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## Article

# Investigation of the forecasting methods

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# Investigation of the Forecasting Methods Use in the Drug Supply Chain: The Pharmacy Perspective in Greece

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## **Abstract**

*This paper reports on the findings of a questionnaire survey aimed to explore the use of drug demand forecasting methods from the pharmacy perspective in Greece. The study revealed that pharmacies have little benefited by the IT systems in terms of optimizing their inventory management and, in particular, exploiting the opportunities offered by demand forecasting. However, it is rather encouraging that the majority of them have realized that demand forecasting is necessary to determine the order quantity. The enhancement of customer satisfaction and the exploitation of probable quantitative and financial rebates offered by the supplier are perceived to be the most important benefits of the drug demand forecasting. Moreover, although, only around 30% of the respondents claimed to have cooperated with a pharmaceutical wholesaler in the past in order to achieve better demand forecasting of drugs, almost all of them say that they are willing to do so in the future. Maintaining long-term relationships with loyal customers, closely followed by the better response to changes in the pharmaceutical market, were considered as the most important benefits of such a cooperation.*

**Keywords:** forecasting methods, drug supply chain management, pharmacy perspective, survey, demand, Greece.

JEL classifications: I11, L14, D21, M31, M10

## **Introduction**

The use of information and telecommunication technology improves logistics operations in terms of speed, agility, real time control, and customer responsiveness (Fredenhall and Hill, 2004). There are academic researches that investigated the importance of the demand forecasting for drugs in the health supply chain. Most of these researches focus on the results observed in retail and wholesale trade when collaborative demand forecasting is used. Jambulingam et al (2009) studied the role of trust in the pharmacy and pharmaceutical warehouse relationship, the manner in which a long-term collaboration is formed between them and the benefits of both parties when such a relationship is characterized by loyalty. Danese (2006) investigated the applications of vendor managed inventory (VMI) along the supply chain and the results of this extended network in the information and products flow to all parts of the distribution channel. Lee et al (1997) explored the bullwhip effect, namely the growth in demand as we move upwards in the chain and the impact on supply chain management. Sekhri et al (2006) inquired into the general principles that should govern a drugs demand forecast so as to be accurate.

The medicines' market, despite any arrangements imposed to promote their accessibility to public as a social good, is integrated into the

real economy and is quite sensitive to demand fluctuations. The first step for any supply chain planning, and as well as for the drug supply chain, is the use of demand-forecasting methods. Supply chain management refers to the planning of goods' production and distribution in order to maximize the value added by the whole supply chain. Thus, supply chain scheduling is a complex process, which gets even more complicated because of the everyday demand fluctuation. Therefore, the availability of the most precise demand forecasts, especially of the independent (consumer) demand, is the cornerstone for maximizing both the effectiveness and efficiency of the supply chains. For this reason the first and most crucial step in supply chain scheduling is the employment of the most appropriate demand forecasting techniques, as well the collaboration of the supply chain participants to share the indispensable relevant information.

The health sector presents some special features in relation to other sectors of the economy. One of its main particularities is the uncertainty regarding the demand, since there is asymmetric information between physician and patient, and uncertainty about the supply, as long as there is lack of information about the outcome of therapeutic intervention (Athanasiadis et al, 2012). This uncertainty combined with the disease risk that every person faces and which threatens the quality of life or even life itself, have led to the pursuit of safety in the health sector to a much greater extent than other economic sectors. Therefore, the peculiarity of the pharmacy sector is that the inventory management is driven solely by the patients' benefit, in contrary to the retail trade, in general, where the inventory management aims to maximize the company's benefits (Ioannou, 2005).

