TECHNIUM
SOCIAL SCIENCES JOURNAL

Vol. 37, 2022

A new decade for social changes

ISSN 2668-7798

www.techniumscience.com

Technium Social Sciences Journal
Vol. 37, 324-340, November, 2022
ISSN: 2668-7798
www.techniumscience.com

Development and Implementation of Quality Assurance According to GMP Guidelines in Lebanese Pharmaceutical Companies

Nour Yassin

Beirut Arab University

ynour1425@gmail.com

Abstract. The quality of pharmaceuticals has always been a concern to the World Health Organization (WHO) from the beginning its inception. Good Manufacturing Practice (GMP) is an important part of a comprehensive system of quality assurance (QA) for both manufacturers and the government. In Lebanon, and since its application, many challenges faced the implementation of the QA program according to GMP guidelines. Yet, this program has been successfully implemented in the Lebanese pharmaceutical industry supported by the Lebanese Ministry of Public Health (MOPH), and the commitment of the national GMP committee, in addition to the involvement of the public and private pharmaceutical sectors. The main objective of this study is to evaluate the implementation of the QA program according to GMP guidelines by selected Lebanese pharmaceutical companies. A descriptive analytical study was conducted between August-November of 2018, using a questionnaire that was administered to the quality departments of 10 Lebanese pharmaceutical companies. Finding showed that all these companies were implementing the QA programs according to GMP guidelines (100%), where 60% of their quality managers are experienced in GMP guidelines for more than 6 years. Further, 50% of these companies were applying QA program according GMP guidelines since more than 6 years, and 80% of them are formulating their programs using all the quality tools of the international GMP standards. Moreover, 80% of them are establishing awareness toward the implementation of GMP guidelines through training by internal expertise and external consultants. On the other hand, the implementation cost was the most important challenge faced by 60% of these firms. Finally, all companies are profiting by an increase in efficacy and efficiency, better product quality, and decrease in defects due to the implementation of the GMP guidelines. All the Lebanese pharmaceutical companies are working toward developing their program to meet the international standards, yet, they still need governmental support to spread and compete around the world.

Keywords. Quality Assurance, GMP Guidelines, Lebanese Pharmaceutical Companies, Medicinal Products

1. Introduction

The quality of pharmaceuticals is a primary concern to the World Health Organization (WHO). Without assurance that these medications are relevant to primary patients' health needs and meeting acceptable standards of quality, safety, and efficacy, any health service will be evidently compromised (WHO, 2016). According to the WHO in its 2010 report, the

Technium Social Sciences Journal
Vol. 37, 324-340, November, 2022
ISSN: 2668-7798
www.techniumscience.com

transparency assessment of the Lebanese pharmaceutical sector lead to many changes, where a number of gaps has been identified. One of the main gaps was related to the national GMP standards (WHO, 2009). This lead to the formation of a national GMP committee in 18 March 2008 by ministerial decree no.212/1 (Serhan, 2010). Many challenges faced the implementation of the QA program according to GMP guidelines since its application, including poor understanding of transparency and good governance, fear of being evaluated, and resistance to change. Yet, this program witnessed a successful implementation in the Lebanese pharmaceutical industry due to the support from the Lebanese Ministry of Public Health, and the commitment of the national GMP committee, in addition to the involvement of both the public and private pharmaceutical sectors (Serhan, 2010), (WHO, 2010).

2. Literature

2.1 Definition of Quality Assurance and Good Manufacturing Practice

Quality Assurance is the sum of organized arrangements aiming to ensure that medicinal products have the quality required for their intended use (Ethiopian Food, Medicine & Healthcare Administration & Control, 2014).

Good Manufacturing practice is defined as a system of directions, codes, and rules that guarantees the reliable production of medication substances and pharmaceuticals, therapeutic devices, in vivo and in vitro diagnostic items, and foods, controlled by quality standards, and designed to minimize risks associated with pharmaceutical production that cannot be avoided by testing the final product alone (Petra Brhlikova, 2007), (WHO, 2004).

2.2 Lifecycle Approach for Process Validation in GMP

According to the Food and Drugs Administration (FDA), the quality and safety of drugs can be enhanced by making each step of the manufacturing process specific and controlled, rather than randomly testing a sample from the finished products' batch (Dr. Christine Oechslein, 2012). This process is carried out in three stages:

Stage 1: Process Design – define and control manufacturing process where the sources of variability should not have any negative impact on the safety and quality of the products.

Stage 2: Process Qualification – each of the facility, equipment, process, and utilities should qualify for GMP, and that the analytical and sampling methods should prove to be within the FDA acceptable operating range.

Stage 3: Continued Process Verification –continuous verification that the entire manufacturing process is controlled and consistent, matching stage 2 documentations.

2.3 Importance of GMP Guidelines in the Pharmaceutical Industry

Poor quality medicines production and distribution result in loss of credibility, reputation, and trust. Therefore, implementing a fully-compliant GMP program results in many benefits such as eliminating production quality defects, enhanced quality products, meeting or even exceeding customers' satisfaction, increasing sales and returns, and enhancing employee empowerment (Karmacharya, 2001).

2.4 Basic Requirements of QA Program according to GMP Guidelines in the Lebanese Pharmaceutical Industry

QA program consists of eight core GMP systems (DIRECTORATE, 2013):

2.4.1 Personnel: The key personnel in charge for supervision and quality control of pharmaceuticals must possess the credentials of a scientific culture and practical experience mandated by national legislation, coupled with an experience in the manufacturing and QA of pharmaceutical products.

Technium Social Sciences Journal
Vol. 37, 324-340, November, 2022
ISSN: 2668-7798
www.techniumscience.com

2.4.2 Premises and equipment: Premises must have specific criteria, including cleanliness and purification of manufacturing areas, storage conditions, contamination protection, prohibition of unauthorized people entry, and cycle of operation link.

Equipment must be designed, personalized, calibrated, and cleaned on a regular basis to satisfy the operation in a way that reduces risk of errors. (WHO EXPERT COMMITTEE ON SPECIFICATIONS FOR PHARMACEUTICAL PREPARATIONS, 2003).

2.4.3 Production operations: Documentation is key for GMP compliance that ensures traceability of all development, manufacturing, and testing activities (Pharm., 2011).

2.4.4 Documentation: Every step done should be recorded and documented in the form of Standard Operating Procedure (SOP).

