3. The questionnaire was used as the main tool in data collection. It was considered in its formulation the ability to diagnose and measure the main and sub-variables of the study. The researcher relied on previous studies to determine the variables of the study, as well as benefiting from the opinions of experts and specialists in this field. The main aim of using the questionnaires in this study is the difficulties on getting the detail quantitative data related to dimensions of the study from the authorities in the pharmaceutical supply chain because it is a sensitive data for them, so, they were hesitant.

The questionnaire consists of three parts: see Table 15 and Appendix 4, which clarify the questionnaire structure. The first part displayed the demographic data such as education qualification, the field of qualification, experience years, place of work and geographic place. The second part represented by the questions of measuring the supply chain relationship quality by four sub-dimensions (trust, co-operation, communication and commitment) to measure the relationship quality between Kimadia and its suppliers, whereas, the third part is dedicated to measuring the supply chain risks by three sub-dimensions (supply risks, demand risks and inventory risks) in whole pharmaceutical supply chain as shown clearly in Figure 8 earlier.

Table 15. The dimensions of the study in the questionnaire

The main dimensions	The sub-dimensions	The question sequence in the questionnaire	The question sequence in the text of study
Supply chain relationships quality	Trust	1-3	X1-X3
	Co-operation	4-6	X4-X6
	Communication	7-9	X7-X9
	Commitment	10-12	X10-X12
Supply chain risks	Supply risks	13-15	X13-X15
	Demand risks	16-18	X16-X18
	Inventory risks	19-21	X19-X21

Source: Author's own

The questionnaires were distributed to Kimadia and Diyala health institutions but for health institutions, just the supply chain risks dimension was in the questionnaire because they do not have relationship with suppliers just Kimadia, and they are linked centrally with them according to the Iraqi health system. Therefore, the researcher saw there was no need to ask them about the supply chain relationship quality dimension because only Kimadia can deal with pharmaceutical suppliers, and through health institutions, we can measure the supply chain risks in their area.

The supply chain relationship quality dimension and its sub-dimensions were constructed based on the questionnaire of FYNES et al. (2005a) and AL-ANI and AL-OMARI (2016) with simple modification to make it suitable for the current study, whereas, the supply chain risks and its dimensions were build based on several previous studies such as MANUJ and MENTZER, (2008), HO et al. (2015) and HASIJA et al. (2017).

In all measures of the questionnaire, the 7-point Likert scale was used from a strongly agreed phrase which took the seven weights to a phrase that strongly disagree that took one weight (strongly disagree = 1, Disagree = 2, Somewhat disagree = 3, Neutral = 4, Somewhat agree = 5,

Agree = 6 and Strongly agree =7). The seven scales were taken to give the responder more options to express his opinion (SEKARAN, 2003: 199).

3.3. The Questionnaire Tests

Several kinds of tests conducted on questionnaire after and before distribution as follows:

1. *Pre-tests of questionnaire before distribution:* The questionnaires were distributed to five experts to read them, to indicate their suitability and to add some amendments. The questionnaires were also presented to three managers, one in Kimadia and the two others in the health institutions for reading and indicating their suitability for the sample studied and all modifications were taken into account. As well as, the questionnaires were distributed two times to 6 directors in Kimadia and 10 directors in the health institutions in order to measure the validity of the questionnaire. The first distribution for the pre-test questionnaire was from 2nd - 5th of October 2017 and the second pre-test distribution was 6th- 8th of November 2017 and the rate of corresponding in the result was 81% in Kimadia and 77% in the health institutions which mean that the validity rate of the questionnaire is high.

   The questionnaire was subjected to Cronbach's Alpha to measure the reliability of questionnaire as mentioned in Table 16 which shows the value of Cronbach's Alpha for each dimension.

Table 16. The value of Cronbach's Alpha for each dimension

Dimensions	The number of questions	Kimadia	Health institutions
		Cronbach's Alpha	Cronbach's Alpha
Supply chain relationship quality	**X1-X12**	**96%**	
Trust	X1-X3	58%	
Co-operation	X4-X6	70%	
Communication	X7-X9	63%	
Commitment	X10-X12	86%	
Supply chain risks	**X13-X21**	**89%**	**93%**
Supply risks	X13-X15	56%	61%
Demand risks	X16-X18	61%	65%
Inventory risks	X19-X21	65%	69%

Source: Author's own

The values of Cronbach's Alpha show the high reliability of questionnaire which is above 60% except (trust and supply risks) which belong to Kimadia questionnaire but the values near to 60%.

2. *The questionnaire tests after distribution:* The researcher was keen to obtain questionnaire with full answers from the sample of the study and then restore them without any interference except in the case of clarification and remove misunderstanding of the questions. As well as, the statistical analysis has been conducted on the questionnaire by using SPSS version 21 software as clarified as follows:
   - Frequencies to show the rate of responses of the respondents.
   - Percentages to indicate the percentage of response to a given variable of the total answers.
   - Mean to display the average responses for a given variable.
   - Standard Deviation: The degree of dispersion of responses from its mean.
   - Correlation relationships to determine the nature of the relationship between variables.
   - Simple linear regression to determine the significance of the effect of independent variables on dependent variables.

3.4. The Study Boundaries and Limitations

The temporal boundaries of the study should be selected. Firstly, the study was conducted for the period from 01/07/2016 to 01/03/2018. The spatial boundaries of the study including the institutions in which the study has been conducted. The study was conducted on the Kimadia company and governmental health institutions in the Iraqi provinces.

The main challenges in this study that there are no previous studies in Iraq pharmaceutical supply chain according to the researcher information which doubled the efforts in achieving the current study.

During the study period, the researcher has faced some difficulties and limitations related to practical part in achieving this research. The first challenges were long administrative procedures to get agreements in order to distribute questionnaires to Diyala health institutions and some directors were hesitated to fill the form. In Kimadia, the first attempt was rejected to make interviews and distribute the questionnaires because they were hesitated, but the researcher tried again to get agreements and the data was collected after that by interviews and questionnaires.

The researcher could not get historical data from authorities about medicines and pharmaceutical supplies with respect to surplus, shortage, delay, expiration and quality problems because the directors rejected the request related to quantitative data, due to afraid of responsibilities. On the other hand, there was some random data published online by Office of Financial Supervision (OFS) in annual and quarterly reports which can support the interviews and questionnaires. Distribution the questionnaires to the other provinces health directorates was so hard because of the challenges of getting agreements and the distance, so the data was collected through some interviews and secondary data which founded online.

4. RESULTS

The main results of the current study have been founded by using three methods. The first method was making interviews with directors of Kimadia and health institutions to describe the Iraqi government pharmaceutical supply chain and understanding the nature of the pharmaceutical system and supply chain activities, to determine the main supply chain risks and knowing the main reasons behind the risks because of lack previous studies about the Iraqi pharmaceutical supply chain. The second method is based on the secondary data which were found in official reports about some problems in the Iraqi pharmaceutical supply chain which can assist to support the results of interviews and statistical analysis. The third method of getting results is the statistical analysis of the data which were gathered by questionnaire survey.

4.1. Analyzing the Iraqi Government Pharmaceutical Supply Chain

The governmental pharmaceutical supply chain in Iraq are represented by Kimadia and Health Institutions, therefore, several aspects related to the pharmaceutical supply chain are taken in this part such as the history of the state company for drug marketing and medical supplies (Kimadia) and Iraqi health institutions. After that, describe the nature of the relationship between Kimadia and suppliers, and Kimadia with health institutions. As well as, determine the strength and weakness of Kimadia; and clarify the supply chain activities in Kimadia and health institutions in details with focusing on the main risks in the supply chain activities. The main source of information of this part is interviews with the directors, as well as, some information online.

4.1.1. The State Company for Drug Marketing and Medical Appliances (Kimadia)

The state company for drug marketing and medical supplies (Kimadia), established in 1964, is one of the main strategic companies in Iraq which is wholly owned by the government. The main headquarter is located in Baghdad. It is governed by the general companies law No.22 of 1997 as amended and the rules of procedure NO.1 of 1999. It is managed by the board of directors, which consists of the general director chairman and eight 8 members, and it contains 17 departments, 4 divisions, 3 distribution centers and 5 warehouses in governorates as illustrated in Appendix 16.

According to interviews, the budget for Kimadia has been reached approximately between 1350 and 600 million USD in the period between 2012 and 2017. It is noted that the years 2016 and 2017 a sharp decline is witnessed in the budget allocated for purchasing medicines and medical appliances due to the economic crisis in the country as shown in Figure 9.

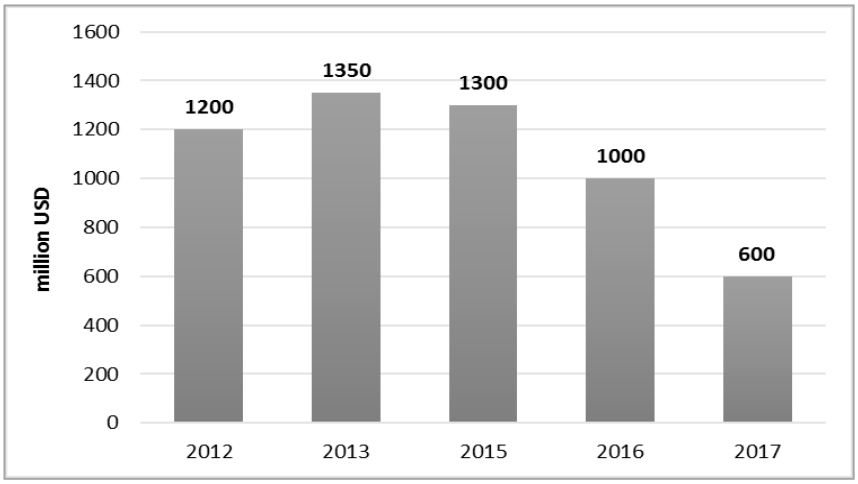

Figure 9. The budget of Kimadia (in million USD)

Source: Author's own

The Kimadia company is connected directly to the Iraqi health ministry. It contributes to support the national economy by providing all Iraqi health institutions both state and private sectors by medicines and pharmaceutical materials, laboratory materials, spare parts for medical and service equipment, and chemicals that are involved in preparing vaccines whether used for medical or other purposes by importing these materials from abroad or manufacturing it within the country and distributed to health institutions as illustrated in Figure 8 earlier (*KIMADIA | HOMEPAGE*, no date). As well as, the company has a role on developing medicines, medical supplies, vaccines at the local and international levels. Besides, they do a maintenance for medical and service equipment, and printing the reports of activities to serve needs of the company and health institutions related to the ministry of health.

4.1.2. The Governmental health institutions

The Iraqi health care system is a free central system financed by the government established in 1921, the government pays the price of medicines, medical supplies, doctors' salaries and hospital staff. The Iraqi health system consists of the Ministry of Health which is the top of the system, then, general directorates in all Iraqi governorates, which is the highest organizational unit in the governorate related to Ministry of Health. Hospitals, health sectors as well as specialized centers are linked to the general directorate in the governorate. The health sectors are the most health institutions distributed in a different geographic area and connected with many primary health care centers. There are public medical clinics, which provide health service in the same government health institutions but in out-working hours at low prices as shown in Figure 10, as well as, there is a private sector.

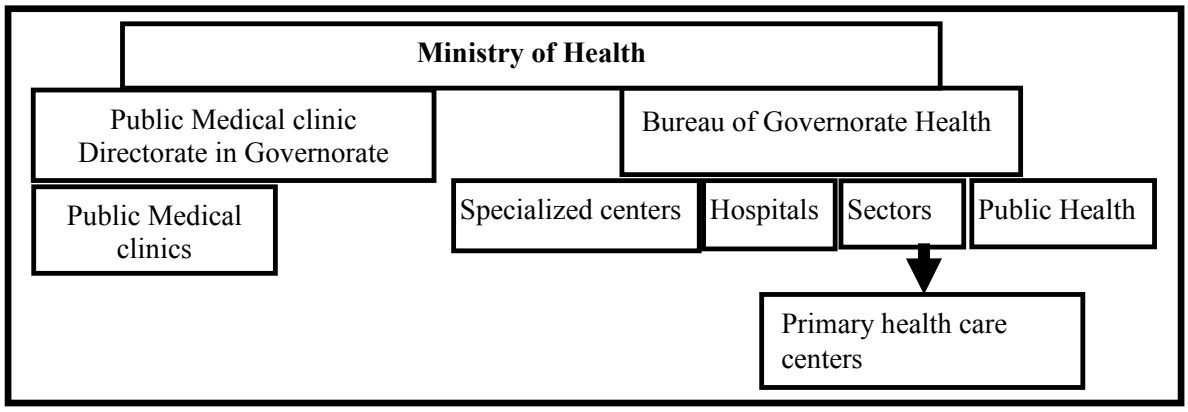

Figure 10. The hierarchy of Health System in Iraq

Source: Author's own

There is private sector as well separated from government health sector, but the government supervises it. This study focuses on government health sector. Table 17 shows the number of government health institutions in each province in 2014, in which Baghdad records the highest number of health institutions.

Table 17. Number of Hospitals, Public Medical Clinics and Other Health Institutions by Governorate for the Year 2014

Governorate	Public medical clinics	Other health institutions	Hospitals
Nineveh	31	266	18
Kirkuk	20	180	9
Al-Anbar	7	194	12
Diyala	13	104	9
Baghdad	69	437	85
Babylon	21	215	18
Kerbela	16	135	8
Wasit	12	127	8
Salah Al-Deen	9	168	12
Al-Najaf	14	174	13
Al-Qadisiya	12	162	10
Al-Muthanna	9	101	4
Thi-Qar	29	239	11
Maysan	14	140	6
Al-Basrah	27	248	19
Duhouk	20	-	22
Erbil	21	-	42
Al-Sulaimaniya	23	-	55
Total	***367***	***2890***	***361***

Source: Ministry of Health in Central Statistical Organization-Iraq

http://www.cosit.gov.iq/AAS2016/HEALTH&VITAL_STATISTICS/1A.htm

4.1.3. The relationship between Kimadia and suppliers

The nature of the company relationship with the suppliers is short-term and does not depend on the principle of partnership. It is possible to change the supplier after each transaction. In addition, there is no data exchange regarding inventory and demand forecasting only formally for contracting and transactions. Therefore, the relationship based on arms-length which depends on low price with taking the quality and essential other requirements into account.