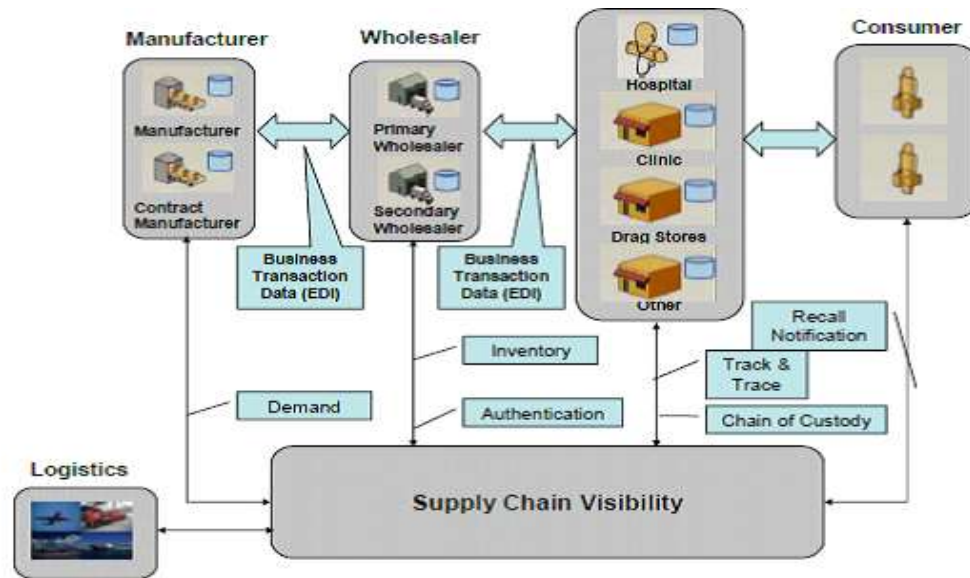
The literature review revealed that a limited number of researches have been conducted concerning the forecasting methods use in the drug supply chain from the pharmacy supply managers' perspective. The second gap observed in the existing literature, refers to the total lack of similar research in the Greek drug supply chain. This paper tries to fill these two research gaps by addressing the following questions: I) how familiar are the supply managers in Greece with the drug inventory management and what is their opinion about the use of demand-forecasting methods? II) What are the expected benefits from utilizing forecasting methods? III) Is there cooperation between pharmacies and pharmaceutical warehouses in the supply chain for demand forecasting? IV) What are the reasons that prevent such cooperation and what are its perceived benefits in terms of demand forecasting?

The paper is organized as follows. Firstly, we will briefly evaluate the literature on the forecasting methods use in the drug supply chain from the pharmacy perspective in Greece in order to explain the research gaps and justify the research objectives. The research design then follows. Next, the original data collected from the questionnaire are analyzed and finally, conclusions summarize the main theoretical and managerial contributions of the research, followed by a discussion on the generalizability of the results and the opportunities for future research.

### **Prior research**

A typical pharmaceutical supply chain according to Figure 1 consists of the crucial manufacturers who produce the drugs' "active ingredient", the manufacturers that receive the prepared active

ingredient and add the appropriate “excipients” to create the final product, the pharmaceutical wholesalers, the private single-owned or chain pharmacies, the hospital pharmacies, the clinics, and the consumers-patients (Shah, 2004; Vecchione, 2009).



**Figure 1: A typical pharmaceutical supply chain**

*Source: Zhang et al., 2008*

The supply chain efficiency depends on the transparency and accuracy that characterizes the stock in drugs, the demand of drugs and the regulations surrounding the pharmaceutical market (Zhang et al, 2008). The most important goal of the distribution channel is to ensure a constant flow of drugs towards patients at an appropriate price, without delays and shortages.

The number of pharmaceutical warehouses in each country are much less than that of pharmacies and, because of this, there is fierce competition between them. Wholesalers are trying to gain a competitive edge to ensure long-term partnerships with pharmacies (Doucette and Jambulingam, 1998). The trust between the members of the pharmaceutical supply chain attracted the interest of several scholars, among them were the Doucette and Wiederholt (1996). According to data of the Panhellenic Pharmaceutical Association, in 2011 the number of pharmacies in Greece amounted to approximately 11,315. Greece has the largest number of pharmacies in Europe compared to its inhabitants and, specifically, the density of pharmacies in Greece corresponds to 1 pharmacy per 1,200 inhabitants, whereas the corresponding average in the EU-27 is one pharmacy per 3,300 inhabitants (EFPIA, 2011; 2012; ELSTAT, 2012).