2.4.5 Packaging and labeling: Containers should offer protection against deterioration or contamination during transportation and storage. They should be cleaned, sanitized, and not reactive or absorptive.

Access to the label storage areas is limited to authorized personnel. Procedures should be applied to monitor the quantities of labels issued, used, and returned, and to assess discrepancies between the number of label and the number of containers. (Q7 Good Manufacturing Practice Guidance for Active Pharmaceutical Ingredients, 2016).

2.4.6 Sanitation and hygiene: A high level of sanitation and hygiene should be implemented in each step of drug manufacturing. The scope of sanitation and hygiene covers personnel who should be skilled in the practices of personal hygiene, premises, equipment, and materials for cleaning and disinfection or any source of contamination to the product. (WHO EXPERT COMMITTEE ON SPECIFICATIONS FOR PHARMACEUTICAL PREPARATIONS, 2003)

2.4.7 Complaints and products recall: Complaint is any communication received from customers to declare that there is something wrong concerning the quality characteristics, labeling, or packaging defects. A systematic approach of customer-focused complaints management, by qualified and skilled personnel, should by applied for handling complaints in order to maintain a good relationship with the customer.

2.4.8 Auditing and self-inspection: Internal Audit Standard Board defines auditing as an independent examination of financial information of any entity to express an opinion thereon (Sumit Kumar, 2013). The auditors are part of the QA for data inspection to decide if the procedures and policies of the company are followed.

2.4.9 Corrective action preventive action: The CAPA system is the basis for a Quality Management System and the reason for Quality improvements in the pharmaceutical industry. It improves the processes, procedures, organization, and business in a planned, controlled, well-documented, and actionable way (Markens, 2014) (Tartal, 2014).

3. Methodology

This research employed a descriptive analysis to evaluate the implementation of QA program according to GMP guidelines in 10 Lebanese pharmaceutical companies, targeting the quality team, quality management, or quality department, where a permission letter from the Lebanese University-Faculty of Pharmacy was addressed to each company, and the questionnaires were sent by emails.

Further, data coding, entry, and descriptive analysis were performed using the SPSS statistical software version 21. Frequencies and percentages were presented for nominal and qualitative variables, whereas Chi-Square analysis was performed to compare qualitative

Technium Social Sciences Journal
Vol. 37, 324-340, November, 2022
ISSN: 2668-7798
www.techniumscience.com

variables by determining if the relation between two nominal variables is statistically significant, with p-value<0.05.

4. Results and descriptive analysis

Empirical findings from the primary data collection from the questionnaire are decoded, discussed, and analyzed in relation to the study objectives and hypotheses.

4.1 General demographic information

4.1.1 Companies' location

The majority of the companies are located in Maten (44%), whereas an equal percentage are located in South and Mount Lebanon (11%), and none of them is located in North Lebanon, as shown in figure 1.

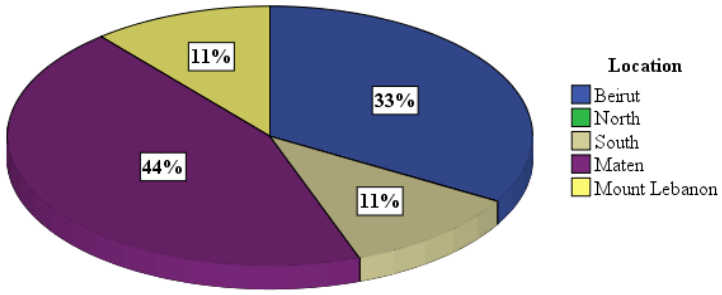

Fig.1 Companies' Location

4.1.2 Types of manufactured products

The types of manufactured products vary where 10% of the companies produce serums, tablets, intravenous injections, and syrups, while 20% produce tablets, intravenous injections, and syrups, and 40% produce both tablets and syrups, as shown in figure 2.

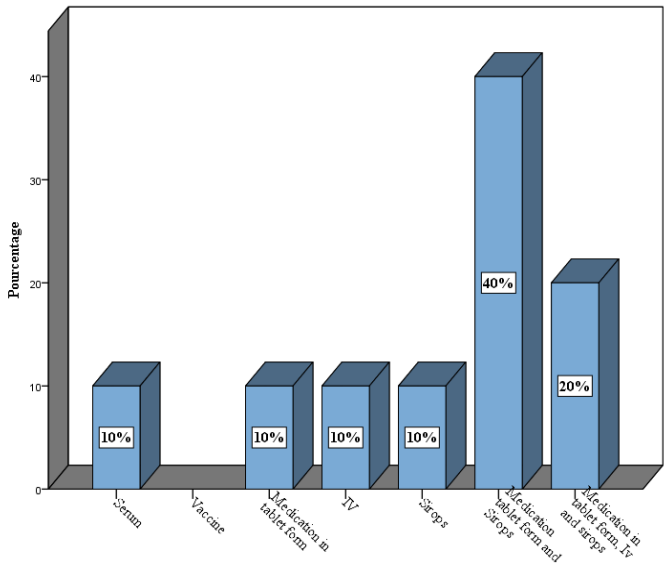

Fig.2 Types of Manufactured Products

Technium Social Sciences Journal
Vol. 37, 324-340, November, 2022
ISSN: 2668-7798
www.techniumscience.com

4.1.3 Responsibility of the quality department

67% of the companies give the responsibility to the quality manager, while 11% give it to the top management. Similarly, 11% give it for both quality manager and quality team, and 11% share the responsibility between the top management, quality manager, and quality team, whereas none gives the responsibility exclusively for external consultant or quality team, as shown in figure 3.