The transactions can happen every year by announcing the deal to suppliers after that the suppliers submit their bids to the company and then the bids are opened by a special committee, which is studied carefully to choose the appropriate tender for the company. After selecting the appropriate tender for the company, the committee will examine the samples of the transaction that will be chosen if it meets the specifications. All these procedures need very long time which might need more than one year. So, the company asks the health institutions, which are committed with the company according to government legislation, to send their needs for specific year earlier at least they start two years before, for instance, the health institutions have to send their needs for 2019 beginning of 2017 to finish all procurement procedures such as the announcement of tenders, contracting of suppliers and checking of goods etc. which need a long time. In the researcher viewpoint, the procurement process has faced several:

1. The company deals with many suppliers to provide medical supplies and drugs, which leads to long process in each transaction because of new procurement procedures each time such as checking the goods, choosing suppliers, etc.
2. The company adopts the government policy in selecting suppliers, which depends on the political, and financial situation can affect the company strategies.
3. Dealing with different suppliers each time can affect material flow especially in emergency situations.
4. Dealing with many suppliers, lead to purchasing a huge amount of materials consequently, high inventory levels which increase the inventory fluctuation in supply chain like surplus and shortage.

Regarding communication, the company does not have communication with suppliers just formal communication when they want to make a transaction which means there is no information sharing about inventory status or consumption. As well as, there is no co-operation to put unified strategy with suppliers even there is no coordination between them.

4.1.4. The relationship between Kimadia and the health institutions

The company under study and health institutions in all Iraqi provinces are related to the ministry of health. All kinds of medicines and medical materials are provided to all Iraqi health institutions by Kimadia according to government rules. The government health institutions are committed with the Kimadia to get all their pharmaceutical needs according to government regulations. There is cooperation with respect sharing risk and needs estimating between Kimadia and health institutions. There is also information sharing with regards needs estimating in both annually and monthly for a specific year but this occurs two years before the date at which the company starts contracting with suppliers but there is no information sharing with respect to inventory levels and consumption.

4.1.5. Strengths and weaknesses of Kimadia

Being the only company to provide health institutions with medicines pharmaceutical materials in Iraq, it is necessary to diagnose strengths and weaknesses of the company under study. The company's strengths can be described as follows:

1. The only company that provides all health institutions in Iraq with medicines and medical supplies.
2. The drug is an essential commodity and the demand is high always.
3. Availability of qualified staff at the company.
4. Good geographical location in the center of Iraq.
5. The company is the only state company in this field in Iraq. Therefore, it has a strong negotiating position.

Whereas, the company has experienced some problems which pose weaknesses, which can cause some fluctuated in the pharmaceutical supply chain, these problems are:

1. Importing most medicines from suppliers abroad, so, they use annual purchasing method which causes some variability in inventory.
2. There are no long-term relationship and commitment with suppliers.
3. Complicated administrative procedures for the purchase of medicines, which need a long time.
4. Adhering to central administrative procedures for importing medicines.

4.1.6. The main Iraqi pharmaceutical supply chain activities

In this part, main activities in Iraqi pharmaceutical supply chain are illustrated to give an idea about the mechanism of supply medicines and pharmaceutical supplies through which the problems can be diagnosed. The activities are Demand forecasting/needs estimating, procurement, inventory management.

4.1.6.1. Demand forecasting/Needs estimating

The company asks the health institutions to send their needs early, which start two years before, for instance, the health institutions, have to send their needs for 2019 at the beginning of 2017 in order to start the procedures of purchasing which needs more than one year. Need estimating depends on the previous year spending and taking population growth into account by adding 10% to next order.

Each institution has to estimate its needs and send it to the higher authority in the supply chain as it was shown earlier in Figure 8. For example, the drugs stores of hospitals and health sectors have to send their needs to the main pharmaceutical department of health governorate in the province, which in turn consolidates the needs estimating of the health institutions in the province and send them to the committee of needs estimating in the ministry of health which in turn send them to Kimadia which in turn starts the procurement procedures with suppliers.

The steps of needs estimating are:

- A file printed on a hard disk containing specific items is sent by the department of needs estimating in the ministry of health to health directorates of provinces which in turn send it to hospitals, health sectors specialized health centers in order to estimate annual needs.
- Hospitals and health sectors form committees called the Needs Assessment Committees consisting of Director of the hospital or health sector, Department managers and Director of the Pharmaceutical Division, after completing their needs estimating, they will send the report needs estimating to the pharmaceutical department in health directorate.
- The Pharmacy Division of the Department of Pharmacy in the Governorate consolidates the needs and discusses them with the Needs Assessment Committee in the Ministry of Health.
- Held a meeting between the needs estimating divisions of provinces with the main needs estimating committee in the ministry of health headquarter in order to modify and discuss needs estimating before sending to Kimadia.
- Then the needs estimating will be printed on a hard disk and send to Kimadia to start contracting with the suppliers.

4.1.6.2. Procurement

The State Company for Drug Marketing and Medical Appliances is concerned with importing medicines, vaccines, medical supplies and, laboratory equipment and materials. This is done through the departments concerned (importation of medicines, import of medical supplies, engineering import, laboratory division). The contracting takes about one year from arriving needs and requirements then signing the contract and provide the materials to the health institutions. The procurement procedures are illustrated in 23 steps as the following:

- Receiving the needs of materials, whether (drugs, equipment, laboratory materials) from the Department of Technical Affairs, and vaccines from the Department of Health Public
- Receiving the estimated cost of the above materials from the same authorities above.
- Receiving clear technical specification for materials for the purpose of attaching them when declaring needs.
- Determining the declaring mechanism of materials by Kimadia as the following: Public announcement, Direct invitations and Direct purchase method, especially from national factories.
- The period of public invitation is 10-60 days and the period of direct invitation is 7-14 days. These invitations include the conditions, instructions stipulated in the instructions of contracts implementation and all other laws and regulations in force.
- Offers are received from foreign, Arab and national companies by the receiving committees specially formed for this purpose by members of different specialties.
- The offers received shall be referred to the study and analysis committees of the presentations, which shall be renewed annually and consist of members from various specialties.
- The offers received shall be studied and conformed for the legal conditions, the existence of official authorization, certificates of incorporation, final accounts and certified certificates of the product from companies participating in the openings and acceptance of offers through completion and acceptance and then analyze the offers received.
- In terms of medicines, the offers are analyzed based on their comparison with the estimated cost prices, the position of the companies on registration, their classification (whether required by Brand or Generic companies), and comparison of the prices of companies for each item, and compare them with the prescribed standard for the substance issued by the National Drug Selection Committee.

- In terms of medical equipment or devices, the offers are analyzed based on comparing them with the estimated cost and correspond it with the technical specifications. In addition, the item must be submitted when the offers are received and sent to the laboratory or clinical evaluation. The technical committees formed by the doctors of consultants are competent in these subjects and this committee is part of the original study committee.
- The referral is recommended by the concerned study committees and submitted to the import committee in Kimadia.
- The Importation Committee shall approve the recommendations submitted in the event that they conform to the contexts and controls and shall be returned to the study committees which shall, in turn, refer them to the concerned department.
- The import committee in Kimadia can approve the material that cost less than 10 million dollars, whereas the material which cost more than that shall be submitted to the approval committee of the central ministerial contracts.
- The import department is responsible for preparing a referring fax to the supplied company. It will be delivered by email and delivered to the representative of the company in Iraq by hand.
- In the case of getting an answer from an equipped company with approval, the contract procedures shall be started, which includes all the conditions which are already mentioned in the tender or direct invitation with details of materials, scheduling of the shipment, and the details of banking information of supplied companies. All these procedures should be within 14 days.
- In the event of objection by the supplier on the condition of referring or assigned price, the objections shall be studied and decided by the concerned department or referred to the study and analysis committee again or the legal department or the import committee to make a decisive decision either for the benefit of Kimadia or for the benefit of the equipped company.
- The contract shall be delivered to the supplier for the purpose of signing and stamping it by the company supplied exclusively and shall be returned to Kimadia within 15 days accompanied by a performance guarantee equal to 5% of the value contract, which must be submitted within 21 days before the signing of the contract by Kimadia.
- After the contract is signed by Kimadia, it will be submitted to the Ministry of Finance by the financial department of our company for the purpose of obtaining the financial allocation in this contract. these procedures take about 3-6 weeks depending on the availability of the allocation in the Ministry of Finance.

- After the receiving the financial allocation and transfer it by the Ministry of Finance to the Trade Bank of Iraq (TBI) and receiving the guarantee of good performance which mentioned in paragraph (17) earlier, the Department of Appropriations in Kimadia start opening accreditation.
- The bank shall notify Kimadia about the opening of credit and provide Kimadia with the opening telegram and the date of notification of the bank of the equipped company in order to notify the companies of this. The standard time for this process is 3-4 weeks in the event of absence any problems related to guarantee of good performance and intermediary banks.
- After informing the supplier to open the accreditation, the company manufactures and ships the materials during the time periods mentioned in the contracts, which vary according to the type of material, manufacturing time and shipping, as agreed in advance in the preparation of contracts.
- The warehouses of Kimadia shall be notified of the expected dates for the arrival of the first shipment of the contract, preparing the customs facilitation letters and the tax exemption for these contracts and materials, as well as informing the health institutions regarding equipment requiring special places to prepare places for installing.
- The import departments should release the suppliers' receivables after arriving and success the shipment in the evaluation, as well as follow up the position of the failed materials in the evaluation and follow up the compensation of the materials that expire and the reasons for that (*Kimadia | Homepage*, no date).

4.1.6.3. Inventory management

The company manages inventory by using annual purchasing method based on the budget allocated by the government treasury for each year. The company has a strategic inventory in its warehouses to face unexpected situations.

With respect to health institutions inventory management, the main drug store of health directorate takes the monthly share from the company warehouses which in turn provide the drug stores of hospitals and sectors with their monthly share and they, in turn, distribute it to the health institutions related to them. There is also a possibility for health institutions to ask extra materials in case there are essential needs.

Sometimes, health institutions get the share for two or three months especially when there is a delay in procurement procedures or shipment.

But in general, there is no fixed way to manage the inventory due to fluctuated inventory in the company warehouses and length of procurement procedures which lead to delay in arrival some materials.

The distribution of medicines and pharmaceutical supplies start after arriving at the Kimadia's warehouses, and the main health departments in the provinces will be informed to receive their shares and in turn, distribute the goods to the other health institutions according to the chain hierarchy.

The steps of distributing the medicines and pharmaceutical materials as the follow:

- The company's warehouses inform all main drug stores in the provinces to receive the share of all health institutions in the province.
- The main drug store in province inform all hospitals, specialized centers and sectors drug stores in the province to receive their planned share.
- The hospitals' drug store provides the pharmacies belong to a hospital which are almost three pharmacies (emergency, inpatient, and outpatient).
- The drug stores of sector inform all primary health care centers in the province to receive their share all steps above are illustrated in Figure 8.

4.1.7. The types and reasons of Iraqi pharmaceutical supply chain risks

This section describes the possible supply chain risks, which related to supply, demand and inventory, according to the viewpoint of the directors who work in the company and the health institutions. This chapter is for determining the main reasons behind these kinds of risks according to previous studies in this field, then how do the company and health institutions mitigate these risks, finding suitable remedies to avoid risks and what are the obstacles that prevent implementing some of these remedies in current situation as following illustration:

4.1.7.1. The types of supply chain risks from the Kimadia's directors' viewpoint and the causes

According to the interviews, which conducted with the directors who work in the company under study the types of supply chain risks are summarized. The directors who work in the health institution were involved to clarify the problem of inaccurate needs estimating because they have a role in this activity. The following problems were diagnosed in Kimadia:

1. *Demand forecasting / Needs estimating:* there is inaccurate needs estimating which cause surplus, shortages and expiration in medicines and pharmaceutical supplies in Kimadia warehouses for many reasons:

- The company asks health institutions to estimate their annual and monthly needs, each institution according to their location. They have to estimate needs two years earlier for a specific year as mentioned before. Health Directorate in each province unify needs of all health institutions in the province then send them to the company which in turn unify all provinces health institutions need to start purchasing procedures and there is an inaccurate due to a long time for estimating.
- It is known that the pharmaceutical supply chain deals with many medicines and medical supplies, and their demand varies from year to year and from season to season, and the prevalence rate of diseases varies from year to year. Therefore, the demand for some drugs is highly volatile.
- The lack of an integrated electronic data exchange system linking the health institutions with each other and the equipped company where all the procedures are done through the official letters, making it difficult to follow the consumption accurately by the authorities.
- Even in the case of reliance on the consumption of previous year to estimate their needs, they might have a shortage in the previous year because the supplied company did not provide them in sufficient quantities, therefore, the estimate will be based on personal experience because of lacking knowledge of the actual consumption of previous.

2. *Lead time:* The procedures are long due to following:

- Selecting suppliers and contracting annually as well as the procedures of checking medical materials need a long time because there is no long-term commitment between company and suppliers
- Centralized procurement and length of administrative procedures
- They do not use modern technologies such as electronic data exchange and other electronic systems that facilitate procurement procedures like contracting
- Lack of coordination mechanism or cooperation with suppliers
- The location of suppliers has a role in this case due to most suppliers are abroad.

3. *Delay arrival time of materials:* Delays in shipping occur due, inter alia, delayed materials in the port, delays in material inspection and other cause sometimes due to an inefficient

supplier to deliver the materials on time. As well as, it might happen due to delay in procurement procedures.

4. *Surplus and shortage in inventory:* The reasons behind the surplus are the

- Lack of precision in needs estimating as mentioned earlier,
- Adopting the policy of keeping high inventory levels to avoid out-of-stock cases,
- Long lead time, and
- Delay the arrival of the first shipment and arrive the second shipment in the same period, which leads to the accumulation of materials and the impossibility of disbursement.

The shortages in medicines can happen due to:

- Delayed material arrival
- Lack of financial allocations
- Epidemics and
- Other emergencies related to security conditions and war.