Dwyer et al., (1987), Frazier et al (1988), Kaufmann and Stern (1988), Anderson and Weitz (1989), Gundlach and Murphy (1993) and Griffith et al (2006) studied the role of justice, loyalty and trust in obtaining effective partnerships. Kumar's et al study (1995) highlighted the significant role of trust amongst the members of the distribution channels. Morgan and Hunt, (1994) and Kwon and Suh (2005) also dealt with the effect of trust in buyer-supplier relationships.

Jambulingam et al (2009) explored the benefits generated by effective cooperation between wholesaler-retailer. They found that the equal and

fair treatment of wholesalers towards pharmacies has very significant impact on their relationship, as it is important for pharmacies to perceive that their suppliers follow specific principles and they make no discriminations. This is a prerequisite in order to trust the wholesalers, by considering them as credible, and to gradually build a strong devoting relationship with them. Moreover, they concluded that the flexibility of wholesalers to effectively correspond to the pharmacy's fluctuating claims, because of the instability of the drug demand, is a fundamental condition to be characterized as a reliable partner. Additionally, the wholesalers' inclination to equally spread the profits and benefits leads to relationships of trust and, consequently, to the pharmacies' loyalty to them.

## **Research Methodology**

### **Questionnaire survey**

The prior research on the use of demand forecasting methods for inventory management in the drug supply chain, as mentioned above, is very limited, and thus, a descriptive and explorative research was considered to be the most appropriate approach to fulfill the aim and objectives of our research (Yin, 1989; McCutheon and Meredith, 1993). Initially, in-depth semi-structured interviews were conducted with 5 pharmacy supply managers which were well educated and knowledgeable about the topic. The findings from these interviews provided very useful information in order to create the first draft of the questionnaire of the quantitative survey. The draft questionnaire was evaluated, in terms of a preliminary test, by 10 pharmacy supply managers, and after their comments and recommendations, the questionnaire was finalized.

The final version of the questionnaire consisted of 5 sections and included 35 closed-ended questions (Appendix). The first section explored the general knowledge of the supply managers about the drug inventory management (LandeghemH., 2009). The second section contains general questions regarding the use of forecasting methods. The third section inquired into the advantages from the use of forecasting methods (Mustaffaetal, 2009; Taylor, 2004; Johnson, 2008; Bowersox et al, 2013). The fourth one concerned the cooperation between pharmaceutical warehouses and pharmacies in order to achieve more accurate forecasting demand methods (Gundlach&Murphy, 1993; Dwyeretal, 1987; Taylor, 2004; Johnson, 2008; Bowersox et al, 2013) and the fifth concerned the respondent demographics.

### **Sample of the survey**

The sample of the survey consisted of 68 pharmacy supply managers, mainly of pharmacy owners and around a quarter of employees (Table 1). The convenience sampling approach was actually utilized, a non-probability sampling method, for data collection. Initially, all the members of the Pharmaceutical Association of Achaia (PAA) were approached through email to participate in the survey, but only a very small number (8) of them responded. Thus, the researchers and some other pharmacists personally visited pharmacies in Patras, Athens, Pyrgos and Kalamata and they requested from the owners or employees to complete the questionnaire. The main criteria for the selection of pharmacies were the inclusion of supply managers from various regions of Greece, as well as from metropolitan, urban and rural areas. Participation in the survey was strictly voluntary and anonymous. The survey lasted 45 days from August to September 2014, and it took

around 10-15 minutes for the participants to complete the questionnaire.

According to pharmacy supply managers' characteristics, presented in the following Table, the research focused mainly on young and middle-aged people. Due to their relatively higher level of education, they could understand the purpose of the study and give answers with clarity and reliability. Conversely, in our sample, there were not many elderly people (>60 years) included, since it was difficult for them to perceive and understand the survey concepts.

**Table 1: Sample of the survey (n=68)**

Characteristics		Percent (%)
Gender	Male	39.1
	Female	60.9
Age	<30	20.3
	30-40	46.9
	41-50	15.6
	51-60	15.6
	>60	1.6
Employment experience	0-5	20.3
	6-10	31.3
	11-20	29.7
	>20	17.2
	No answer	1.6
Position	Owner	73.4
	Employee	26.6
PC & Internet use	Yes	93.8
	No	6.2
Education	BSc in Pharmacy	71.9
	Other BSc	4.7
	BSc in Pharmacy & MSc	14.1
	BSc in Pharmacy & PhD	1.6
	Vocational training	7.8

### Data analysis

SPSS Version 21.0 was used for data analysis. In particular, it included frequencies, some descriptive measures (i.e. mean, mode, median, standard deviation), as well as the Friedman test and the Mann-Whitney test (non-parametric tests).