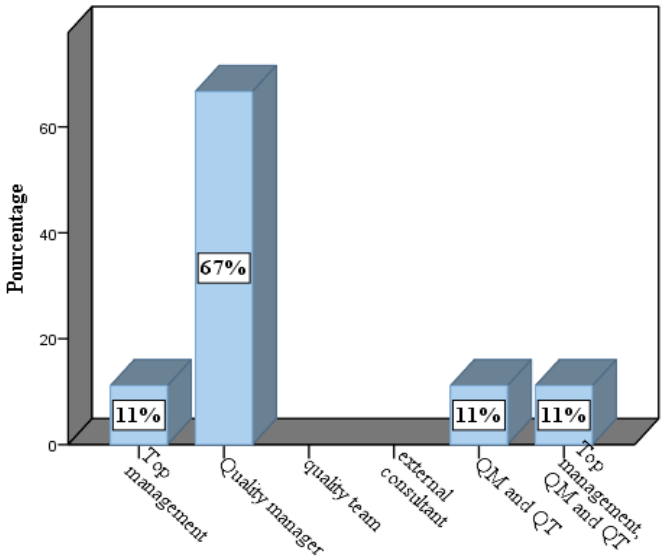

Fig.3 Responsibility of the Quality Department

4.1.4 Educational background of the quality manager

Figure 4 shows that over the pharmaceutical companies questioned in Lebanon 44% of the quality managers have BS in pharmacy, 44% have PharmD, while only 11% have PharmD, MBA, and industrial masters.

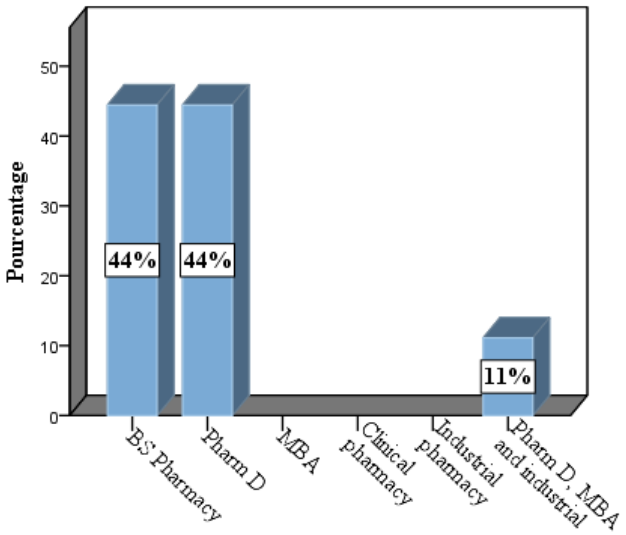

Fig.4 Educational Background of the Quality Manager

Technium Social Sciences Journal
Vol. 37, 324-340, November, 2022
ISSN: 2668-7798
www.techniumscience.com

4.1.5 Quality staff number of the quality department

Figure 5 shows that 44% of the companies have 3 members in the quality team, 32% have 4, 11% have 3, and 11% have more than 6 members.

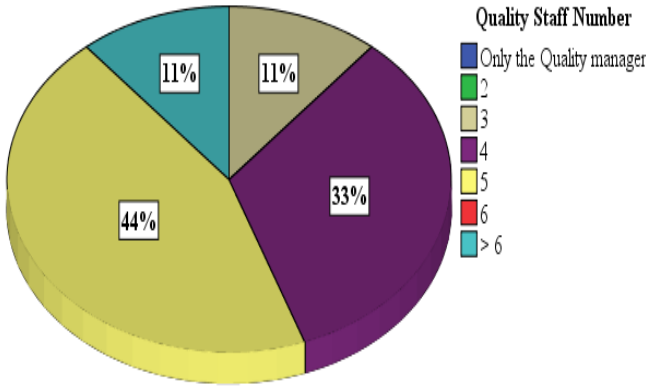

Fig.5 Quality Staff Number of the Quality Department

4.1.6 Years of GMP experience of the quality manager

60% of the companies' quality managers have more than 6 years of GMP experience, while 40% have 3-6 years of experience, whereas none of them has experience between 1-3 years or less than 1 year, as shown in figure 6.

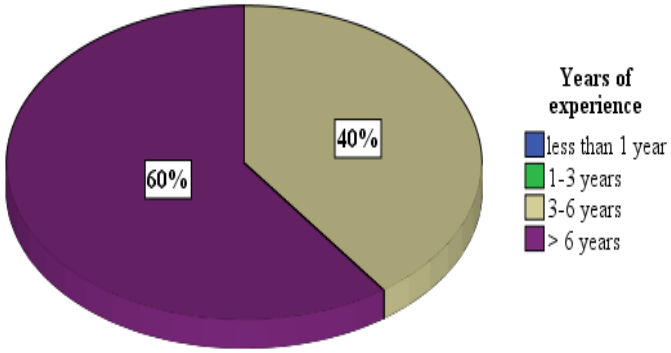

Fig.6 Years of GMP Experience of the Quality Manager

4.2 Evaluation of the effectiveness of QA implementation according to GMP guidelines

4.2.1 Time of QA program application according to GMP guidelines by the company

Figure 7 shows that 50% of the companies are applying the QA according to GMP guidelines for more than 6 years, 40% are doing so from 4-6 years, while 10% start applying it from 2-4 years, and none of them is applying the GMP guidelines from less than 2 years.

Technium Social Sciences Journal
Vol. 37, 324-340, November, 2022
ISSN: 2668-7798
www.techniumscience.com

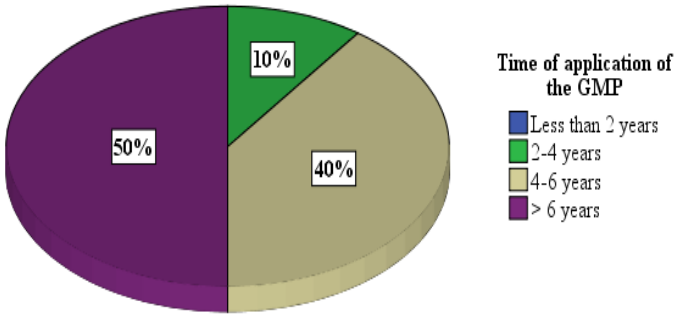

Fig.7 Time of QA Program Application According to GMP Guidelines

4.2.2 Criteria of choice of the quality manager and quality department team

As shown in figure 8, 33% of the companies select their QM and QT according to their educational level in pharmaceutical sciences, in addition to the education in the quality system, along with experience in the pharmaceutical field, and in the application of quality systems, while 22% base their selection on their education in pharmaceuticals and quality, in addition to experience in pharmaceutical field, and finally, 11% select them according to their education in pharmacy or education in quality, or both education in pharmacy and experience in quality system application.