5. *Expiration:* Expiry occurs as a result of the surplus because of poor of monitoring of inventory and consumption in the supply chain. As well as, long procedures to inform authorities which in turn inform the other health institutions that there is a surplus pharmaceutical supplies and medicines if they in need of it. Therefore, the authorities have extended the period of reporting about surplus from six months till nine months before expiry date.

6. *Long administrative procedures:* long administrative procedures to report about product quality problems, inventory situation and consumption between the company and the health institutions due to using official letters sending manually which need a long time to arrive all health institutions in the supply chain.

7. *Quality of product:* It can happen rarely, the supplier responsible for it and the supplier will afford all cost related such as products, administration and logistics costs. The problem might occur as a result of poor selection of the supplier which can be affected by personal tendencies.

4.1.7.2. The types of supply chain risks from the health institutions' directors' viewpoint and the causes

1. *Demand forecasting / Needs estimating:* This problem can be happened due to inaccurate needs estimating as mentioned in detail earlier.
2. *Lead time:* The lead time is a bit fluctuated because the company sends the share monthly but sometimes there is a delay in receiving share due to some problem related to the company, so, they send a share for two months or more.
3. *Delay arrival time of materials:* this is related to the company situation and its suppliers which mentioned earlier.
4. *Surplus and shortage in inventory:* surplus can happen because of several reasons as follows:

- Inaccurate needs estimating.
- The company might send an extra amount of medicines or pharmaceutical supplies, which is overstock in their warehouses or the expiration date is close to finishing to health institutions in order to dispense it for patients.
- In the case of a doctor specialized in a particular specialty in the health institution, the health institution will send their need of medicines and pharmaceutical supplies related to the doctor's specialty and the needs estimating occur two years earlier before the specific year and the doctor might move to another place and there is no doctor can occupy this place for long period to use or dispense these medicines and pharmaceutical supplies, so, the medicines and pharmaceutical supplies will be surplus.
- Some cases related to security situation as happened with some cities in Iraq after 2014, where three provinces came out of government control while the company contracted with suppliers before the accident and the needs of the provinces were bought, which led to the emergence of a large surplus medicines and pharmaceutical supplies.
- As well as, there are weakness in the reliability of the supplier in the delivery of required quantities which lead to exaggerating estimated quantity of pharmaceutical supplies and medicines by directors of health facilities because they think that this way will help them to get quantity they aspire to obtain even in the case of the company cannot provide it fully but the problem occurs when company provide them full estimated quantity and sent to the requesting authorities, leading to a big problem occurs because of excess quantities.

The shortages might happen due to lack of financial allocations and matters related to the company's status as mentioned earlier or occurrence emergency events such as a pandemic, disease or security conditions

5. *Expiration:* It occurs rarely but if it happens can be due surplus which mentioned earlier might lead to expiration especially when the authorities sending an extra amount of medicines and pharmaceutical supplies and the expiration date is close to finishing before dispensing it to patients. Another reason that may happen is due to employee negligence because of invisibility in the store.
6. *Long administrative procedures:* because of using official letters sending manually to report authorities which need time to arrive and reply.
7. *Quality of product:* there are a few cases related to medicines quality. The first-tier supplier responsible for it.
8. *The other reasons:* the medicines and pharmaceutical supplies might be damaged due to warehousing situation in some small primary health care centers especially in villages or small towns because of fluctuation of electricity, especially in the summer when the temperature is high which reach up to 50 centigrade on some days and they cannot operate generators for long time in case of power outages.

4.1.8. Reducing risks at Kimadia and health institutions

After reviewing the problems and risks facing the Iraqi pharmaceutical supply chain represented by Kimadia and health institutions, it is necessary to know the mechanisms used by health institutions to reduce the potential risks, which are summarized below:

1. *Long lead time:* the company follows annual purchasing and the lead time of pharmaceutical supplies and medicines are long as mentioned and they keep high inventory levels to deal with this problem. So, the health institutions don’t have problem with lead time because the company responsible to provide them with their needs monthly but there are some problems occur when the warehouses of the company is empty due to some reasons related to company such as delay contracting or financial crisis. In this case, the health institutions can help each other by asking another health institution in the same province or the other provinces if they have extra medical supplies to send it to the health institution in need of it.

2. *Surplus and shortage problem:* In the event of the surplus in the company's stores, the company pushes the excess quantities to the health institutions to use it as much as they can before the end of the validity date but sometimes the health institutions do not accept if they do not need it which cause overstock in the company's warehouses.

   With respect of surplus in health institutions, they have to inform the higher authorities at least six months before medicines expiry date, but recently this process has been changed to nine months. This change was implemented due to the long administrative procedures about the excess quantities for the purpose of announcing the surplus quantity by sending an official letter to the other health institutions within governorate whether they need or not. In addition, they shall transfer the medicines if it is needed, otherwise, the main pharmaceutical department in the governorate has to report other health institutions of other governorates if there is a need or not for the medicines to take the necessary measures.

   In case of shortage, the company has a flexibility to provide health institutions with extremely important medicines and medical materials if there is a shortage in. Another way to face this case, inform all health institutions within the governorate to inquire whether the required material is available in their stores or not. If the required material is not available within the governorate, other health institutions will be reported in other governorates. As well as, if there is a shortage, the health institutions can buy some kinds of medicines from the private sector if there is an urgent need but not always.

3. *Expiration:* A follow-up committee is formed to diagnose the causes and whether the medication or pharmaceutical supplies were reported at least six months but (recently has changed to nine months) before the expiration date or not. In the case of informing the authorities on the specified date (as mentioned in dealing with surplus), it will be sent to the competent authorities to discard the medicines and pharmaceutical supplies, but in case of default, the employee will be responsible for that according to regulations and laws related.

4. *Quality of product:* In case of any problem in the quality of medicine in any health institution, it must inform the highest authority in the province, which in turn informs all health institutions within the province to stop using this kind of medicine and send a report to the Ministry of Health to inform other health directorates in the other provinces, to inform their health institutions to stop using this medicine until check the quality. The supplier responsible for compensation the medicine and afford all costs related to administrative and logistics activities according to the contracting instruction of the company.

5. *Warehousing:* the ministry of health tries to avoid this problem by distributing refrigerators which run on solar energy, oil or gas to some primary health care center in the cities which have a fluctuating electricity to avoid the problem of warehousing. As well as, using special kind of refrigerators which stay cold for a long time if there is no electricity.

4.1.9. Findings of the relationship between the study variables according to interviews

After analyzing Kimadia and health institutions and their supply chain activities, the problems in the supply chain activities were discussed and how the Kimadia and health institutions deal with the problems. There are several issues have been indicated, the relationship between Kimadia and their suppliers, because of the use of arm-length relationship, which means the main important thing is the price and there is no long-term relationship or commitment with the players. This relationship type lead to renew the contract every year and companies change their supplier every year if there is no agreement about the price or quality according to the financial policy situation of Kemadia. This affects negatively the supply chain activities such as inaccurate demand forecasting/needs estimating, long procedures of procurement and variability in inventory management. It shows that the *hypothesis H1* "There is a significant relationship between supply chain relationship quality (trust, co-operation, communication, and commitment) and supply chain risks (supply risks, demand risks, and inventory risks) in the pharmaceutical supply chain" *is accepted.*

It also was noted that any problem in the supply chain activities could cause lots of waste in the supply chain. For example, if the demand forecasting of medicines and pharmaceutical supplies is inaccurate, it can cause surplus or shortage in medicines and pharmaceutical supplies which might lead to expiration or damaging the quality of health service. The complicated procedures of procurement create many problems in the pharmaceutical supply chain such as surplus, shortage, expiration, and delay in medicines and pharmaceutical supplies because of purchasing a huge amount annually. It also causes an inaccuracy to estimate needs and increase the inventory costs, which leads to the increase of pharmaceutical supply chain risks and adding some kind of waste in the pharmaceutical supply chain (for example in transportation, waiting, inventory, extra-process). These findings *support the hypothesis H5* "there is a relationship between the pharmaceutical supply chain activities (i.e. demand forecasting / needs estimating, procurement and inventory management); and the supply chain risks".

The inventory risks such as surplus, expired and damaged medicines push the authorities to investigate these problems and select who is responsible about it. This will mean extra-process

and work such as the formation of committees, transfer the surplus to other health institutions or urgent orders if there is a shortage. Whereas, shortages and delay in receiving the pharmaceutical supplies may cause other kinds of waste in transportation, waiting and extra-processes. Thus*, the hypothesis H4* "there is a relationship between supply chain risks and wastes in the pharmaceutical supply chain" *is accepted*.

4.2. Cross Checks of Primary Research Results and Official Reports Data

In this part, additional information is given based on the annual reports of Office of Financial Supervision (OFS), which has the power to access most of the information in the government's ministries and institutions, official website pages or other reports. The assessment of these reports could support the interviews and questionnaire results, because I could get real quantitative data which shows the problems of Iraqi pharmaceutical supply chain clearly. In these reports, such data were found which show the amount of surplus, shortage and expiration medicines and pharmaceutical supplies and some other problems related to delay and supplier obligations. This information can be considered as a small window to see the reality in the Iraqi pharmaceutical supply chain because these reports cannot discover all the problems pharmaceutical supply chain in Iraq.

4.2.1. Introduction of the Official Reports

The reports have been discussed according to the information which were collected from interviews and questionnaire which describe the current situation of Iraq pharmaceutical supply chain. The following 12 reports were assessed:

1. Annual Report for 2008 Prepared by (OFS)
2. Annual Report for 2011 Prepared by (OFS)
3. Annual Report for 2012 Prepared by (أرنست ويونغ, Ernst & Young)
4. Fourth Quarter Report for 2014 Prepared by (OFS)
5. First Quarter Report for 2015 Prepared by (OFS)
6. Second Quarter Report for 2015 Prepared by (OFS)
7. Fourth Quarter Report for 2015 Prepared by (OFS)
8. First Quarter Report for 2016 Prepared by (OFS)
9. Second Quarter Report for 2016 Prepared by (OFS)
10. Fourth Quarter Report for 2016 Prepared by (OFS)
11. First Quarter Report for 2017 Prepared by (OFS), and
12. Third Quarter Report for 2017 Prepared by (OFS)

The reports above are detailed and analyzed in the next part of the chapter.

1. Annual Report for 2008 Prepared by Office of Financial Supervision (OFS)

There is a shortage in some kinds of medicines whereas there is a surplus in other kinds of medicine due to sending it by the company to the health institutions without needing for it **(**OFS, 2008: 81)

2. Annual Report for 2011 Prepared by Office of Financial Supervision (OFS)

Several problems have been founded in this report as following**:**

- There is a shortage of medicines and pharmaceutical supplies because hospitals are not equipped with insufficient quantities comparing with annual needs in many provinces such as (Baghdad- Al-Rusafa, Kirkuk, Basrah, Muthanna, Salaheddine, Babylon, and Ninevah), which requires the health departments to coordinate with the General Company for the Marketing of Medicines and Medical Supplies on this matter.
- There are surplus medicines for hospitals needs and in large quantities e.g. (Baghdad Health Department / Basra Health Department). The necessary procedures have not been taken in relation to transfer them to other health institutions to use them.
- There are medicines and medical supplies that have expired or are close to expiry date in most hospitals. The necessary procedures have not been taken to disposal them until the date of preparation of the report, including the health department (Baghdad- Al-Rusafa, Basra, Diyala, Dhi Qar, Muthanna, Wasit.
- Huge amount of medicines and pharmaceutical supplies was expired in the warehouses of the company, its value in 31/12/2010 up to 34,683,000,000 dinars which equivalent about 28,000,000 USD.
- There is large quantity of medicines and pharmaceutical supplies in the Kimadia warehouses which is failed in the test without getting any compensation from equipped companies or withdraw it which occupied spaces in the warehouses.
- Using a kind of medicines at the Baghdad Teaching Hospital, which was supplied by Kimadia, despite the Ministry of Health has prevented its use because it is causing health problems.
- Return 1378 syringes which is used for treating cancer after using 1046 syringes to patients because they did not meet the required specifications.

- The quantities of radioactive iodine capsules were discarded during the year 2010 for non-use during the validity period, which cost between 31- 1043 USD per capsule (OFS, 2011: 32-33).

3. Annual Report for 2012 Prepared by (أرنست ويونغ, Ernst & Young)

The report was conducted to assess the risk degree in health institutions and Kimadia. Many risks were pointed related to inventory situation like surplus and expiration. The risk degree was very high related to inventory management because of the high quantity of surplus and expiration, for example, there was a huge quantity of expiration in the stores of the public clinics which cost about 649000 USD.

As well as, the company send some kinds of medicines and the expiry date is close to finishing which makes it difficult to transfer medicines and pharmaceutical supplies to other health institutions. In addition, the ministry of health force the health institutions to accept the medicines and pharmaceutical supplies, which is close to expiry date, from the Kimadia warehouses. All these reasons led to appearing expiry date in medicines and pharmaceutical supplies in the stores of the public clinics as shown in Table 18 (أرنست ويونغ, 2012, 173).

Table 18. The quantity and cost of expiry date medicines

Name of medicines	No. of tablets	Total cost of medicines in Iraqi Dinar	Total cost of expiry medicines in USD
Aldomet Tab.	7, 602, 330	438, 401, 030	365, 335
Becotide Inh	91, 960	304, 479, 560	253, 733
Mestinon Tab.	298, 950	35, 575, 050	29, 646
Total cost		778, 455, 640	648, 714

Source: ERNST & YOUNG ارنست ويونغ, (2012: 173)

4. Fourth Quarter Report for 2014 Prepared by Office of Financial Supervision (OFS)

It was indicated that there are expired medicines in the stores and pharmacies of some hospitals and health institutions as shown in Table 19.

Table 19. The quantity of expired medicines in health institutions for fourth quarter report in 2014

Name of health directorates	Health institutions	Name of item	Quantity
Diwaniya	Al-Salaahia primary health care center	Keflex Syrup	780 bottles
	Afik general hospital	Mycoheal Cream	2240
	Al-Shamia general hospital		30000 set
Muthanna	Al-Rometha general hospital	Tami flu	32510
	Al-Hussein general hospital		13000
Diyala	All health institutions	Nebenzin Nessel	16953 Vial
		scholine	9647 ampoule
	Baquba teching hospital	vlavli	3000 capsule
		Valium	12794 ampoule

Source: OFS, 2014d, 125

As well as, there were medicines and pharmaceutical supplies which are close to expiry date and it is surplus in the stores of some health institutions as mentioned in Table 20. That means that all of these medicines shall be compulsorily transferred to other health institutions after informing the official authorities. This means lots of extra processes and transportation costs, and of course it will raise management issues as well.