### Analysis

#### Knowledge and attitudes about drug inventory management and demand forecasting methods

39.1% of the respondents stated that they know what the drugs' demand forecasting methods are, 35.9% that they have heard, but they do not know what exactly are, and the remaining 25% that they do not know. Given that almost none of the modules included in the curriculum of the Greek Pharmaceutical Schools is related to the economic and managerial sciences, it is rather encouraging that around 40% of the participants in the survey are aware of the drugs' demand forecasting methods and only 25% are ignorant of them. Moreover, 75% of the pharmacists or their employees reported to know that IT (Information Technology) systems enable drugs' sales and demand forecasting. However, only 18.8% claimed to rely solely on an IT system for their

inventory management, 45.3% used the traditional handwritten system, while 35.9% a combination of IT and handwritten system. According to Anifantakis (2012), a co-founder of a leading company developing specialized software for pharmacies, the main barriers that hinder pharmacists from adopting and implementing a complete IT system for their pharmacy management are the lack of understanding of the importance of the IT system and how it can provide competitive advantages to the contemporary pharmacy.

Table 2 presents the techniques employed by the participants in the survey to determine the order quantity. It is found that 75% of the pharmacies rely on the daily sales and the manager’s experience and judgement to determine the order quantity, without using any mathematical model at all. According to Anifantakis (2012), the pharmacists are still using their IT systems merely to issue transaction receipts, without exploiting any of the features provided by the relevant software to computerize their business operations.

**Table 2: Techniques used to determine the order quantity**

Technique	N	%
Mathematical demand forecasting model	2	3.1
Experience and judgment	15	23.4
Daily sales	16	25.0
Experience and judgment & Daily sales	17	26.6
Mathematical demand forecasting model & Experience and judgment	0	0.0
Mathematical demand forecasting model & Daily sales	1	1.6
Mathematical demand forecasting model & Experience and judgment & Daily sales	13	20.3

**The use of demand forecasting methods by the pharmacies**

59.4% of the respondents stated that demand forecasting is very necessary to determine the order quantity, while only 11% and 3% think that it is a little and not at all necessary, respectively (Table 3). However, in line with the above mentioned findings, only 26.6% of the participants in the survey claimed to have used any demand forecasting method so far. But, we should bear in mind that there is a likelihood some of the remaining 73.4% do not really know whether the standard procedures, they follow, include indirectly forecasts or not. However, it is rather encouraging that 82.8% of the pharmacists and their employees declare to be positive to utilize demand forecast methods in the future in order to achieve a more effective drugs’ inventory control. Therefore, it is observed that those who do not know about the advantages of forecasting, are willing to get acquainted in the future with the applications provided by their pharmacy’s IT system.

**Table 3: Necessity to use demand forecasting to determine the order quantity: Frequencies (%) and Descriptive statistics**

1	2	3	4	5	No answer	Mean	Std. Dev.
3.1	10.9	23.4	28.1	31.3	3.1	3.7	1.126

**Expected benefits from the use of demand forecasting methods**

Table 4 reports the participants’ views regarding the expected benefits from the use of demand forecasting methods. The pharmacists and their employees seem to have very high expectations from the

demand forecasting methods, as more than half of them strongly agree that their business will enjoy almost all the proposed benefits.