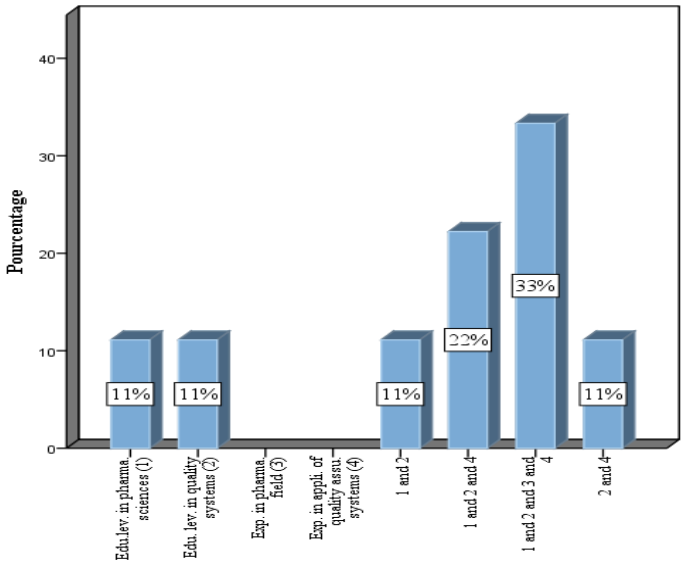

Fig.8 Criteria of Choice of the Quality Manager and Quality Department Team

4.2.3 Preparation of QA program regarding GMP guidelines

Figure 9 shows that 100% of the companies used SOP documentation and QC measurement as tools in the preparation of QA programs, while 90% used quality tools technique, audit control system, training programs, job description, premises facilities, and process analysis, and finally, 80% used CAPA and quality management plans.

Technium Social Sciences Journal
Vol. 37, 324-340, November, 2022
ISSN: 2668-7798
www.techniumscience.com

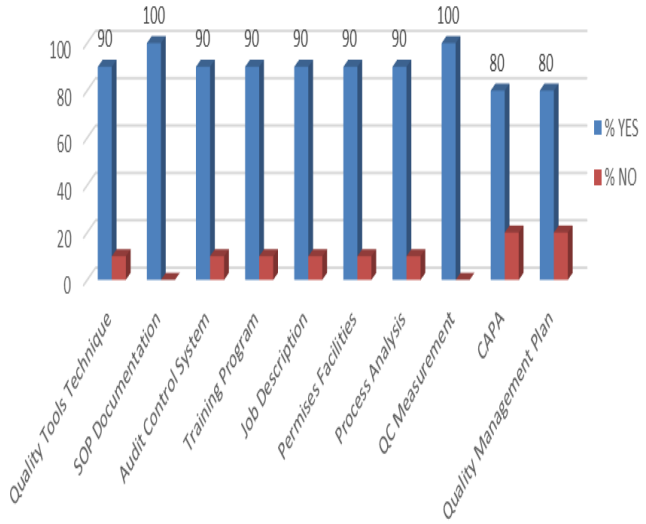

Fig.9 Preparation of QA Program Regarding GMP Guidelines

4.2.4 Accordance of the employee's responsibilities respecting GMP guidelines in QA

50% of the employees' responsibility is designed according to job descriptions, 40% according to both job description and SOP manual, while 10% are designed according to SOP manual only, as shown in figure 10.

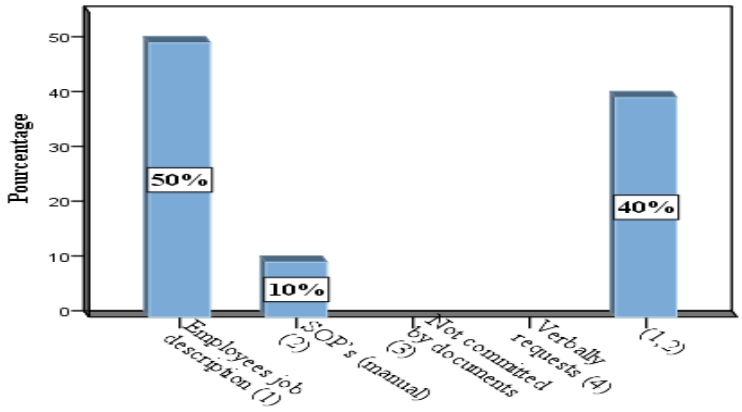

Fig.10 Accordance of Employees' Responsibility

4.2.5 Establishment of awareness and implementation of QA program according to GMP guidelines

Figure 11 shows that 80% of the companies established the awareness and implementation of QA program according GMP guidelines through training by internal expertise and by external consultant, 10% through training by internal expertise and cooperated with the MOPH, and 10% only through training by internal expertise.

Technium Social Sciences Journal
Vol. 37, 324-340, November, 2022
ISSN: 2668-7798
www.techniumscience.com

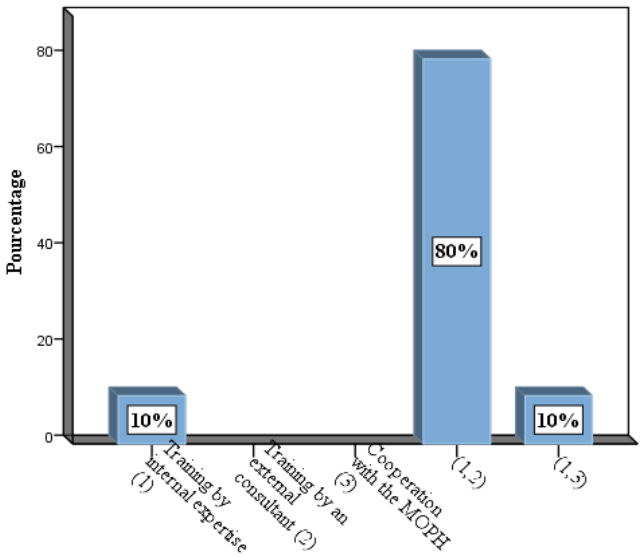

Fig.11 Establishment of Awareness and Implementation of QA program according to GMP Guidelines

4.2.6 Challenges faced during QA program implementation according to GMP guidelines

The most challenges faced by 60% of the companies during QA program implementation was the culture and the cost of implementation, while 30% faced legal and environmental challenges coupled with lack of experience, and 20% were challenged due to lack of awareness, and finally 10% faced the lack of resources challenge, with the absence of political challenges, as shown in figure 12.