Table 20. The medicines and pharmaceutical supplies which is surplus and close to expiry date in health institutions for fourth-quarter report in 2014

Name of health directorates	Health institutions	Name of item	Quantity	Details
Babylon	Al-Hashmia hospital	combined pills / packet	1595	Surplus
		mini pills / packet	458	Surplus
		Contraceptive injections / packet	1400	Surplus
Baghdad	Alwasiti hospital	Face mask/ box	200000	Surplus
		Glucose salin/bottel	2200	Surplus and close to expiry date
		Ceftax vial mg1	1680	
Diyala	-	Condom/ pecies	700	Surplus and close to expiry date
		Cordaron/ ampoule	850	

Source: OFS, 2014d, 126

In addition, the report pointed that Kimadia did not notify the suppliers who were delayed for signing the contracts on time after the extension period as illustrated in Table 21.

Table 21. The period of delaying to sign the contracts by equipped companies in 2014

Contract number and Date	Contract cost/$	Period of delay/day
40/2014/113	574575	109
40/2014/75	3248100	73
40/2014/126	338701	57
40/2014/121	1951290	55
40/2014/81	909130	73
40/2013/966	441537	135

Source: OFS, 2014d, 126

The medicines, which were failed in the examination by Kimadia, were indicated in this report. The medicines which were sodium bicarbonate were sent to two hospitals and they stopped it and returned it later. The medicines quantity was 1132 bottles. The report also mentioned shortage in some kind of medicines and pharmaceutical supplies in health institutions such medical city in Baghdad. As well as, it was pointed that the medicines and pharmaceutical supplies, which were sent by Kimadia to Babylon Health Directorate, were failed in the laboratory examination later, the medicines and pharmaceutical supplies were used for two months after the examination results in Babylon health institutions due to notification delay as

shown in Table 22 which illustrate the supplied quantity and used quantity of the failed medicines and notification delay.

Table 22. The supplied quantity, used quantity and failed medicines with notification delay

Type of medicines	Supplied quantity	Used quantity	Remained and returned quantity	Consumption Rate of failed medicines	Received amount date	Results examina-tion date	Notify health institutions date
Clotrimazole 500 mg/ injections	2250	2173	77	97%	30/4 and 26/5/2013	3/7/2013	23/7/2013
Clotrimazole 100 mg/ injections	6642	4825	1817	73%	28/3 and 9/4/2013	16/5/2013	23/6/2013
Aspirin/ tablets	5252	502	4750	10%	12/9/2013	6/10/2013	2/1/2014
amoxil 125 mg/ bottles	16200	15630	570	96%	30/6/2013	30/5/2013	23/7/2013
sodium bicarbonate / bottels	4360	3833	527	88%	30/1/2013	5/5/2013	12/1/2014

Source: OFS, 2014d, 130

In addition, there was a shortage of some medicines in health directorate of Babylon comparing with the required quantity. In the Najaf health directorate, there was a delay to send some essential medicines by Kimadia which affected some patients. In Thi-Qar city there was shortage in some medicines such as Bacentantab 125 mg and 625mg; Soldina file 50mg and 25mg, Noradrenalin and Milrinone Ephedrine (OFS, 2014d).

5. First Quarter Report for 2015 Prepared by Office of Financial Supervision (OFS)

Delay some companies, which contracted with Kimadia, in supplying or achieving the contract of medicines and pharmaceutical supplies as shown in Table 23.

Table 23. Delay time to achieve contracts

Contract number and date	Implementing company	Nationality	Delay time/ day
(19/2014/34) On 29/5/2014	(ARD (unifert) SAL)	Lebanese	50
(95/2012/191 / R1) On 17/11/2013	Aicon	Swiss	159
(92/2013/37/1) On 16/6/2014	Aesculap AG	German	114
(40/2013/739)	F.HOFFMAN- La Rochr ltd	Swiss	53
(40/2014/18)	Sanofi	French	108
(40/2014/13)	ARD	Lebanese	162

Source: OFS, 2015a, 177

6. Second Quarter Report for 2015 Prepared by Office of Financial Supervision (OFS)

The report indicated a shortage in some essential and nonessential medicines and pharmaceutical supplies in the health institutions such as (Diyala health directorate and Al-Dewania health directorate). As well as, the company did not put some essential medicines on the essential list which cause a shortage in these kinds of medicines which is very important for patients. there was also an expiry date in some types of medicines and pharmaceutical supplies (OFS, 2015b).

7. Fourth Quarter Report for 2015 Prepared by Office of Financial Supervision (OFS)

The shortage in chronic diseases medicines was a shortage because of lacking in supplied quantities whereas, there was a huge quantity of expired medicines stacked in the stores of public clinics department for previous years. The health service was affected due lack in some kinds of medicines and pharmaceutical supplies which should be provided by Kimadia. With regards to Medical City, there was surplus medicines and pharmaceutical supplies in the stores which should be transferred to the other health institutions if they in need (OFS, 2015d).

8. First Quarter Report for 2016 Prepared by Office of Financial Supervision (OFS)

Delaying supplier to sign the contracting. The first contract 10 days and the other contract 20 days (OFS, 2016a: 133)

9. Second Quarter Report for 2016 Prepared by Office of Financial Supervision (OFS)

In this report, there are many observations that have been diagnosed regarding the performance of Kimadia and its suppliers, such as delaying suppliers in the signing of contracts reached 73 days for some suppliers as clarified in Table 24.

Table 24. Delay time to achieve contracts

Name of the company	Nationality	Delay time to sign the contract/ day
State company for drug manufacturing (Samarra)	Iraqi	16
Acai	Iraqi	58
Pioneer company for pharmaceutical industries	Iraqi	17
Al-Mansour Pharmaceuticals & Medical Supplies	Iraqi	73
medac Gesellschaft für klinische Spezialpräparate	German	34

Source: OFS, 2016b, 94

Kimadia contracted with some suppliers who have indicators of poor performance both in supplying or product quality and import drugs which have been produced since long time.

Contracting with intermediate companies which increase costs and make delays in the contracting procedures between Kimadia and the supplied companies for more than one year from the date of the declaration until the signing of the contract. Meanwhile, there is no reserve stock in the warehouses where the date of the declaration of one of the contracts was 3/9-23/9-2014 and was signed on 4/10/2015 and the date of the declaration of the contract. The other is 12/1/2015 and the date of the signing of the contract is 9/3/2016. Postponement of some shipments were made by Kimadia because there is not enough space to store it and this indicates not to take into account the inventory levels when contracting with suppliers. There are inaccurate needs estimating, and the poor coordination between the import department and warehouses in the company on the one hand and between the company and suppliers on the other hand. (OFS, 2016b, 94-104).

10. Fourth Quarter Report for 2016 Prepared by Office of Financial Supervision (OFS)

There is a deficiency for some medicines and medical supplies and shortage in the others in some health institutions which are essential for emergency cases.

The Babylon health institutions received medicines and pharmaceutical supplies even after the decision of stop using, which was returned from the Health Directorate of Babylon to Kimadia later, as well as, there is a delay in receiving the notification of stop using in the other cases as illustrated in Table 25.

Table 25. The supplied quantity and used quantity even after the stop using notification and delay in receiving the notification

Type of medicines	Supplied quantity	Used quantity	Remained quantity and returned	Received medicines date	The issue notification date of stop using
Gentadar eyedrop	11475	8961	2514	4/3/2013	25/11/2014
Ophtazolin Eyedrop(shafastine)	864	843	21	28/3/2013	13/4/2015
Sod.bicarbonate	660	532	128	2/4/2014	15/3/2014
Vitamin C	80000	60020	19980	17/11/2014	7/5/2015
EndotrachiaII tube	23690	11131	12559	7/2012 1/2013 3/2013 10/2013	25/1/2015
Sod-bicarbonate	200	93	107	23/10/2014	15/3/2015
SYnthamin with No: Out electrolyte B	525	245	280	2/3/2015	18/5/2014
Sod-bicarbonate	660	532	128	2/4/2014	15/3/2014

Source: OFS, 2016d, 61

There were also expired medicines which are about 108 items in different quantities in Babylon pharmaceutical department (OFS, 2016d: 60-62).

11. First Quarter Report for 2017 Prepared by Office of Financial Supervision (OFS)

There is a shortage in some kinds of medicines and pharmaceutical supplies due to the low share received or allocated.

12. Third Quarter Report for 2017 Prepared by Office of Financial Supervision (OFS)

There is a shortage for a long time for many medicines, laboratory materials, and medical supplies for hospitals despite the need of the hospitals, which reflected negatively on the medical services provided in the health directorates of (Babylon, Baghdad/ Al-Rusafa, Karbala and Medical City).

There are also some medicines expired or close to expiry date in Babylon health directorate and did not take appropriate measures to transfer them to other health institutions to use them.

As well as, the report pointed that there was quite a big amount of surplus medicines in Karbala health directorate and Baghdad / Al- Rusafa and did not take appropriate measures to transfer them.

With regard to Kimadia, the report mentioned that there has been a weakness in the procedures of the Kimadia during the contracting, storage and distribution stages, which led to existing large amount of medicines and pharmaceutical supplies that were damaged and expired in the Kimadia's warehouses for several previous years. The value of these products amounted to 98,000,000,000 Iraqi dinars which equivalent to 82,000,000 USD, for various types of medicines, including cancer, vaccines, heart disease, chronic diseases, and others (OFS, 2017c).

4.2.2. Data discussion on the previous Official Reports

Although the data obtained with respect to surplus and damaged medicines and other related problems, it does not reflect the real situation in the Iraqi pharmaceutical supply chain because the data and reports obtained reflect just a small percentage of what actually happens due to the reluctance of the official authorities to give data. So, the study was based only on which is disclosed in the reports of the Office of Financial Supervision as well as what is published in the official website of the Kimadia because there is no inventory management database. In this part, we clarify and discus the reasons which leaded to cause the identified problems and which kind of waste might be generated as results of the problems as follows:

1. Surplus, Shortage and Expiration

All the reports from 2008 to 2017 indicated a lack of certain types of medicines and other species surplus as previously indicated in the 2008, 2011, 2012, 2014, 2015, 2016 and 2017 reports, as shown as well in Table 20 and Appendixes 6, 7, 8, 9, 10, 11, 12, 13, 14 and 15, which is consistent with the personal interviews and questionnaire form indicating that there is a shortage of some types of medicines and surplus in others.

The surplus medicines should be transferred to the other health institutions which in need of medicines and pharmaceutical supplies according to government regulations. This means more administrative procedures, storage, and transport costs, thus increasing the cost in the supply chain, or it is liable to be expired in case there is no need to these kind of surplus as shown in Table 18, which refers to the costs of expired medicines, which reflect the large quantity of expiration. Table 19 indicates the presence of large amounts of damaged medicines and pharmaceutical supplies in the warehouses which worth millions of dollars and this means waste of public money, which can be used to buy important drugs or fill the shortage of other species.

The existence of surplus in medicines and pharmaceutical supplies mean more administrative procedures and the formation of committees to look for the default, if there are damaged medicines and waiting for the availability of medicine or if there is a shortage and increase transport operations, in order to transfer the surplus to the needy health institutions. Or, if there is need and increase the consumption of energy used for storage and thus increase emissions, which reflected negatively on the environment. As well as, damage to the interests of the people through the lack of the possibility of providing other essential medicines. The problems of surplus, shortfall and expiry of the validity period are due to inefficient procurement activity and existing inventory management systems Kimadia and health institutions because they depend on the annual contract and bulk purchases (DIAS, 2012) which leads to inaccurate needs estimation. This inaccurate estimation can occur due to fluctuation in demand and poor coordination between the parties of supply chain, weak transparency and length of waiting or inflexibility as stated in previous studies (LEE et al., 1997; CHENT et al., 1999; NIENHAUS et al., 2006; BALTZAN & PHILLIPS, 2009; RAHMAN et al., 2014; WANG et al., 2016; AUGUSTO et al., 2014; GOODARZI et al., 2017; CAO et al., 2017).

This means that there is a weakness in the efficiency of the Iraqi pharmaceutical supply chain, which stems from the weakness of the awareness of managers to modern administrative systems, which aims to avoid waste in all activities that do not add value and maintain a low stock level

by building strong relationships with all parties in the supply chain starting from suppliers to customers and commitment to a limited number of suppliers and an attempt to rely on local suppliers and thus to achieve the interests of all parties as stated in the studies (FYNES et al., 2005a; MOHAGHAR & GHASEMI, 2011; STEVENSON, 2012; HEIZER et al., 2017).

The shortages also cause more administrative procedures and urgent requests to compensate for the shortage, which is causing confusion in the work of health institutions as well as Kimadia. As for damaged products, committees should be formed to investigate the causes of the problem, in addition to accompanying administrative procedures and transport operations in order to transfer them to those responsible for their destruction, which requires additional operations and funds in addition to environmental impact. Table 26 shows the waste associated with excess, shortfall and expiry.

Table 26. The types of waste associated with the surplus, shortage and expiration in medicines and pharmaceutical supplies

Type of wastes / Problems of Ph.SC	Transport	Extra-processing	Inventory	Waiting	Defects	Energy
Surplus	*	*	*		*	*
Shortage	*	*		*		
Expiration	*	*	*			

Source: Author's own (Legend: Ph. SC refers to pharmaceutical supply chain)

As well as, this type of problem can be avoided through the use of the Vendor Managed Inventory (VMI), which can be implemented by building relationships with limited suppliers and complying with them and exchanging stock and consumption information using information technology (USAID, 2012), or the use of the continuous review system (DIAS, 2012. This requires suppliers who produce high-quality products in order to adopt the principle of quality at the source and not to spend a long time in inspection procedures, which increase the length of the waiting period and thus raise the level of safety inventory (STEVENSON, 2012; HEIZER et al., 2017).