**Table 4: Frequencies (%), Descriptive statistics and Ranking<sup>a</sup> of the benefits from the use of demand forecasting methods**

	1	2	3	4	5	No answer	Mean	Std. Dev.	Mean Rank <sup>a</sup>
Improved management of drug procurement	0	0	4.7	35.9	54.7	4.7	4.5	0.594	5.20
Enhancement of customer satisfaction	0	0	4.7	26.6	64.1	4.7	4.6	0.582	5.62
Increase of the enterprise's reliability	0	0	4.7	29.7	59.4	6.3	4.5	0.590	5.43
Reduction of inventory holding cost	0	3.1	10.9	32.8	48.4	4.7	4.3	0.810	4.53
Reduction in operating costs	3.1	3.1	9.4	26.6	51.6	6.3	4.2	1.009	4.64
Minimising the time for the order preparation	3.1	3.1	14.1	37.5	35.9	6.3	4.0	0.989	3.79
Greater safety from the risk of a drug shortage	0	3.1	4.7	28.1	56.3	7.8	4.4	0.751	5.17
Greater safety from possible delays of suppliers	0	1.6	7.8	34.4	50.0	6.3	4.4	0.719	5.04
Exploitation of probable quantitative and financial rebates offered by the supplier	0	0	3.1	28.1	64.1	4.7	4.6	0.548	5.57

<b>N</b>	58
<b>Chi-Square</b>	50.184
<b>Df</b>	8
<b>Asymp. Sig.</b>	.000

<sup>a</sup>: *Friedman (K-Related Samples) Test*

The main benefits appear to be the enhancement of customer satisfaction and the exploitation of probable quantitative and financial rebates offered by the supplier, closely followed by the increase of enterprise's reliability, the improved management of drug procurement and the great safety from both the risk of a drug shortage and possible delays of suppliers. The mean values range from 4.0 to 4.6, while standard deviation has relatively low values indicating high unanimity among the participants in the survey.

According to Lauer (2004) and McKone-Sweet et al (2005), one of the major problems in the drug supply chain management is the lack of drug demand forecasts. The benefits of demand forecasting are visible to all levels of the drug distribution channels and particularly to the retailers-pharmacies that directly contact with the patient-client. Moreover, Mustafa et al (2009) studied two levels of the drug distribution system in Malaysia, wholesale and retail distribution, and they concluded that monitoring the customer satisfaction level and controlling the operating costs by reducing emergency orders, due to inventory shortage, are the keys to the successful operation of a pharmacy. Thus, the results of this study are in line with prior research findings.



**Cooperation between pharmacy and wholesaler for better demand management**

Next, the pharmacists and their employees were asked about the necessity of the cooperation between pharmacy and wholesaler in order to manage demand more effectively. Rather positively, 89% of respondents strongly (53.1%) or rather agreed that such cooperation is necessary (Table 5). However, not surprisingly 71.9% of the participants stated that they have not cooperated with a pharmaceutical wholesaler in the past in order to achieve better demand forecasting of drugs, while 26.6% answered positively to the relevant question and only 1 participant did not answer. Nonetheless, it is very pleasant that 93.8% of the respondents claimed that they would cooperate with a pharmaceutical wholesaler today in order to achieve better demand forecasting of drugs, and only 4.7% were negative to such a cooperation.

**Table 5: Necessity for the cooperation between pharmacy and wholesaler for better demand management: Frequencies (%) and Descriptive statistics**

1	2	3	4	5	No answer	Mean	Std. Dev.
0	0	9.4	35.9	53.1	1.6	4.4	0.666

According to the results reported in Table 6, none of the proposed barriers for the cooperation between pharmacy and wholesaler seems to be considered as rather important by the pharmacists and their employees. Mean values range from 3.20 to 3.52, namely between fairly (3) and a lot (4) important, but it should be mentioned that the standard deviation values are relatively high indicating significant divergence in respondents' views. The lack of trust to the pharmaceutical wholesaler and, in particular, the fear that the pharmaceutical wholesaler will hide important information are considered to be slightly the most important barriers to cooperate with wholesalers, as more than 50% of the participants claim to be a lot or extremely important. Thus, there is an important portion of pharmacists that are rather cautious to cooperate with wholesalers, generally, because of the lack of trust to them.

According to Jambulingam et al (2009) trust plays an important role in the relationship between warehouse and pharmacy. They stress that the establishment of long-term relationships that are characterized by dedication, reliability and stability is the key to inventory optimization. Doucette (1998), Kumar (1995), Frazier et al., (1988), also concluded that the gradual building of confidence between wholesalers and retailers and the collaborative demand forecasting, maximize the competitive advantages of the integrated supply chain.