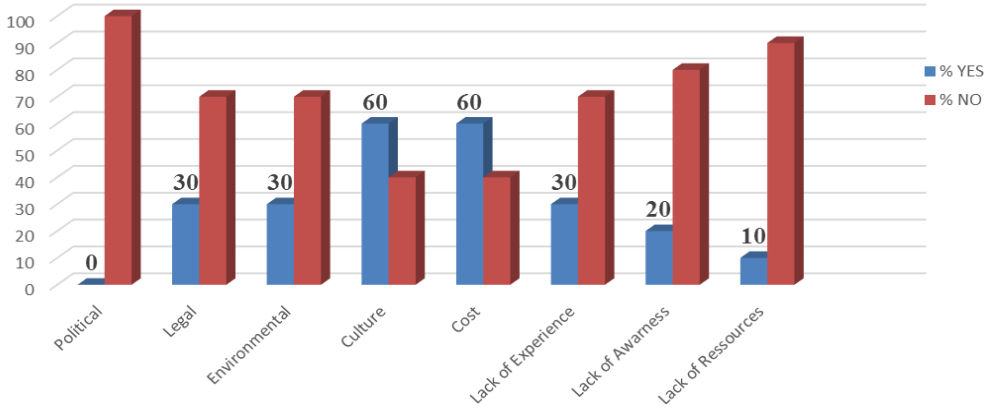

Fig.12 Challenges Faced during QA Program Implementation according to GMP Guidelines

4.2.7 Industry confrontation of the challenges encountered during QA program implementation

Figure 13 shows that 44% of the pharmaceutical companies in Lebanon are facing the challenges encountered during the QA program implementation due to changing the management program, while 22% gaining access to more performance data, and 11% are applying new strategies (PESTEL), where 11% are combining change in management along with gaining access to more performance data with similar percentages for options 1 and 2.

Technium Social Sciences Journal
Vol. 37, 324-340, November, 2022
ISSN: 2668-7798
www.techniumscience.com

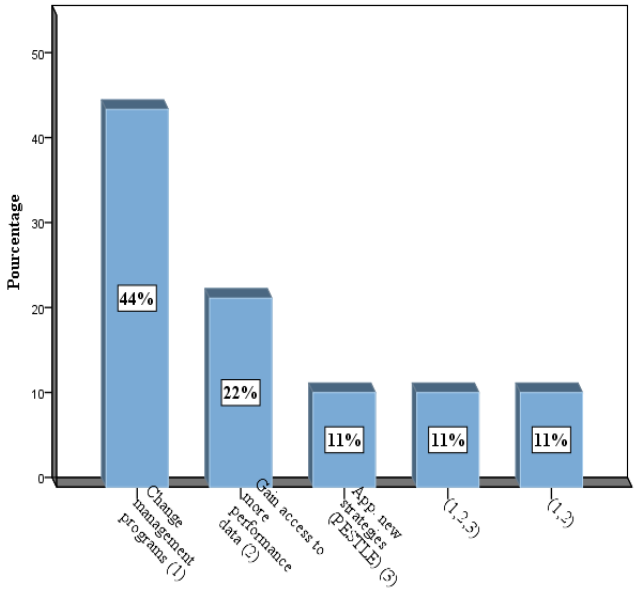

Fig.13 Industry Confrontation of the Challenges Encountered during QA Program Implementation

4.2.8 Frequency of training programs regarding GMP guidelines

50% of the Lebanese pharmaceutical companies perform a GMP guidelines training program 2 times per year, however 40% conduct it as needed, and 10% do it once per year, as shown in figure 14.

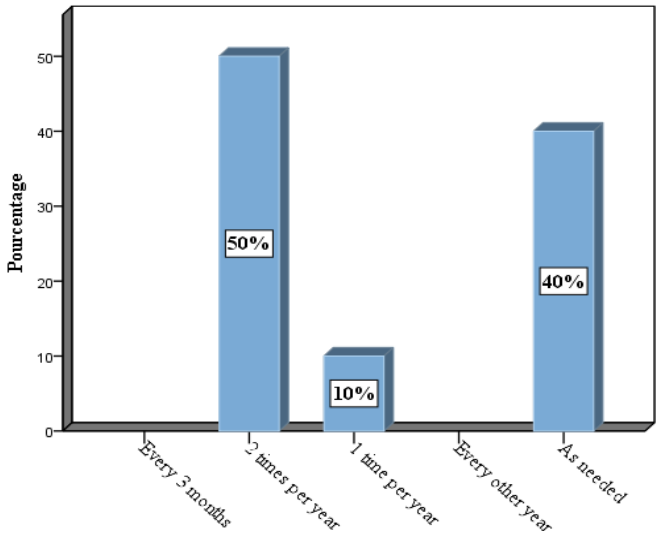

Fig.14 Frequency of Training Programs

4.2.9 Best method of documentation control in the quality assurance process

Figure 15 shows that the majority of the companies (30%) are using the control of document reports only, 20% of them combine document reports with the electronic system, or use a mixture of all methods, while 10% are controlling documentation by using an electronic system or combining achieving with SOP and documents report, but none is using SOP alone.

Technium Social Sciences Journal
Vol. 37, 324-340, November, 2022
ISSN: 2668-7798
www.techniumscience.com

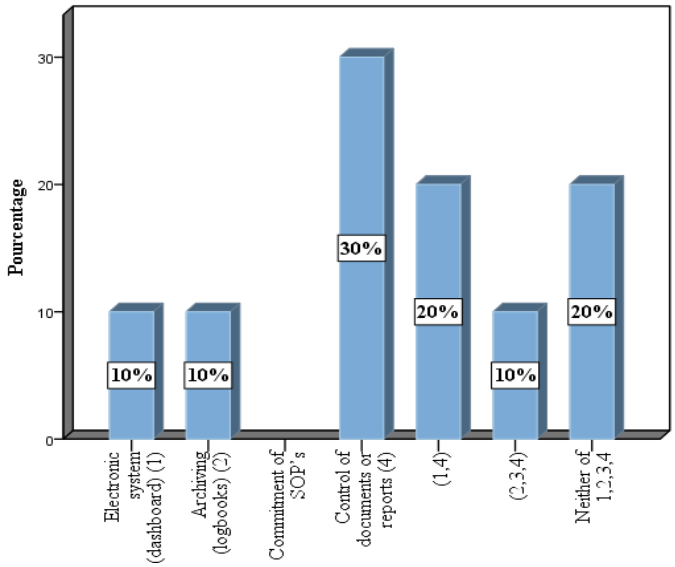

Fig.15 Best Method of Documentation Control in the QA Process

4.2.10 Documents control quality assurance program process

Figure 16 shows that 50% of the Lebanese pharmaceutical companies are controlling the documentation of the QA process using all the methods, 20% are relying on one individual responsible, and 10% are using PDF documents only or combining PDF with one responsible or an original stamp with a specific color.