2. Delay in shipment

The reports indicate that there is a delay in the completion of contracts, therefore delay in receiving the medicines and pharmaceutical supplies as in Tables 21, 23, 24, which corresponds to the information contained in the questionnaire and interviews. In the interviews, the officials interviewed said there was a delay in the completion of some contracts which leads to a defect in

the scheduling of shipping and the accumulation of some materials in the warehouses as a result of delay in the first shipment and synchronization of arrival with the second shipment and this indicates the inefficiency of some suppliers or the lack of cooperation of some others or because of repeated contracts and long and traditional procurement procedures annually. This affects negatively the availability of the needs of health institutions for medicines and pharmaceutical supplies thus adversely affect patients.

In order to solve the problem of delay, the company must select the suppliers whose products are characterized by high quality and depend on the quality at the source as well as, commitment to a specific number of suppliers, preferably local suppliers or to attract the pharmaceutical companies to the inside of the country for the advantage of Kimadia strengths and work with them or long-term contracts and coordination through data sharing to provide the needs of health institutions on time, quantity and cost.

The delay in arriving the medicines shipment on time can cause several wastes as shown in Table 27.

Table 27. The types of waste associated with the delay in medicines and pharmaceutical supplies

Type of wastes / Problems of Ph.SC	Transport	Extra-processing	Inventory	Waiting	Defects	Energy
Delay	*	*		*		

Source: Author's own

3. Quality of medicines and pharmaceutical supplies

Some previous reports indicated problems with the quality of some products as showed in Tables 22 and 25. This indicates the unreliability of some suppliers handled by Kimadia. This indicates either a weak relationship with suppliers or inability to choose the right supplier or decision-makers are influenced by personal preferences or personal relationships.

In order to avoid this situation, the conditions to be met by the supplier must be observed. That any problem with the quality of the product requires the return of all products from all health institutions in the country which cause extra administrative processes and transportation to return the failed goods to the main supplier to return the amounts paid or compensation, which leads to a shortage of medicines until the arrival of the new shipment. Table 28 reflects waste activities associated with product quality problems.

Table 28. The types of waste associated with the quality problems in medicines and pharmaceutical supplies

Type of wastes / Problems of Ph.SC	Transport	Extra-processing	Inventory	Waiting	Defects	Energy
Quality problems	*	*	*	*	*	*

Source: Author's own

4. Delay in information sharing (Communication)

The reports indicate that there is a delay in informing some health institutions about the failed medicines and pharmaceutical supplies despite the discovery early and the continued health institutions to use them even after the results of the examination as in Tables 22 and 25, which indicate the use of a high proportion of some medicines up to 97% for some of them despite the failure of the examination. The problem can happen as a result of weak communication and adopt traditional procedures by Kimadia and the health institutions, which need time to notify all health institutions and this also has serious damage to the health of patients to continue to use some failed medicines for a long period.

There are several kinds of wastes activities associated with delaying the reporting of failed medicines and pharmaceutical supplies, the most important one is affecting the health of citizens, which lead to the formation of committees to look for the person who responsible for that, which is accompanied by very large administrative procedures.

Therefore, the health institutions and Kimadia have to adopt the modern information technology systems such as (ERP, RFID) and linking all institutions with an electronic system for the purpose of raising transparency and reducing risks.

4.3. Statistical Analysis

The questionnaire has been used as a tool to collect data for statistical analysis, which is important to investigate the study hypotheses, by using the following analyses (with the number of subchapters):

4.3.1. Statistical description
4.3.2. Correlation and
4.3.3. Regression

4.3.1. Statistical description

In order to understand the responses of the study sample for each dimension of the research, the frequencies, percentages, mean and standard deviation (S.D.) were used. The supply chain relationship quality was measured by four main dimensions (Trust, Co-operation, Communication, and Commitment); the second main dimension was measured by (Supply risk, Demand risk, and Inventory risk). Therefore, this analysis shows to what extent the pharmaceutical supply chain of Kimadia has a relationship with the suppliers and which kind of risks they have and is there any possibility to transfer the supply chain risks of Kimadia to health institutions. so, it is necessary to clarify the supply chain relationship quality of Kimadia and the supply chain risks, as well as, illustrate the supply chain risks at health institutions as follows:

4.3.1.1. Statistical description of supply chain relationship quality in Kimadia

The supply chain relationship quality dimension including four sub-dimensions namely trust, cooperation, communication and commitment. The statistical description for mentioned variables as follows (in the tables questions "Qs." are indicated with "X1-21"):

1. Trust

Table 29 shows that there is consistency in the answers of the sample in question X1 and X2 which tends to disagree and with the mean (2.6) and (2.9) and standard deviation (S.D.) (0.54) and (0.66), which means there is a weakness in loyalty and mutual help with suppliers. The answers of X3 indicating the dispersion of the answers and with the mean (4) and standard deviation (S.D.) (1,06), which means that some suppliers are well-qualified while there is a weakness in the competence of other suppliers.

Table 29. Frequency, percentage, mean and standard deviation of Trust

Qs.	(1)		(2)		(3)		(4)		(5)		(6)		(7)		Mean	S.D
	F	%	F	%	F	%	F	%	F	%	F	%	F	%		
X1			18	42.9	23	54.8	1	2.4							2.6	0.544
X2			8	19	30	71.4	2	4.8	2	4.8					2.9	0.661
X3			2	4.8	15	35.7	8	19	15	35.7	2	4.8			4	1.06

Source: Authors' own based on SPSS results

2. Co-operation

Table 30 shows that there is a harmony in the answers of the sample in question X4 and X5 which tends to disagree and with the mean (2.29) and (1.76) and standard deviation (S.D.) (0.86) and (0.65), which means there is a weakness in cooperation to improve products quality; and production, demand and consumption planning. Whereas the answers of X6 indicating the dispersion of the answers and with the mean (3.98) and standard deviation (S.D.) (1.19), which means that some suppliers are able to deal immediately with the complains, whereas, there is a weakness of response from other suppliers.

Table 30. Frequency, percentage, mean and standard deviation of co-operation

Qs.	(1)		(2)		(3)		(4)		(5)		(6)		(7)		Mean	S.D
	F	%	F	%	F	%	F	%	F	%	F	%	F	%		
X4	9	21.4	14	33.3	17	40.5	2	4.8							2.29	0.86
X5	15	35.7	22	52.4	5	11.9									1.76	0.65
X6			3	7.1	18	42.9	1	2.4	17	40.5	3	7.1			3.98	1.19

Source: Authors' own based on SPSS results

3. Communication

Table 31 indicates that there is a harmony in the answers of the sample in question of communication X7, X8, and X9 which tend to disagree and with the mean (1.81), (1.81) and (1.76) and standard deviation (S.D.) (0.59), (0.74) and (0.65), which means there is a very weak communication with suppliers.

Table 31. Frequency, percentage, mean and standard deviation of communication

Qs.	(1)		(2)		(3)		(4)		(5)		(6)		(7)		Mean	S.D
	F	%	F	%	F	%	F	%	F	%	F	%	F	%		
X7	12	28.6	26	61.9	4	9.5									1.81	0.59
X8	16	38.1	18	42.9	8	19									1.81	0.74
X9	15	35.7	22	52.4	5	11.9									1.76	0.65

Source: Authors' own based on SPSS results

4. Commitment

The answers of X10 and X11 indicating the dispersion of the answers and with the mean (3.98) and (4.05) and standard deviation (S.D.) (0.97) and (1.1), which means that some suppliers deserve to keep the relationship with them and Kimadia is committed with some suppliers whereas, other suppliers do not deserve to keep the relationship with them. The X12 with the mean (2.55) and standard deviation (0.83) indicates there is no long-term relationship with all suppliers because Kimadia follows the government regulation and it can be affected by the political situation. See Table 32.

Table 32. Frequency, percentage, mean and standard deviation of commitment

Qs.	(1)		(2)		(3)		(4)		(5)		(6)		(7)		Mean	S.D
	F	%	F	%	F	%	F	%	F	%	F	%	F	%		
X10					20	47.6	3	7.1	19	45.2					3.98	0.97
X11			3	7.1	14	33.3	4	9.5	20	47.6	1	2.4			4.05	1.1
X12	5	11.9	13	31	20	47.6	4	9.5							2.55	0.83

Source: Authors' own based on SPSS results

4.3.1.2. Statistical description of supply chain risks in Kimadia

The supply chain risks dimension including three sub-dimensions namely supply risks, demand risks and inventory risks, so, in this part we will review and clarify the the statistical description for each variable as follow:

1. Supply risks

Table 33 indicates that there is a harmony in the answers of the sample in questions of supply risks X13, X14, and X15 which tend to agree and with the mean (5.69), (5.40) and (6.26) and standard deviation (S.D.) (0.83), (0.98) and (0.73), which means there is a risk related to supply medicines and pharmaceutical supplies because of long lead-time, delay in receiving and long purchasing procedures.

Table 33. Frequency, percentage, mean and standard deviation of supply risks

Qs.	(1)		(2)		(3)		(4)		(5)		(6)		(7)		Mean	S.D
	F	%	F	%	F	%	F	%	F	%	F	%	F	%		
X13									22	52.4	11	26.2	9	21.4	5.69	0.83
X14					4	9.5	1	2.4	13	31	22	52.4	2	4.8	5.40	0.98
X15									7	16.7	17	40.5	18	42.9	6.26	0.73

Source: Authors' own based on SPSS results

2. Demand risks

Table 34 indicates that there is a harmony in the answers of the sample in questions of supply risks X16, X17, and X18 which tend to agree and with the mean (6.40), (5.31) and (5.21) and standard deviation (S.D.) (0.66), (0.84) and (0.60), which means there is a risk related to demand medicines and pharmaceutical supplies because of inaccurate needs estimating, difficulties in facing urgent orders and there is no possibility to get all needs.

Table 34. Frequency, percentage, mean and standard deviation of demand risks

Qs.	(1)		(2)		(3)		(4)		(5)		(6)		(7)		Mean	S.D
	F	%	F	%	F	%	F	%	F	%	F	%	F	%		
X16									4	9.5	17	40.5	21	50	6.40	0.66
X17					1	2.4	4	9.5	21	50	13	31	3	7.1	5.31	0.84
X18					1	2.4			31	73.8	9	21.4	1	2.4	5.21	0.60

Source: Authors' own based on SPSS results

3. Inventory risks

Table 35 indicates that there is a harmony in the answers of the sample in questions of supply risks X19, X20, and X21 which tend to agree and with the mean (5.55), (5.29) and (6.52) and standard deviation (S.D.) (0.55), (1.1) and (0.50), which means there is a risk related to inventory medicines and pharmaceutical supplies such as surplus, expiration, and shortages. In X20 we can see a high rate of neutral responses because some responders afraid of responsibility.

Table 35. Frequency, percentage, mean and standard deviation of inventory risks

Qs.	(1)		(2)		(3)		(4)		(5)		(6)		(7)		Mean	S.D
	F	%	F	%	F	%	F	%	F	%	F	%	F	%		
X19							1	2.4	17	40.5	24	57.1			5.55	0.55
X20					4	9.5	6	14.3	10	23.8	18	42.9	4	9.5	5.29	1.1
X21											20	47.6	22	52.4	6.52	0.50

Source: Authors' own based on SPSS results

4.3.1.2. Statistical description of supply chain risks in Diyala health institutions

In this part, the frequencies of questionnaires which distributed to the directors in Diyala health institutions will be clarified to illustrate the supply chain risks. These risks are represented by Supply risks, Demand risks, and Inventory risks, in order to show to what extent the supply chain risks are founded in the health institutions and show if it is possible to transfer the risk from supplier to customers as follows:

1. Supply risks

Table 36 indicates that there is a harmony in the answers of the sample in the question X13 which shows a high rate of disagree and the mean is (1.81) with standard deviation (0.67), which means that there is a suitable lead time for health institutions to get medicines and pharmaceutical supplies. Whereas there is a fluctuation in time delivery of medicines and pharmaceutical supplies as shown in the rate of agreeing of X14 which is (79.6) and the mean is (5.21) with standard deviation (1.04). In the X15 the rate of strongly disagree is (100%) they choose that because they are not responsible for buying medicines and pharmaceutical supplies which are provided by Kimadia and they can just buy a few urgent kinds of medicines.

Table 36. Frequency, percentage, mean and standard deviation of supply risks

Qs.	(1)		(2)		(3)		(4)		(5)		(6)		(7)		Mean	S.D
	F	%	F	%	F	%	F	%	F	%	F	%	F	%		
X13	14	33.3	22	52	6	14.3									1.81	0.67
X14					5	11.9	1	2.4	19	45.2	14	33.3	3	7.1	5.21	1.04
X15	42	100													1	0.0

Source: Authors' own based on SPSS results

2. Demand risks

Table 37 indicates that there is a harmony in the answers of the sample in questions of supply risks X16, X17, and X18 which tend to agree and with the mean (5.24), (5.43) and (6.19) and standard deviation (S.D.) (0.72), (0.50) and (0.67), which means there is a risk related to demand medicines and pharmaceutical supplies because of inaccurate needs estimating, difficulties in facing urgent orders and there is no possibility to get all needs.

Table 37. Frequency, percentage, mean and standard deviation of demand risks

Qs.	(1)		(2)		(3)		(4)		(5)		(6)		(7)		Mean	S.D
	F	%	F	%	F	%	F	%	F	%	F	%	F	%		
X16					2	4.8	1	2.4	24	57.1	15	35.7			5.24	0.72
X17									24	57.1	18	42.9			5.43	0.50
X18									6	14.3	22	52.4	14	33.3	6.19	0.67

Source: Authors' own based on SPSS results

3. Inventory risks

Table 38 indicates that there is a high rate agreeing on X19, X20 and X21 in the answers of the sample in questions of inventory risks and with the mean (4.95), (4.50) and (5.90) and standard deviation (S.D.) (1.05), (0.99) and (0.72), which means there is a risk related to inventory medicines and pharmaceutical supplies because of such as surplus, expiration, and shortages.

Table 38. Frequency, percentage, mean and standard deviation of inventory risks

Qs.	(1)		(2)		(3)		(4)		(5)		(6)		(7)		Mean	S.D
	F	%	F	%	F	%	F	%	F	%	F	%	F	%		
X19					7	16.7	3	7.1	17	40.5	15	35.7			4.95	1.05
X20					11	26.2	3	7.1	24	57.1	4	9.5			4.50	0.99
X21									13	31	20	47.6	9	21.4	5.90	0.72

Source: Authors' own based on SPSS results

After explaining the risks in Diyala health institutions, it can be said that the risks of supplier can transfer to the customers.