Data analyses revealed that maintaining long-term relationships with loyal customers is the most important expected benefit for the cooperation or pharmacies with pharmaceutical wholesalers, as 50% deem that it is extremely important and 33% a lot important (Table 7). The better response to changes in the pharmaceutical market was evaluated as the next most important benefit, as 75% of the participants stated to be a lot or extremely important.

The mean values of respondents answers for the rest of the proposed expected benefits ranged from 3.86 to 4.08, namely around 4 corresponding to a lot important. Moreover, the standard deviation values were relatively low, as a very slight portion (less than 3.1%)

of the participants in the survey think that any of proposed expected benefits is not at all or little important. It should also be mentioned that around 11% of the respondents did not answer the relevant sentence to bullwhip effect mainly due to their lack of knowledge to that term.

**Table 6: Frequencies (%), Descriptive statistics and Ranking<sup>a</sup> of the barriers for the cooperation between pharmacy and wholesaler**

	1	2	3	4	5	No answer	Mean	Std. Dev.	Mean Rank <sup>a</sup>
The lack of trust to the pharmaceutical wholesaler	10.9	17.2	12.5	14.1	35.9	9.4	3.52	1.48	2.69
The fear of a leak of confidential information from the pharmaceutical wholesaler	9.4	20.3	18.8	21.9	21.9	7.8	3.29	1.33	2.40
The fear that the pharmaceutical wholesaler will hide important information	12.5	4.7	20.3	35.9	18.8	7.8	3.47	1.26	2.67
The pharmaceutical wholesalers are not interested in such a cooperation	14.1	9.4	31.3	21.9	17.2	6.3	3.20	1.29	2.24

<b>N</b>	56
<b>Chi-Square</b>	6.533
<b>Df</b>	3
<b>Asymp. Sig.</b>	.088

<sup>a</sup>: *Friedman (K-Related Samples) Test*

**Table 7: Frequencies (%), Descriptive statistics and Ranking<sup>a</sup> of the benefits from the cooperation between pharmacy and wholesaler**

	1	2	3	4	5	No answer	Mean	Std. Dev.	Mean Rank <sup>a</sup>
Higher accuracy in demand forecasting	0.0	3.1	15.6	56.3	20.3	4.7	3.98	0.72	3.20
Cost reduction due to lower safety stock inventory	0.0	1.6	17.2	46.9	28.1	6.3	4.08	0.74	3.46
Reduction in the bullwhip effect	0.0	0.0	20.3	48.4	20.3	10.9	4.00	0.68	3.36
Maintaining long-term relationships with loyal customers	0.0	1.6	9.4	32.8	50.0	6.3	4.40	0.74	4.24
Generation of independent and objective forecasts	0.0	1.6	28.1	42.2	18.8	9.4	3.86	0.76	3.03
Better response to changes in the pharmaceutical market	0.0	3.1	14.1	35.9	39.1	7.8	4.20	0.83	3.71

<b>N</b>	56
<b>Chi-Square</b>	26.693
<b>Df</b>	5
<b>Asymp. Sig.</b>	.000

<sup>a</sup>: *Friedman (K-Related Samples) Test*

The findings from our survey are supported by the prior research. Gambetta (1988), Bradach and Eccles (1989) and Cropanzano et al (2002)

investigated the benefits of the cooperation between pharmacies and wholesalers for demand forecasting and they also concluded that maintaining long term relationships with loyal customers and the best response to the pharmaceutical market changes, are the best strategies of private pharmacies to confront the threats of the increasingly competitive environment mainly driven by the huge pharmacy chains.

### **Conclusions, Recommendations and Limitations**

The survey results revealed the lack of knowledge of pharmacists and their employees engaged in inventory management about the demand forecasting and its benefits to their business. Although, the great majority (75%) of the respondents know that their IT system can provide to them drug demand forecasts, only a small portion (around 20%) of them state that they exclusively use the capabilities of computer systems to prepare their orders to suppliers. Indeed, around 75% of the participants in the survey reported that they do not use any demand forecasting method.