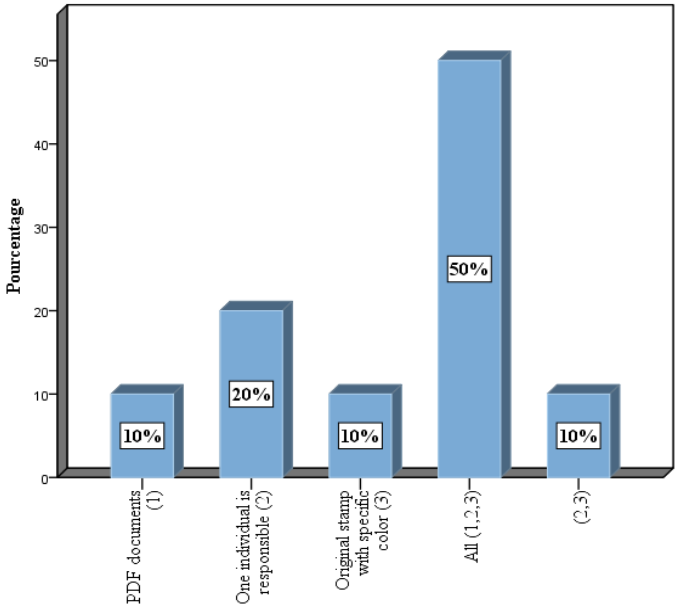

Fig.16 Documents Control of the QA Program Process

4.3 Evaluation of the effectiveness of QA implementation according to GMP guidelines

4.3.1 Monitoring of the QA program implementation

Figure 17 shows that the main way of monitoring QA program implementation in the Lebanese pharmaceutical companies is by the internal auditing reaching (90%), while external audit and

Technium Social Sciences Journal
Vol. 37, 324-340, November, 2022
ISSN: 2668-7798
www.techniumscience.com

self-assessment was conducted in 70%, and none of them is using competencies or benchmarking.

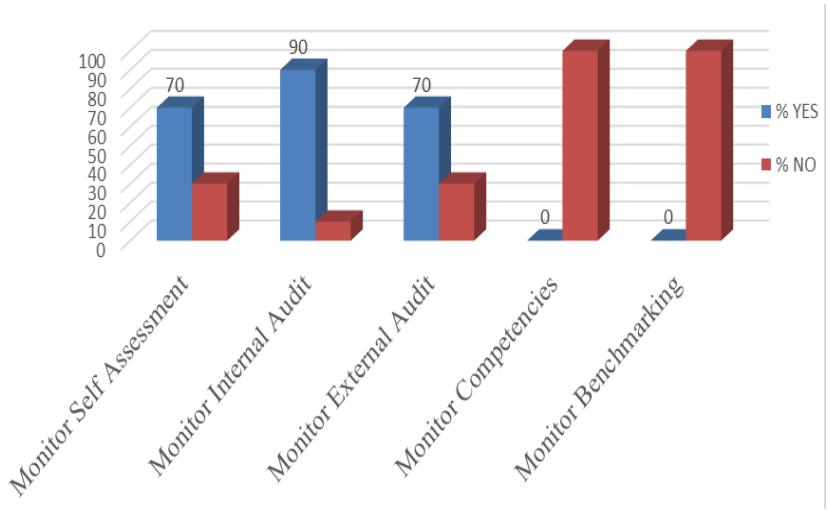

Fig.17 Monitoring of the QA Program Implementation

4.3.2 Mean of communication used during GMP process in case of defect

As shown in figure 18, in case of defect, 80% of the Lebanese pharmaceutical companies prepare a employees' meeting to solve the problem, 70% use records on logbooks, 30% send a report by mail, while 10% use reports' folder as a way of communication, but none of them use the dashboard.

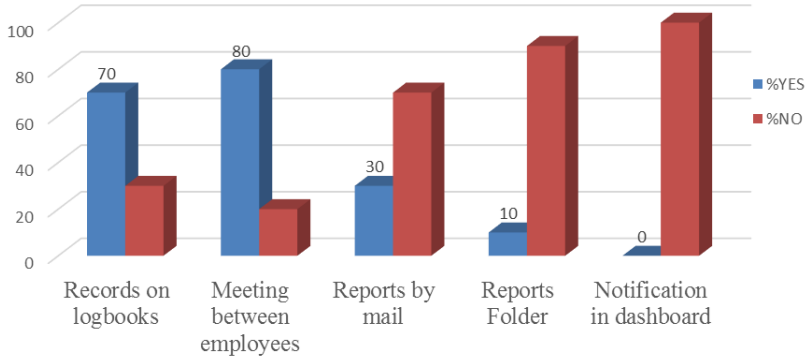

Fig.18 Means of Communication Used during GMP Process in Case of Defect

4.3.3 Measure of the QA program implementation effectiveness

Figure 19 shows that 80% of the Lebanese pharmaceutical companies are using the analysis of KPI and the report of audits when measuring the QA program implementation effectiveness, while 20% collect customer feedback, and only 10% use surveys.

Technium Social Sciences Journal
Vol. 37, 324-340, November, 2022
ISSN: 2668-7798
www.techniumscience.com

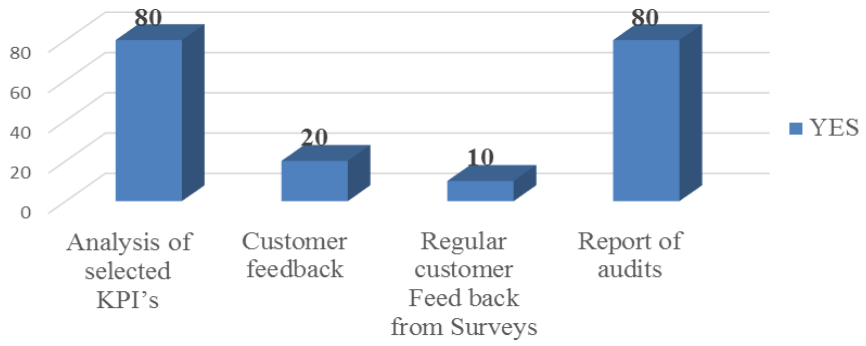

Fig.19 Measurement of the QA Program Implementation Effectiveness

4.3.4 Types of selected KPI

Figure 20 shows that all the Lebanese pharmaceutical companies (100%) use the deviation or defect in the KPI process, while 88.9% selected the process of implementation, 77.8% use customer complaints and product recalls, and 66.7% use risk identification and staff performance.