4.3.2. Correlations Analysis

The researcher seeks to verify the validity of research hypotheses related to the correlation between the research variables, which were formulated based on the problem of research and used Pearson correlation to test the correlation between the key variables and sub-variables to determine the relationship between the variables of research by using the statistical program (SPSS).

Based on the first main hypothesis, which states that there is a significant relationship between supply chain relationship quality (trust, co-operation, communication and commitment); and supply chain risks (supply risks, demand risks and inventory risks) in the pharmaceutical supply chain of Kimadia, Table 39 shows the significant correlation between the supply chain relationship quality and supply chain risks. The correlation coefficient between supply chain relationship quality and supply chain risks is (- 0.892**) which is significant at the (0.01) level which indicate that there is a significant and negative correlation of correlation, which provides a basis for accepting the first main hypothesis. The highest correlation value is between supply chain relationship quality and supply risks which is (- 0.828**) whereas the lowest one is between supply chain relationship quality and demand risks which is (- 0.727**).

The other correlation values indicate that there is a significant correlation between trust and supply chain risks can be clarified through correlation values which show that there is a significant correlation between trust and supply chain risks which is (- 0.812**) which is significant at the (0.01) level. The highest correlation coefficient recorded with supply chain risks (- 0.820**), whereas, the lowest one indicated with demand risks (- 0.603**).

The correlation values between cooperation and supply chain risks is significant. The correlation coefficient between the cooperation and supply chain risks which is (- 0.787**) which mean there is a negative significant correlation. The correlation coefficient between cooperation and supply risks is the highest which is (- 0.779**), whereas, the lowest correlation coefficient pointed with demand risks (- 0.584**).

The relationship between communication and supply chain risks has been indicated by correlation values (- 0.576**) which mean there is a negative significant correlation. The correlation coefficient between the communication and demand risks is the highest (- 0.584**), whereas, the lowest coefficient is recorded with inventory risks (- 0.463**).

The significant relationship between commitment and supply chain risks, proved by the correlation coefficient between commitment and supply chain risks which is (- 0.807**). the

highest correlation coefficient is between commitment and inventory risks (- 0.754**), whereas, the lowest is with demand risks (- 0.686**).

Table 39. Correlation coefficients of the study variables

SCR variables / SCRQ variables	Supply chain risks	Supply risks	Demand risks	Inventory risks
SCRQ	- 0.892**	- 0.828**	- 0.727**	- 0.793**
Trust	- 0.812**	- 0.820**	- 0.603**	- 0.702**
Co-operation	- 0.787**	- 0.779**	- 0.584**	- 0.699**
Communication	- 0.576**	- 0.489**	- 0.584**	- 0.463**
Commitment	- 0.807**	- 0.692**	- 0.686**	- 0.754**

Source: Author's own based on SPSS results

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Table 40 shows the significant correlation between supply chain relationship quality dimensions (trust, cooperation, communication, and commitment). The highest correlation coefficient between trust and cooperation which is (0.780**) whereas, the lowest value is between cooperation and communication which is (0.471**). So, the *second main hypothesis H2* "there is a significant correlation between the dimensions of supply chain relationship quality" is *accepted*.

Table 40. Correlation coefficients of supply chain relationship quality

	Trust	Co-operation	Communication	Commitment
Trust	1	0.780**	0.575**	0.684**
Co-operation		1	0.471**	0.703**
Communication			1	0.481**
Commitment				1

Source: Author's own based on SPSS results

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Table 41 shows the significant correlation between supply chain risks dimensions (supply risks, demand risks, and inventory risks). The highest correlation coefficient indicated is between

supply risks and inventory risks which is (0.734**) whereas, the lowest value is between demand risks and inventory risks which is (0.588**). According to results, *the third main hypothesis H3* "there is a significant relationship between the dimensions of supply chain risks (supply risks, demand risks and inventory risks)" *is accepted*.

Table 41. Correlation coefficients of supply chain risks

	Supply risks	Demand risks	Inventory risks
Supply risks	1	0.661**	0.734**
Demand risks		1	0.588**
Inventory risks			1

Source: Author's own based on SPSS results

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

4.3.3. Regression Analysis

This part clarifies the regression analysis for study variables and approving the study hypothesis by using Simple Linear Regressions.

According to Table 42, there is the significant impact of supply chain relationship quality on supply chain risks at the significance level (0.00), the F value is (155,161) and R2 is (0.795) which mean that the supply chain relationship quality can interpret 79.5% of the changes in supply chain risks, whereas, the 20.5% of changes can be happened because of other variables are not founded in the current research. Therefore, the *first main hypothesis H1* "There is a significant relationship between supply chain relationship quality (trust, co-operation, communication and commitment) and supply chain risks (supply risks, demand risks and inventory risks)" *is accepted*.

Table 42. The impact of supply chain relationship quality on supply chain risks

Independent variable	Dependent variable	R2	F-value	Sig.
Supply chain relationship quality	**Supply chain risks**	0.795	155,161	0.00
P $\leq$ 0.05				

Source: Author's own based on SPSS results

The results in Table 43 indicate the significant impact of trust on the supply chain risks, the F value is (77.245) at the significance level (0.00) and R2 (0.659) which mean that trust interprets 65,9% of changes in supply chain risks, whereas, 34.1% of changes related to other variables. As well as, there are three significant impacts of trust on supply risks, demand risks and inventory

risks with F value (82.244, 22.835 and 38.906) at the significance level (0.00) and R2 (0.673, 0.363 and 0.493). The significant impact of trust on supply chain risks (supply risks, demand risks and inventory risks) enhances approving of H1 "There is a significant relationship between supply chain relationship quality (trust, co-operation, communication and commitment) and supply chain risks (supply risks, demand risks and inventory risks)".

Table 43. The impact of trust on supply chain risks dimensions

Independent variable	Dependent variables	R2	F-value	Sig.
Trust	**Supply chain risks**	0.659	77,245	0.00
	Supply Risks	0.673	82.244	0.00
	Demand risks	0.363	22.835	0.00
	Inventory risks	0.493	38.906	0.00
P ≤ 0.05				

Source: Author's own based on SPSS results

The results in Table 44 shows significant impact of co-operation on supply chain risks (supply risks, demand risks and inventory risks) according to F value (65.162) at the significance level (0.00) and R2 (0.620) which interprets 62% of changes in supply chain risks, whereas, 38% of changes are interpreted by other variables. As well as, the significant impact of cooperation indicated on (supply risks, demand risks and inventory risks) with F value (61.858, 20.654 and 38.177) at the significance level (0.00) and R2 (0.607, 0.341 and 0.488). So, the significant impact enhances approving of H1 "There is a significant relationship between supply chain relationship quality (trust, co-operation, communication and commitment) and supply chain risks (supply risks, demand risks and inventory risks)".

Table 44. The impact of cooperation on supply chain risks dimensions

Independent variable	Dependent variables	R2	F-value	Sig.
Cooperation	**Supply chain risks**	0.620	65.162	0.00
	Supply Risks	0.607	61.858	0.00
	Demand risks	0.341	20.654	0.00
	Inventory risks	0.488	38.177	0.00
P ≤ 0.05				

Source: Author's own based on SPSS results

Table 45 shows the significant impact of communication on supply chain risks (supply risks, demand risks and inventory risks) which is clarified through F value (19.837) at the significance level (0.00) and R2 (0.332) which mean that the communication interprets 33.2% of changes in supply chain risks, whereas, 76,8% of changes are interpreted by other variables. As well as, communication has the impact on (supply risks, demand risks, and inventory risks) with F value

(12.604, 20.747 and 10.939) at the significance level (0.01, 0.00 and 0.02) and R2 (0.240, 0.342 and 0.195). So, the significant impact *enhances approving the first hypothesis H1* "There is a significant relationship between supply chain relationship quality (trust, co-operation, communication and commitment) and supply chain risks (supply risks, demand risks and inventory risks)".

Table 45. The impact of communication on supply chain risks dimensions

Independent variable	Dependent variables	R2	F-value	Sig.
Communication	**Supply chain risks**	0.332	19.837	0.00
	Supply Risks	0.240	12.604	0.01
	Demand risks	0.342	20.747	0.00
	Inventory risks	0.195	10.939	0.02
P ≤ 0.05				

Source: Author's own based on SPSS results

Table 46 shows the impact of commitment on supply chain risks (supply risks, demand risks and inventory risks) through F value (74.443) at the significance level (0.00) and R2 (0.650) which mean that the commitment interprets 65% of changes in supply chain risks. As well as, the commitment has the significant impact on (supply risks, demand risks, and inventory risks) with F value (36.701, 35.564 and 52.666) at the significance level (0.00) and R2 (0.478, 0.471 and 0.568). So, the significant impact enhances the approving of H1 "There is a significant relationship between supply chain relationship quality (trust, co-operation, communication and commitment) and supply chain risks (supply risks, demand risks and inventory risks)".

Table 46. The impact of commitment on supply chain risks dimensions

Independent variable	Dependent variables	R2	F-value	Sig.
Commitment	**Supply chain risks**	0.650	74.443	0.00
	Supply Risks	0.478	36.701	0.00
	Demand risks	0.471	35.564	0.00
	Inventory risks	0.568	52.666	0.00
P ≤ 0.05				

Source: Author's own based on SPSS results

Based on the results in Table 47 and Table 48, the *third hypothesis H3* "there is a significant relationship between the dimensions of supply chain risks (supply risks, demand risks and inventory risks)" *is enhanced*. The supply risks and demand risks F value is (30.955) at the significance level (0.00) and R2 (0.436) which means that the supply risks interpret 43.6% of changes in demand risks. Whereas, F value of supply risks and inventory risks is (46.680) at the significance level (0.00) and R2 (0.539) which means that the supply risks interpret 53.9% of changes in inventory risks.

Table 47. The impact of supply risks on demand risks and inventory risks

Independent variable	Dependent variable	R2	F-value	Sig.
Supply risks	**Demand risks**	0.436	30.955	0.00
	Inventory risks	0.539	46.680	0.00
P ≤ 0.05				

Source: Author's own based on SPSS results

Table 48 shows the significant impact for demand risks on inventory risks based on the results which represented by F value (21.139) at the significance level (0.00) and R2 (0.346).

Table 48. The impact of demand risks on inventory risks

Independent variable	Dependent variable	R2	F-value	Sig.
Demand risks	**Inventory risks**	0.346	21.139	0.00
P ≤ 0.05				

Source: Author's own based on SPSS results

4.4. New scientific results

Based on the discussion of my research results, the new results that are important in the pharmaceutical supply chain are summarized in the following:

1. **The long procedures of procurement which increase the lead-time, affect both the accuracy of demand forecasting/needs estimating and inventory management which increases the risks of supply chain** (i.e. supply risks, demand risks, and inventory risks) and creates waste in the pharmaceutical supply chain in transportation, extra-processes, waiting and inventory. (This was proved by the results of the interviews and the statistical analysis, as interviewed managers mentioned the long and complicated procurement which needs more than one-year for Kimadia to increase the inventory level to avoid shortages in the health institutions. This leads to the increase of inventory risks such as surplus and shortages, the long waiting time for receiving the orders placed by health institution will assist to create waste in the pharmaceutical supply chain (e.g. in transportation to transfer extra amount to another place, extra-processes and losing medicines due to expiration.)

2. **The inventory management policy in Kimadia by using annual review based on annual purchasing** affect the Iraqi pharmaceutical supply chain and **increase the supply chain risks** which mean the annual replenishment system cannot be effective in reducing the risks in the Iraqi pharmaceutical supply chain. Whereas, the vendor

managed inventory (VMI) and continuous review system are effective according to the previous literature review but, in some countries, which have close suppliers and using information technology system. The current annual purchasing system forces Kimadia to use annual replenishment, which has the main role to increase the inventory risks, whereas, it was clear in the literature review that Vendor Managed Inventory (VMI) and Continues Review are effective in managing inventories.

3. **I categorized the problems and risks of the Iraqi pharmaceutical supply chain from the viewpoint of the different players and proved, that supply chain risks, represented by supply risks, demand risks and inventory risks, are considered the essential source for generating several types of waste in Iraqi pharmaceutical supply chain.** These findings were appeared clearly in the results of interviews, especially, when there is a delay in receiving the pharmaceutical materials at time that leads to the accumulation of pharmaceuticals in the coming times and causing excess inventory which in turn leads to create waste in the pharmaceutical supply chain. Health institutions have to find a solution for extra inventory by informing the authorities and transfer the surplus of medicines to another health institution if they need, otherwise the extra medicines will be exposed to expiry or damage that means extra-processes, transportation, more motion, and more energy for storage.

4. **The supply chain relationship quality including trust, co-operation, communication, and commitment has a negative significant relationship with the supply chain risks** represented by supply risks, demand risks, and inventory risks, which lead to create several kinds of waste in the pharmaceutical supply chain. This has been clarified in the statistical analysis which shows that the supply chain relationship quality represented by its dimensions (trust, co-operation, communication, and commitment) has a significant impact on supply chain risks which lead to create waste.

5. **The supply risks and demand risks in the pharmaceutical supply chain affect the inventory risks, which create waste in the pharmaceutical supply chain**. The problems created by supply risks such as delay, unreliable and inflexible supply lead to make the directors of pharmaceutical storages confused about the required amount because of uncertainty, which leads to inaccurate estimating for pharmaceutical materials which also increase the waste in the pharmaceutical supply chain.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusions

The issues of the supply chain are one of the most important topics in organizations today, especially in the field of medicines and pharmaceutical supplies, because of the challenges faced by organizations today, which is reflected in the constant search for new ways to improve the efficiency of supply chain in providing the service permanently and reduce the risks by establishing strong relationships with the supply chain members, consequently, reduce the waste. According to collected and analyzed data through interviews, questionnaires and secondary data, several results are concluded as follows:

1. According to the literature review, the management of supply chain activities has the main role in increasing the efficiency by enhancing the relationship quality through the members of the supply chain which lead to reducing risks and waste in the supply chain.