Although, it is obvious that pharmacies have little benefited by the IT systems in terms of optimizing their inventory management and, in particular, in exploiting the opportunities offered by demand forecasting, it is rather encouraging that the majority of them have realized that demand forecasting is necessary to determine the order quantity. For this reason, more than 80% of the pharmacists and their employees declared that they are ready to get more familiar with applications provided by their pharmacy's IT system in the future. The great majority of the respondents appear to have very high expectations from the demand forecasting methods, as more than half of them strongly agree that their business will enjoy almost all the proposed benefits. The enhancement of customer satisfaction and the exploitation of probable quantitative and financial rebates offered by the supplier, closely followed by the increase of enterprise's reliability, the improved management of drug procurement and the great safety from both the risk of a drug shortage and possible delays of suppliers, were found to be the most important benefits.

From the above it can be concluded that the pharmacists seem to be rather convinced that they have to rely more on formal-scientific ways of decision making in their everyday struggle to survive in an increasingly competitive entrepreneurial environment with continuously shrinking profit margins.

However, medicines' demand forecasts should always be treated with caution, as there are several cases that demand overestimation created severe problems to the drug supply chain and, in particular, to the pharmaceutical companies. In 2007, for example, Novartis, one of the largest pharmaceutical manufacturers worldwide, estimated that 30 million doses of the ACTs medicine would be necessary to deal with the malaria disease in Africa. However, only 9 million doses were required, resulting to several billion dollars loses for the company (CGD, 2007).

The study also revealed that almost all the participants in the survey (around 90%) think that the cooperation between pharmacy and wholesaler is necessary for the optimization of demand management. Thus, although, only around 30% of them claimed to have attained such a cooperation so far, around 90% of them are willing to do so in the future. This stand can be justified by the pharmacy managers' very positive attitudes that the cooperation of pharmacies with

pharmaceutical wholesalers will significantly improve the drugs' demand management. Specifically, maintaining long-term relationships with loyal customers, closely followed by the better response to changes in the pharmaceutical market, were considered as the most important benefits.

In line with the prior research the lack of trust appears to be the most important barrier to the cooperation between pharmacies and wholesalers. Even though, none of the proposed barriers for the cooperation between pharmacy and wholesaler seems to be considered, in general, as rather important by the pharmacists and their employees, more than 50% of the participants claimed the lack of trust to the pharmaceutical wholesaler and, in particular, the fear that the pharmaceutical wholesaler will hide important information, to be a lot or extremely important. Consequently, the gradual and everyday building of confidence between wholesalers and retailers is the prerequisite for their collaboration in the drug supply chain.

The low level of IT systems utilization, mentioned above, may, *inter alia*, be explained by the lack of any managerial or IT related modules in the curricula of the Greek Pharmaceutical Schools. Therefore, it would be rather beneficial to the graduates of the Pharmaceutical Schools their curricula to be enriched by modules that would encourage the scientific managerial decision making exploiting the contemporary IT applications. Moreover, through interactive seminars the pharmacy's managers would improve their knowledge on the principal inventory management issues which would facilitate the complete and effective computerization of their company's operations.

More than 50% of the participants are skeptical to a cooperation with the pharmaceutical wholesalers due to the lack of trust, although the vast majority of them recognize the great importance of such a cooperation. Therefore, it would be rather lucrative for all the participants in the drug supply chain to undertake initiatives to extensively investigate the opportunities of attaining and maintaining competitive advantage through the integrated supply chain. The benefits of the long term collaborations among participants in the supply chain would provide them with reasonable incentives to identify the ways to building the necessary confidence among them.

The participants in the drugs supply chain have access to high quality demand data, but they do not share this information and they do not invest in a market survey that would constitute a good basis for relatively accurate demand forecasting. Therefore, it would be beneficial to all the creation of a Greek health data base tailored to the needs of the country.

It is also proposed that future research focuses on the attitudes of the managers responsible for inventory managements of the pharmaceutical manufacturers and wholesalers, as well as of the public and private hospitals, clinics and health centers. Such research would allow to obtain a comprehensive picture of the knowledge and attitudes of all those involved in the drug supply chain.