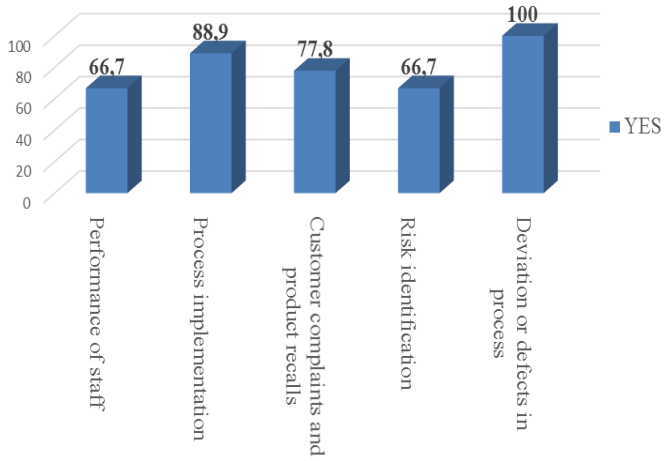

Fig.20 Types of Selected KPI

4.3.5 Benefits of QA program and GMP guidelines implementation on pharmaceutical companies

When implementing QA program and GMP guidelines, all the Lebanese pharmaceutical industries are gaining an increase in efficacy, efficiency, and product quality, as well as a decrease in defects. Further, 90% stated that there is an increase in customer satisfaction, while 80% benefit from an increase in productivity, profit, staff performance, and continuous improvement, as well as a decrease in cost and in customer recalls and complaints, as shown in figure 21.

Technium Social Sciences Journal
Vol. 37, 324-340, November, 2022
ISSN: 2668-7798
www.techniumscience.com

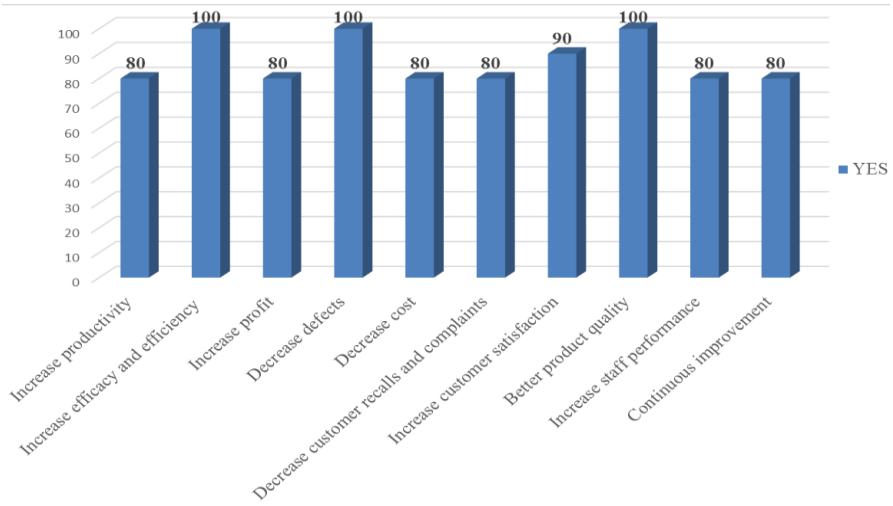

Fig.21 Benefits of QA Program and GMP Guidelines Implementation on Pharmaceutical Companies

4.4 Chi-square analysis

4.4.1 Relationship between years of experience and the measurement of effectiveness of QA program implementation according to GMP guidelines

H_0: There is no significant relation between years of experience and the measurement of effectiveness of QA program implementation according to GMP guidelines.

H_1: There is a significant relation between years of experience and the measurement of effectiveness of QA program implementation according to GMP guidelines.

The results of table 1 revealed no significant relation since all p-values>0.05, which indicates that H_0 is accepted.

		YearsExperience		Total	p-value
		3-6 years	> 6 years		
MeasureEffectAnalysisKPI					0,33
	YES	4 (100%)	4 (66,7 %)	8 (80 %)	
	NO	0 (0%)	2 (33,3 %)	2 (20%)	
MeasureEffectCF					0,133
	YES	2 (50 %)	0 (0%)	2 (20%)	
	NO	2 (50%)	6 (100%)	8 (80 %)	
MeasureEffectCFSurveys					0,4
	YES	1 (25 %)	0 (0 %)	1 (10 %)	
	NO	3 (75 %)	6 (100%)	9 (90%)	
MeasureEffectReportAudits					0,133
	YES	2 (50 %)	6 (100%)	8 (80%)	
	NO	2 (50%)	0 (0%)	2 (20 %)	

Table 1: Relationship between Years of Experience and the Measurement of Effectiveness of QA Program Implementation according to GMP Guidelines

4.4.2 Relation between time of GMP application and the monitoring of the QA program application

H_0: There is no significant relation between the frequency of training and the types of monitoring.

H_1: There is a significant relation between the frequency of training and the types of monitoring.

Technium Social Sciences Journal
Vol. 37, 324-340, November, 2022
ISSN: 2668-7798
www.techniumscience.com

Table 2 shows a significant relation between time of GMP application and using the monitoring tools with p-value 0.037 (< 0.05), which indicates that H_1 is accepted.

		Time of GMP Application			Total	p- value
		2-4 years	4-6 years	> 6 years		
Monitor QAPI						0,037
	Internal audit (2)	0 (0%)	0 (0%)	2 (40%)	2 (20 %)	
	(1-2-3)	0 (0%)	4 (100%)	1 (20%)	5 (50%)	
	(1-2)	1 (100%)	0 (0%)	0 (0%)	1 (10 %)	
	(1-3)	0 (0%)	0 (0%)	1 (20 %)	1 (10 %)	
	(2-3)	0 (0%)	0 (0%)	1 (20%)	1 (10 %)	

Table 1: Relation between Time of GMP Application and the Monitoring of the QA Program Application

4.4.3 Relationship between frequency of training and types of monitoring

H_0: There is no relation between frequency of training and the type of monitoring.
H_1; There is a relation between frequency of training and the type of monitoring.
The table 3 shows that there is a significant relation between the frequency of training and the external audit with p-value=0.04 (< 0.05), while there is no significant relation between the frequency of training and the internal audit and the self-assessment.