2. Based on the interviews, there is a weakness in the relationships between Kimadia and their suppliers and use traditional way for procurement and inventory management by using annual purchasing, as well as estimate needs two years before the specific time. In addition, there are several risks in the pharmaceutical supply chain of Kimadia and health institutions such as surplus, shortages, expiration, delay and quality problems. These problems lead to creating waste like extra-transportation, waiting, inventory, over-process, and defects, because when there are surpluses, shortages, expiration, delay and quality problems the authorities try to investigate the problems and transfer the surplus amount to other institutions and apply for an urgent order if there is a shortage. Moreover, the health institutions have to wait without medicines and pharmaceutical supplies if there is a delay in shipment arriving, whereas, if there are expiration or problems in the medicines quality the authorities have to formulate a committee to determine who is responsible about that. All the previous risks or problems lead to extra administration process, transportation, and waiting.

3. The results of questionnaires indicate some conclusions related to frequencies, correlations and regression analysis as follow:

    - The frequencies mention that there is a weakness in the supply chain relationship quality between Kimadia and their suppliers and there are supply, demand and inventory risks in the supply chain, whereas, the frequencies of health institutions indicate that there are

risks related to supply, demand and inventory which mean the risks of suppliers can affect the customer as well.

- There is a significant correlation between supply chain relationship quality and supply chain risks, as well as, between the dimensions of supply chain relationship quality itself and between supply chain risks itself as well.
- There is a significant regression between the supply chain relationship quality and its dimensions; and supply chain risks and its dimensions. As well as, there is a significant regression between supply and inventory risks and demand and inventory risks.

4. The secondary data / quantitative data which founded in the reports proved that there are supply, demand and inventory risks through the surplus, shortage, expiration, quality problems and delay in the medicines and pharmaceutical supplies. As well as, indicate that there is a weakness in communication through supply chain because of late informing the health institutions about the quality problems in medicines and pharmaceutical supplies which lead to create waste such as transportation, inventory, waiting, extra-process and defects as mentioned in the paragraph of interviews.

According to the results, the study hypothesis is clarified in term of acceptance in Table 49.

Table 49. Verification of Hypotheses

Hypothesis	The reason of acceptance
H1:	The hypothesis is accepted according to the correlation analysis results which is (- 0.892**) and the regression analysis results which shows F-value (155,161) at significance level 0.00 and R2 is (0.795). As well as, the results of interviews confirm that. In addition, the regression analysis results of supply chain relationship quality dimensions (trust, co-operation, communication and commitment) show that there is significant impact on supply chain risks (supply risks, demand risks and inventory risks).
H2:	The hypothesis is accepted according to the correlation analysis results as follows: Trust and cooperation is (0.780**). Trust and communication is (0.575**). Trust and commitment is (0.684**). Cooperation and communication is (0.471**) Cooperation and commitment is (0.703**). Communication and commitment is (0.481**)

Hypothesis	The reason of acceptance
H3:	The hypothesis is accepted according to the correlation analysis results as follow: Supply risks and demand risks is (0.661**) Supply risks and inventory risks is (0.734**) Demand risks and inventory risks is (0.588**). As well as, the regression analysis confirms that according to the results of F value and R2 as follow: The impact of supply risks on demand risks is significant according to F-value (30.955) at significance level 0.00 and R2 is (0.436). The impact of supply risks on inventory risks is significant according to the F value (46.680) at significance level 0.00 and R2 is (0.539). The impact of demand risks on inventory risks is significant according to F-value (21.139) at significance level 0.00 and R2 is (0.346).
H4:	The hypothesis is accepted according to the interview results which shows that risks in the pharmaceutical supply chain such as delay or inaccurate demand forecasting or surplus or shortages create several kinds of waste such as waiting, transportation, extra-process, and energy.
H5:	The hypothesis is accepted according to the interview results, which shows that the activities of supply such as demand forecasting, procurement, and inventory management have the main role in creating risks in the pharmaceutical supply chain. Especially when there are long and complicated procedures of procurement which affect the accuracy of demand forecasting and increasing the inventory risks which create waste.

Source: Author's own

5.2. Recommendations

Based on the conclusions presented earlier, this part presents the most important recommendations to the state company for medicines marketing and pharmaceutical appliances (Kimadia) and health institutions as follows:

1. Trying to invite the pharmaceutical manufacturers inside the country or support local medicines companies to ensure flow the medicines and pharmaceutical supplies in small frequent batches to reduce the inventory levels, consequently, reducing supply chain risks and waste.
2. Kimadia has to pay attention towards enhancing the relationship quality with the suppliers in order to reduce the supply chain risks and increase the efficiency of the supply chain

activities such as procurement and inventory management consequently increase the accuracy of demand forecasting or needs estimating which eliminate waste.

3. Using modern information technology system to manage the warehouses, sharing information with the supply chain members and facilitate the purchasing procedures. This case needs increasing the efforts to train the employees in health institutions to use new information system and another challenge is that the internet network is still weak.

4. Using quality at source strategy instead of spending long time to inspect medicines and pharmaceutical supplies by dealing with high-quality suppliers.

5. Using the strategy of removing waste and problems from source instead of treating the problem after happening. In order to achieve this goal, the responsible managers have to deployment the lean thinking in the whole Iraqi pharmaceutical supply chain.

6. Try using the continuous review of inventory instead of annually purchasing / review to raise the level of demand forecasting or needs estimating accuracy and removing the waste in inventories such as surplus, shortage, expiration, and check time of medicines and pharmaceutical supplies. This recommendation depends on the previous recommendations which mentioned in 1, 2, 3, 4 and 5.

6. SUMMARY

The government supply chain in Iraq suffers from many disorders and risks related to supply, demand and inventory. In view of the importance of supply chain activities and relationships quality between the members of supply chain and their vital role in supply chain risks and waste, this research attempts to shed light on the study of the activities of the Iraqi pharmaceutical supply chain and the relationship quality in the supply chain of Kimadia and its role in the supply chain of Kimadia and health institution and find the main solutions for the problems and obstacles which face the government pharmaceutical supply chain of Iraq. Therefore, according to the aim and problems of the study, there were several questions as follows:

1. To what extent the activities of the pharmaceutical supply chain (Needs estimating or demand forecasting, Procurement and Inventory system) are efficient?
2. How well is the supply chain relationship quality in the pharmaceutical supply chain under study?
3. Is there any risk in the pharmaceutical supply chain under study?
4. Is there any kind of waste in the pharmaceutical supply chain under study?
5. Is there any relationship between the supply chain relationship quality and its dimensions, and supply chain risks and its dimensions?
6. Is there any relationship between the dimensions of supply chain risks?
7. Is there any relationship between supply chain risks and wastes?
8. Is the supply chain risks transfer from supplier to customers?

After understanding the Iraqi pharmaceutical supply chain clearly and select the main risks and the types of waste based on the literature review and collected data, the study has reached to several conclusions which can be clarified as follows:

1. There was inaccurate demand forecasting or need estimating and long procurement procedures, as well as, the company under study (Kimadia) and health institutions use central inventory management system with annual purchasing which lead to several problems such as surplus, shortages, and expiration.

2. The relationship quality of Kimadia supply chain is weak with the suppliers because of governmental policy in organizing the contracting with the suppliers which depend on annual contracting and choosing suppliers based on the allocated financial.
3. Supply, demand and inventory risks were found in Kimadia and health institutions supply chain.
4. There are several kinds of waste along the pharmaceutical supply chain such as inventory, transportation, extra-process, defects and waiting.
5. The significant relationship indicated between supply chain relationship variables (trust, cooperation, communication and commitment) and supply chain risks (supply risks, demand risks and inventory risks).
6. There is a significant relationship between supply and demand risks; and inventory risks.
7. The supply chain risks can create the waste in the supply chain such as (inventory, transportation, waiting, defects and over-process).
8. The risks in the supply chain of suppliers can be transferred to the customers.

7. APPENDIXES

Appendix (1): References

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Appendix (2): List of tables

Appendix (3): List of figures

Appendix (4): Questionnaire of Supply Chain Relationships Quality and Supply Chain Risks

Dear Mr. / Ms.

I would like to attach the questionnaire form which is part of the requirements for the preparation of the doctoral thesis which is tagged (the role of the relationships quality and the logistic activities of pharmaceutical supply chain on reducing waste / case study in the Iraqi health sector). Your participation in providing the real picture has a positive impact in the output of this thesis at the required level, so please thank you by choosing the answer you think is appropriate for each question, take note of the notes below before starting to answer the question.

1. Researcher is interested in your cooperation and opinion depending on your experience in the field through your work in the company, which helps to achieve the objectives of the research. So, please, all the questions contained in the questionnaire should be answered (the appropriate answer in your opinion) because leaving any question or (paragraph) means that the form is not valid for analysis.
2. Please mark (✓) in front of the appropriate selection which represents your true view, and with all honesty.
3. No need to write the name or sign the form, it will be used for scientific research. We need just your answers to reach the numerical results used for the preparation of statistical indicators only.

"Thank you for your cooperation"

Waleed Ali Hussein Al-Zaidi

PhD Student

Part 1: General data for responders

1-What are you Education qualification please tick the highest level. Please tick in front of the suitable option.						
High school and below						
Technical Diploma						
Bachelor						
Higher Diploma						
Master						
PhD						
Others						
2-Please in which field your qualification is? Please tick in front of the suitable option.	Medical		biology		Management	
	chemistry		physics		Others	

3-How many years in work? Please tick years' work in front of the year number.					
Less than 2 Years		2-5 Years		5-8 Years	
8-11 Years		11-15 Years		More than 15 Years	

4- Place of work. Please tick in front of the suitable option.			
Main warehouse of company		Store of Health directorate	
Drug store of hospital		Pharmacy of hospital	
Public Clinic		Primary health care	
Center Medical Unit		**Others**	

5- Location name of workplace (city)	

Part 2: supply chain quality relationship (Trust, Collaboration, Communication, Commitment)

F	Trust	1	2	3	4	5	6	7
1	The relationship with all our suppliers is highly loyal							
2	Our suppliers can be counted on to help us.							
3	We believe that all our suppliers are highly competent so that their products can be relied upon with confidence							

F	Collaboration	1	2	3	4	5	6	7
4	We cooperate with our suppliers regarding improvement of products quality							
5	We cooperate extensively with our suppliers with respect to forecasting and production planning.							
6	Our suppliers are able to handle our complaints immediately.							

F	Communication	1	2	3	4	5	6	7
7	Exchange of information with suppliers takes place informally, and not only according to a per-specified agreement.							
8	Our suppliers can know the level of our inventory and consumption at any time with high accuracy							
9	Using sophisticated information system to exchange information accurately and quickly with related parties.							

F	Commitment	1	2	3	4	5	6	7
10	The relationship that we have with the suppliers deserves our maximum effort to maintain							
11	The relationship that we have with the suppliers is something we are very committed to.							
12	We have long-term relationship with the suppliers.							

Part 3: Supply chain risks

F	Supply risks	1	2	3	4	5	6	7
13	Lead time is long (the period between placing order and delivery)							
14	Fluctuation or delay in the time of receiving and delivering products is possible							
15	The procedures of procurement are long and complicated							

F	Demand risk	1	2	3	4	5	6	7
16	It is possible to have an error of estimating needs for medicines and pharmaceutical supplies							
17	There are difficulties to face fluctuations in demand or urgent orders for medicines and pharmaceutical supplies and providing them in the appropriate time and quantity and in the required place and the right quality							
18	We cannot get the exact required quantity, which we need, of medicines and pharmaceutical supplies							

F	Inventory risk	1	2	3	4	5	6	7
19	Surplus in some medicines and pharmaceutical supplies is possible to occur							
20	Expiry date of some medicines and pharmaceutical supplies is possible to occur in the stores							
21	Shortage in some medicines and pharmaceutical supplies is possible to occur							

Appendix 5: Interview Questions

1. Which kind of problems do you face in your workplace related to medicines and pharmaceutical supplies such as surplus, shortages, expiration, delay and quality etc.
2. If you have any kind of problems which mentioned in number 1, what is the reason behind that.
3. If you face any kind of problems which mentioned in number 1, how can you deal with them.
4. What are the mechanisms of receiving or procurement and distributing the medicines and pharmaceutical supplies?
5. What is the period of receiving medicines and pharmaceutical supplies i.e. monthly or annually?
6. How do you determine your needs of medicines and pharmaceutical supplies, i.e. are the needs of medicines and pharmaceutical supplies determined based on the equations based on the previous data or based on personal experience or there are other ways to calculate the needs?
7. How long do you use demand forecasting/needs estimating i.e. annually, 6 months, quarterly, or there is another way?
8. How do you manage your inventory?
9. Are there any other notes which you would like to add?