The findings of our study are subject to a number of limitations, which are often common to similar studies. Exploring entrepreneurial attitudes always involve a self-assessment bias and particularly. Moreover, because of the complexity of the issues investigated and the limited familiarity of pharmacists with them, we cannot know precisely the degree of reliability of the responses. Additionally, it was

difficult to attain a large sample of pharmacists and to have them participate in a longitudinal study. Thus, we should generalize the findings of this survey with caution, as the sample of the pharmacy managers originate mainly from four Greek cities and towns, and particularly, it is rather representative of the young and middle aged and most educated professionals.

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**Appendix - Survey Questionnaire**

- 1.1. Do you know what the drugs' demand forecasting methods are? A. I have heard, but I do not know what exactly are, B. Yes I know, C. No I do not know.
- 1.2. Do you know that IT systems enable drugs' sales and demand forecasting? A. Yes, B. No.
- 1.3. Which inventory management system do you use in your pharmacy? A. Handwritten, B. IT, C. Combination of handwritten and IT.
- 1.4. For the determination of the order quantity you use: A. a mathematical model based on demand forecasting method, B. Daily sales, C. Your experience and judgment.
- 2.1. Please state with X the level you think that drugs' demand forecasting is necessary for the determination of order quantity (from 1=Not at all, to 5=Extremely).
- 2.2. Have you ever used any demand forecasting method? A. Yes, B. No.
- 2.3. Would you use today a demand forecasting method? A. Yes, B. No.
3. Please state with X the level you agree or disagree that the drugs' demand forecasting will have the following benefits in your business management: A. Improved management of drug procurement, B. Enhancement of customer satisfaction, C. Increase of the enterprise's reliability, D Reduction of inventory holding cost, E. Reduction in operating costs, F. Minimising the time for the order preparation, G. Greater safety from the risk of a drug shortage, I. Greater safety from possible delays of suppliers, J. Exploitation of probable quantitative and financial rebates offered by the supplier.  
(1=Totally disagree, 2=Rather disagree, 3=Neither disagree nor agree, 4= Rather agree, 5=Totally agree).
- 4.1. Please state with X the level you agree or disagree regarding the necessity of the cooperation between pharmacy and wholesaler to manage demand more effectively.  
(1=Totally disagree, 2=Rather disagree, 3=Neither disagree nor agree, 4= Rather agree, 5=Totally agree).
- 4.2. Have you cooperated with a pharmaceutical wholesaler in the past in order to achieve better demand forecasting of drugs? A. Yes, B. No.
- 4.3. Would you cooperate with a pharmaceutical wholesaler today to achieve better demand forecasting of drugs? A. Yes, B. No.
- 4.4. Please state with X the level you think that following barriers are important for your cooperation with pharmaceutical wholesalers: A. The lack of trust to the pharmaceutical wholesaler, B. The fear of a leak of confidential information from the pharmaceutical wholesaler, C. The fear that the pharmaceutical wholesaler will hide important information, D. The pharmaceutical wholesalers are not interested in such a cooperation.  
(1= Not at all, 2=Little, 3=Fairly, 4= A lot, 5=Extremely)
- 4.5. Please state with X the level you think that following benefits are important for your cooperation with pharmaceutical wholesalers: A. Higher accuracy in demand forecasting, B. Cost

reduction due to lower safety stock inventory, C. Reduction in the bullwhip effect, D. Maintaining long-term relationships with loyal customers, E. Generation of independent and objective forecasts, G. Better response to changes in the pharmaceutical market.

(1= Not at all, 2=Little, 3=Fairly, 4= A lot, 5=Extremely)

- 5.1. Gender: A. Male, B. Female.
- 5.2. Age: A. <30, B. 30-40, C. 41-50, D. 51-60, E. >60
- 5.3. Education level: A. BSc in Pharmacy, B. Other BSc, C. BSc in Pharmacy & MSc, D. BSc in Pharmacy & PhD, E. Vocational training.
- 5.4. Do you use PC and Internet for your everyday needs at home? A. Yes, B. No.
- 5.5. Workingexperience: A. <5 years, B. 5-10, C. 11-20, D. >20
- 5.6. Position in the Pharmacy: A. Owner, B. Employee