		Frequency of Training			Total	p- value
		2 times/ year	1 time / year	As needed		
Self Assessment						0,073
	YES	5 (100%)	0 (0%)	2 (50 %)	7 (70%)	
	NO	0 (0%)	1 (100%)	2 (50 %)	3 (30 %)	
Internal Audit						0,574
	YES	4 (80 %)	1 (100%)	4 (100%)	9 (90%)	
	NO	1 (20%)	0 (0%)	0 (0%)	1 (10%)	
External Audit						0,04
	YES	5 (100%)	1 (100%)	1 (25 %)	7 (70%)	
	NO	0 (0%)	0 (0%)	3 (75%)	3 (30%)	
Monitor Competencies						x
	YES	0 (0%)	0 (0%)	0 (0%)	0 (0%)	
	NO	5 (100%)	1 (100%)	4 (100%)	10 (100%)	
Monitor Benchmarking						x
	YES	0 (0%)	0 (0%)	0 (0%)	0 (0%)	
	NO	5 (100%)	1 (100%)	4 (100%)	10 (100%)	

Table 2: Relationship between frequency of training and types of monitoring

5. Discussions and conclusions

The study verifies the WHO report of 2010 about Lebanon as a success case-study, where it was found that all the questioned Lebanese pharmaceutical companies are applying the QA program according to GMP guidelines which verifies their commitment to the GMP implementation. Further, all quality managers are experienced in implementing the quality standards resulting in a positive impact on the quality of the GMP implementation. Moreover, most of the companies use all the quality tools necessary for effective QA program applications which demonstrates that quality managers are experts in the GMP field. In addition, it has been shown clearly that not only the efficacy, efficiency, and quality of drugs increase, but also customer satisfaction and staff performance, coupled with a decrease in the cost of production

as well as the defect rate, complaints, and recalls due to the successful application of the GMP guidelines. The Lebanese pharmaceutical companies should follow the strategies based on the continuous training programs and improvement, top management commitment, meeting the targeted Key Performance Indicator (KPI), as well as staff involvement in decision making, which indicates that training plays a major role in building awareness regarding GMP implementation. Further, half of the companies document the process of QA indicating that they are using all the documentation tools listed in the GMP guidelines which give a positive impact on the documentation and the GMP implementation. On the other hand, most of the Lebanese pharmaceutical companies are outsourcing external audit in monitoring the manufacturing process, where few of them are relying on internal audit and self-assessment. Yet, none of them is applying benchmarking and competencies as tools of monitoring and developing process. This show a good quality of implementation but not strong enough because they are not reaching the level of monitoring competencies and benchmarking. Moreover, the relationship between frequency of training and external audit used by the quality managers as a type of monitoring revealed that as the frequency of training increases, the external audit as a tool affect more the quality of implementation, while using other tools as internal audit and self-assessment does not show that impact. Further, the relationship between time of GMP application and using monitoring tools as internal audit, external audit, and self-assessment in applying QA program according to GMP guidelines showed that as the time of GMP application increases, that impacts positively the quality of GMP implementation. Finally, By correlating years of experience of the quality managers and the measurement of effectiveness of QA program, the results show that there is no relation between these two factors, which indicates that measuring effectiveness is not related actually to the years of experience, whereas it is mostly related to the accurate application and commitment to the international standards by the Lebanese pharmaceutical companies.

References

[1] DIRECTORATE, E. C. (2013). *The Rules Governing Medicinal Products in the European Union Volume 4 EU Guidelines for Good Manufacturing Practice for Medicinal Products for Human and Veterinary Use.* Brussel: Eudralex.

[2] Dr. Christine Oechslein, M. S. (2012, 1 2). GMP LOGFILE features. *Process validation from the viewpoint of the FDA*, pp. 1-3.

[3] Ethiopian Food, Medicine & Healthcare Administration & Control. (2014). *GOOD MANUFACTURING PRACTICE GUIDELINE.* ADIS ABABA: EFMHACA press.

[4] Karmacharya, J. B. (2001). *Good Manufacturing Practices (GMP)for Medicinal Products.* Nepal: Omnica Laboratories Private Limited.

[5] Markens, U. (2014). CAPA management in GMP envireoment. *VP Corporate Quality and compliance, SGS life Science Services*.

[6] Petra Brhlikova, I. H. (2007). *Good Manufacturing Practice In The Pharmaceutical Industry.* Endinburgh: University of Endenburgh.

[7] Pharm., J. Y. (2011). Documentation and Records: Harmonized GMP Requirements. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3122044/#CIT4.

[8] *Q7 Good Manufacturing Practice Guidance for Active Pharmaceutical Ingredients.* (2016). Office of Communications, Division of Drug Information,U.S. Department of Health and Human Services.

[9] Serhan, G. B.-S. (2010). *WHO Good Governance for Medicines programme.* geneva: WHO press.

Technium Social Sciences Journal
Vol. 37, 324-340, November, 2022
ISSN: 2668-7798
www.techniumscience.com

[10] Sumit Kumar, D. T. (2013). International Journal of Research and Development in Pharmacy and Life Sciences. *THE ROLE OF REGULATORY GMP AUDIT IN PHARMACEUTICAL COMPANIES*.
[11] Tartal, J. (2014). Corrective and Preventive Action Basics. *Postmarket and Consumer Branch Chief Division of Industry and Consumer Education Office of Communication and Education Center for Devices and Radiological HealthU.S. Food and Drug Administration*.
[12] WHO. (2016). *quality assurance of pharmaceuticals.* geneva 27: WHO press.
[13] WHO. (2009). *Measuring transparency in the public pharmaceutical sector.* GENEVA: WHO press.
[14] *WHO EXPERT COMMITTEE ON SPECIFICATIONS FOR PHARMACEUTICAL PREPARATIONS.* (2003). Geneva: WHO Library Cataloguing-in-Publication Data-37.