Appendix (6): The surplus pharmaceutical supplies and medicines in the warehouses of medicines storage department of Kimadia until 27/2/2014

No.	Item	The surplus quantity
1	Metoprolol tartrate 1mg/1ml I.V. inj (5ml) Ampoule	7353
2	Adenosine inj. 3mg/ml (2ml) Vial	500
3	Verapamil Hcl 80mg Tablet	59460
4	Verapamil Hcl inj 2.5mg/ml, (2ml) Ampoule slow I.V. inj	23895
5	Nifedipine 20mg (s/r) or retard Capsule (60% of the need)	351800
6	Dobutamine (as Hcl)l i.v infusion 250 mg/vial(12.5 mg/ml 20 ml)	1471
7	Aminophylline 25mg/ml (10ml)(I.V. Inj) Ampoule or Aminophylline 2H2O :25mg/1ml (10ml)(I.V. Inj)	158495
8	Salbutamol inj 0.5mg/ml, (1ml) Ampoule	13326
9	Dextromethorphane HBr 15mg Tablet	164470
10	Sertraline as Hcl 50mg Tablet	69180
11	Prochlorperazine maleate 5mg Tablet (limited amount)	260700
12	Morphine sulphate 15mg/ml slow I.V., I.M., s.c. Injection (1ml amp)	1098
13	Sodium valproate 500mg Tablet	84120
14	Levodopa 250mg + Carbidopa (as monohydrat)or (anhydrous) 25mg Tablet	198090
15	Cloxacillin as sodium 500mg Capsule	25000
16	Cloxacillin as sodium inj. 500mg Vial	70200
17	Cloxacillin as sodium 125mg/5ml, Suspension	112205
18	Pipercillin as sodium 1g (I.V & I.M) Injection	64650
19	Tazobactam as sodium salt 250mg + Piperacillin as sodium salt 2g inj. – vial (I.V Infusion) (with or without EDTA)	62941
20	Clindamycin as phosphate 150mg/ml, inj (2ml) Ampoule	18660
21	Ciprofloxacin (as lactate) 2mg/ml in Nacl 0.9% (100ml bottle) I.V. infusion (Electrolyte Na + 15.4 mmol/100ml bottle)	19267
22	Rifampicin 300mg Capsule	40000
23	Ribavirin 200mg/5ml (100 ml) oral solution	1040
24	Griseofulvin 125mg/5ml, Suspension	2413
25	Fluconazole 50mg Capsule	2700
26	Caspofungin (as acetate) IV infusion:50mg – vial (powder for reconstitution)	638

No.	Item	The surplus quantity
27	Tetracosactrin as acetate (aqueous) 250mcg /1ml (1ml) Ampoule (diagnostic test)	2934
28	Carbimazole 5mg Tablet	107900
29	Goserelin acetate implant 3.6mg in syring application	10446
30	Finasteride 5mg Tablet	123300
31	Testosterone propionate 30mg + Testosterone phenyl propionate 60mg + Testosterone isocaproate 60mg + Testosterone decanoate 100mg/ml (1ml) inj Ampoule	15540
32	Calcitonin 100 MRC unit equivalent to 100 IU calcitonin synthetic/1ml (1ml) Ampoule	1803
33	Miferpristone emergency pills(tab 200mg-3tab)	996
34	Clotrimazole 100mg Vaginal Tablet	166950
35	Iron-dextran inj 50mg/ml, (2ml Ampoule) by deep I.M or slow I.V or by slow I.V infusion	39301
36	folinic acid 15mg (as calcium folinate or as calc.leucovorin) Tablet	7920
37	Heparin sodium 5000 IU/ml SC.,I.V.(5ml) Vial	16507
38	Warfarine sodium 1mg Tablet	210500
39	Recombinant Factor VIII, 500 IU (HSA Free)	9279
40	Vitamin K 1-(Phytomenadione) mixed micelles inj (Vit. K1-MM) 10mg/ml (I.V. inj or slow I .V. inj (withen 30 sec) (1ml) Ampoule	52780
41	Vamin 9 Glucose : Nitrogen 9.4g + Na+ 50 mmol + K+ 20 mmol + Ca+2 2.5 mmol + Mg+2 1.5 mmol + Cl - 50mmol + Anhydrous Glucose 100g /L (500ml) I.V infution	1395
42	Glucose (dextrose) 10% 500ml I.V. Infusion	660000
43	Sodium bicarbonate 8.4% slow I.V.,continous I.V. Infusion inj. 50ml Ampoule	25570
44	Glucose (dextrose hydrous or anhydrous) 5 % 100 ml I.V. Infusion	78563
45	Sevelamer carbonate 800mg tab For hyperphosphataemia in patients on haemodialysis	5760
46	Tropicamide 0.5% Eye Drop	2252
47	Xylometazoline Hcl 0.1% Nasal Drop	98423
48	Betamethasone as valerate 0.1% Scalp Application	36534
49	Clindamycin as phosphate 1% topical Solution.	1564
50	Glutaraldehyde aqueous buffered to PH 7.5 8.5 2% solution with activator X5 L	12328
51	Propofol I.V. inj 1%	814

No.	Item	The surplus quantity
	Propofol EDTA or Propofol metabisulphite but Propofol EDTA is the Safe alternative	
52	Isoflurane volatile liquid anaesthesia 100ml bottle	3832
53	Vecuronium Bromide as powder 10mg/ Vial injection .	28458
54	Fentanyl transdermal 100mcg/h System	18025
55	Fentanyl transdermal 50mcg/h (5mg/system) System	16215
56	Fentanyl as citrate 50mcg/ ml (10ml)Ampoule	13451
57	Diazepam emulsion inj 5mg/ml, (2ml Amp)	90586
58	Ephedrine Hcl inj 3% 30 mg / ml, slow I.V. injection 1ml ampoule (limited amount)(hypotension prevention in epidural/spinal anaesthesia) لا يستعمل الا بعد التخفيف	11552
59	Temozolomide 100mg capsule	8360
60	Mitoxantrone as Hcl 2mg/ml inj (10ml vial)	4441
61	Etoposide 50mg Capsule	2016
62	Etoposide 100mg Capsule	13800
63	Oxaliplatin 100mg/vial powder for solution I.V.Infusion (limited use)	1425
64	Carboplatin inj 10mg/ml (45ml) Vial i-e 450mg/45ml	5352
65	Octreotide 0.05mg/ml Injection	8950
66	Methyl prednisolon (as sod. Succinate) 250 mg IM,slow IV,IV infusion inj	5788
67	Bacteriostatic water for inj medrolone 500 mg vial	15910
68	Tamoxifen as citrate 20mg Tablet	109290
69	Anastrozole tab 1mg. to be dispence by medical committee for these indications :Thromboembolic (Drug intolerability) / Tamoxifen Not to be use as an Alternative in case that Tamoxifen tab are not availableTamoxifen	267036
70	Bicalutamide 50mg tablet	25452
71	Anti-Thymocytic-Globulin inj100mg/5ml (ATG) Vial (Rabbit type) (limited for kidney)	171
72	Cytomegalavirus immunoglobulin	1531
73	Tacrolimus 500mcg Capsule	6100
74	sunitnib as malate 50mg cap	1830

No.	Item	The surplus quantity
75	Docetaxel 40mg/ml (0.5ml vial) inj	6172
76	Docetaxel Trihydrate = Anhydrous Docetaxel 80 mg/2ml - vial (with diluent)	2299
77	Paclitaxel inj 6mg/ml 50ml vial	25180
78	Irinotecan Hcl or Hcl Trihydrate I.V infusion : 20mg/ml (5ml-vial)	5351
79	Anti D immunoglobulin 250mcg Injection	11659
80	Human normal immunoglobulin 1g/20ml SD (solvent detergent) treated solution for I.V. use Vial	6669

Appendix (7): The surplus medicines and pharmaceutical supplies in Al-Adel warehouse in 2014

No.	Item	The surplus quantity
1	Aminophllin Amp.	158495
2	Iron-Dextran Amp.	39301
3	Cordaron Amp.	5000
4	Ventolin Evoheuler	73000

Appendix (8): The quantity of needs estimating received and surplus in Basra warehouse in 2014

No.	Item	Needs estimating for 2014	Received quantity	The surplus quantity
1	Cytosar 1g vial	2000	2337	337
2	Almeta 500 mg 50 mg vial	0	48	48
3	Sustanon 250 mg amp	1570	19490	8420

Appendix (9): The quantity of surplus in Basra warehouse in 2014

No.	Item	The surplus quantity
1	Rabies vaccin	1127 and 7470 doses
2	Anti snak serum	3000 doses 1000 doses 84 doses
3	Anti-scorpion serum	2000 doses
4	B.C.G vaccin	100000 doses
5	Ventomadin 2mg,10 tab	16540 sheets
6	Dacarbuzine 200mg x 10	102
7	Sustanon 250mg amp	8420
8	Prostcare 5mg x 30tab	330 pack

Appendix (10): The surplus medicines and pharmaceutical supplies in Al-Najaf warehouse in 2014

No.	Item	The surplus medicines
1	Simulect 20mg vial	150
2	Primine 10%	255
3	Adenosine 6mg /2ml	246
4	Omnipage 240 vial	160
5	Desferal 500mg vial	4160
6	Carboplatin 450/45 ml vial	86
7	Isoptin 2.5mg amp	100
8	Mitoxantron 20mg/10ml amp	20
9	Betaloc 1mg amp	495
10	Ringer solution	157660
11	Dextrose 10% 500mg	149300
12	Dextrolyt powder	20390
13	Durogesic 50 micg patch	85 pkt
14	Durogesic 100 micg patch	55 pkt
15	Durogesic 100 micg patch	40 pkt
16	Mifestad 200mg tab	270 x 3
17	Water purification tab	33600 x 10
18	Piocine 10mg tab	16929 x 20
19	Epilat retard 20mg tab	13 x 20
20	Azathioprin 500mg tab	9 x 100
21	Lastet 100mg tab	15 x 10
22	Carbimazol 5mg tab	20 x 50
23	Megacard 25mg tab	55 x 30
24	Leukeran 2mg tab	59 x 25
25	Alkeran 2mg tab	27 x 25
26	Glivec 100mg tab	223 x 120
27	Merevan 1mg tab	1 x 100
28	Nyrin 15mg tab	13 x 30
29	Cidamex 250mg tab	23 x 10
30	Isoptin 80mg tab	80 x 20

Appendix (11): The surplus medicines and pharmaceutical supplies in Al-Muthanna warehouse in 2014

No.	Item	The surplus quantity
1	Dextrose 10% bottle 500 ml	188270
2	Glutacid 28 X 5L	1060
3	Hexatan solution X 5L	4683

Appendix (12): The surplus medicines and pharmaceutical supplies in Babylon warehouse in 2014

No.	Item	The surplus quantity
1	Glutacide	280 Galon
2	Janvia 100 mg *28 tab	165
3	Povidone 10 % Alchoolic	4992
4	Povidone 10 % Aqueos	4752
5	Hexatane sol	2000
6	Ventomaxin 2 mg *10 tab	2900 + 4570
7	Butamol 2 mg * 10 tab	3848

Appendix (13): The surplus quantity of medicines and pharmaceutical supplies in Babylon warehouse in 2015

No.	Item	The surplus quantity
1	Pentosam 100 g / 100 ml	113
2	Millex-Hv Filter	500

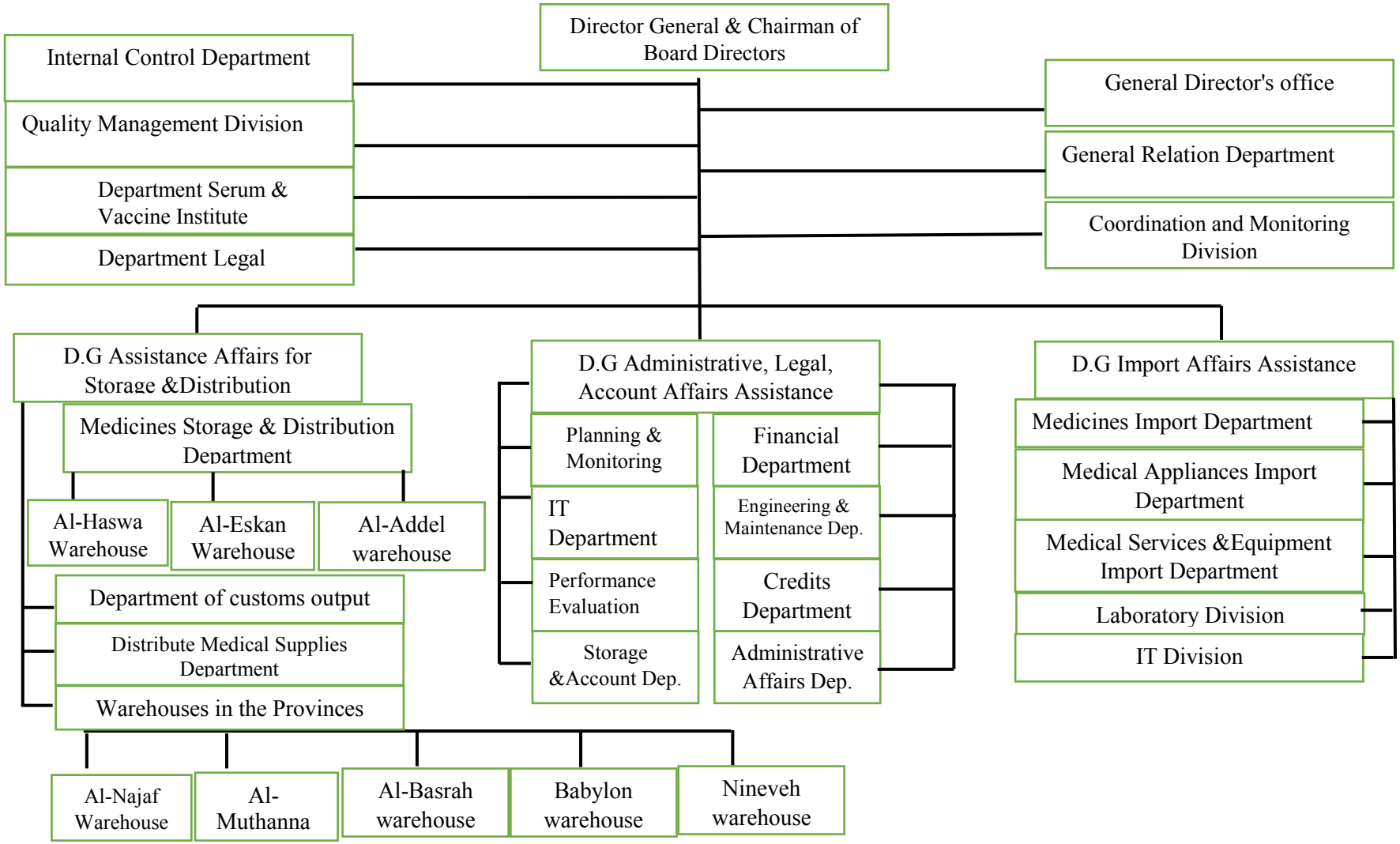
Appendix (14): The surplus quantity of medicines and pharmaceutical supplies in the store of Babylon Health Directorate in 2015

No.	Item	The surplus quantity
1	Temodol 100mg*5cap	pack 297
2	Sod. Bicarbonet 8.4% 100ml	2675

Appendix (15): The surplus quantity of medicines and pharmaceutical supplies in the store of Babylon and Wasit Health Directorate in 2016

No.	Item	The surplus quantity
1	Recombinat Factar (v11)	1012
2	Rhophylac 300MCG (Pack*1 Pfs Of 2 ml)	2325
3	Heparin Leo 5000IU/ml 5ml IV vial	2650
4	Sodium Bicarbonat 8.4% 100 ml	1789

Appendix (16): Kimadia Structure (Author's own)



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