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Evaluation of Medical Equipment Management in Governmental Health Facilities in Gaza Governorates

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Evaluation of Medical Equipment Management in Governmental Health Facilities in Gaza Governorates

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Dedication

To whom because of them and for them I exist, my family ……

To my friends who always supported my endeavors ……

To those who had inspired me to conduct this study ……

To the hope for peace and tolerance throughout the world ……

I dedicate this work

Declaration

I certify that all this thesis is submitted for the degree of Master is the result of my own research, except where otherwise acknowledged, and that this thesis (or any part of the same) has not been submitted for a higher degree to any other university or institution.

Signed: .....

Abedalrahman Khalil Murad

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Abstract

In resource poor countries substantial sums of money from governments and international donors are used to purchase equipment for health facilities. This study aims to evaluate the current status of medical equipment management cycle in the governmental health facilities in Gaza governorates from the line manager's perspectives at each department. The key issues in the purchase, distribution, installation, management and maintenance of equipment were discussed.

This is a quantitative cross sectional study and the instruments were a self administered questionnaire filled by the medical department heads, senior nurses and technicians. Also observational checklist was used in the X-ray departments in all hospitals. The total number of the study population was 208, with a response rate of 92.2%.

The problems within the medical equipment management cycle that were identified are generic. Some of the root causes of such problems are lack of decentralized planning and in adequate management capacity. In addition, within the health budget the proportion allotted for repair and maintenance is abysmally low which compounds the management problem.

The study showed that 92.6% of the health managers, doctors, and nurses didn't receive any training course in the last three years. Politically and administratively hardly any attention is paid to training. More than 54.4% of the participants reported that there are no adequate spaces and suitable stores for keeping and using medical equipment, and 61.1% reported that there is no preventive maintenance system in their department; 83.7% of them reported that most of equipment that were malfunctioning were due to lack of spare parts; and 54.8% were unsatisfied about the status of medical equipment management in their departments.

As a result, there is wastage of precious resources in term of non-functioning and not utilization of equipment in facilities. Non- functioning equipment has very serious consequences on health services. Various donor agencies and governments need to promote better equipment management rather than invest in the purchase of new equipment when most facilities have usable and reliable equipment. Capacity development is required to manage equipment in the health system.

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List of abbreviations

AMDD	Averting Maternal Death and Disability
ANOVA	Analysis of Variance
BME	Biomedical Equipment
CSU	Colorado State University
DFID	Department for International Development
EMOC	Emergency Obstetric Care Services
GDP	Gross Domestic Product
GNP	Gross National Product
HEI	Health Equipment Information
IEC	International Electrotechnical Commission
ISO	International Organization Standardization
KSA	Kingdom of Saudi Arabian
MOH	Ministry of Health
MRI	Magnetic Resonance Imaging
NGOs	Non Governmental Organizations
PCBS	Palestinian Central Bureau of Statistics
PHC	Primary Health Care
R&M	Repair and Maintenance
SFDA	Saudi Food and Drug Authority
SPSS	Statistical Package of Social Sciences
UNRWA	United Nations Relief and Works Agency
WHO	World Health Organization
PNGO	Palestinian Non Governmental Organizations Network

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Chapter I

Introduction

1.1 Research Background

Medical equipment are essential component of Palestinian health system infrastructure which consumes high percentage of gross domestic product and critical in achieving health quality for all. So without that it would be difficult for health services to be provided. An effective strategy based on the availability of mechanisms for careful needs assessment, planning, and selection should be established (WHO, 1992).

In recent years, health care organizations have begun to rely heavily on medical technology in order to achieve and maintain the high standards required of today's health care providers. In particular, the Middle East typically spends hundreds of millions of dollars annually to equip, replace, or maintain their medical technology, and in many cases, this is in an ineffective way. In addition, developing countries in general must rely on developed counties to provide most, if not all, the needed technology. Which results in attempting to manage technology for equipment that is expensive, and difficult to support and may be not easy to use, within diverse environment (Al Fadel, 2006).

Many developing countries are increasingly dependent on donor assistance to meet the equipment needs of their health care systems. However, because not all important parameters

are taken into consideration, donations sometimes do not achieve their intended objectives, and could even constitute an added burden to the recipient health care system (WHO, 2000).

Studies showed that about 25%-50% of all health equipment in developing countries can't be used due to many reasons such as: (i) difficulty in acquiring spare parts, (ii) lack of trained operators and service technicians, (iii) inadequate infrastructure for installation and operations, (iv) excessive amount of sophisticated equipment and insufficient basic equipment, and (v) obsolete and unsafe equipment. These reasons are mainly due to inadequate management and lack of decision awareness regarding modern technology, which is result of lack/deficiency of policies and procedures for comprehensive technology management in the health system (WHO, 2003).

Health care technology management is a very important discipline which requiring assessment, strategic planning, evaluation, acquisition, utilization, maintenance, asset control, replacement planning, and quality assurance (Dyro, 2004).

Many disciplines participate in managing the medical equipment life-cycle including procurement, storage, distribution, and maintenance that communication and coordination among them need further improvement.

Currently, the Palestinian Ministry of Health (MOH) has two central departments for the procurement of medical equipments in the Gaza Strip and the West Bank with full-time staff, in addition to a number of affiliated operational procurement functions, including hospital and PHC-based units. And at the MOH there are two departments of maintenance in the Gaza Strip

and the West Bank that currently managing the maintenance in respect of hospital services (MOH, 2003).

In spite of the great efforts made to control the management of medical equipments, the status of many equipments remain deteriorated and a lot of areas still require assessment and development. Development needs include using internationally standards, guidelines, specifications, availability of spare parts, and well trained clinical staff to assure safety, quality and cost-effectiveness for optimizing the utilization, distribution, and maintaining resources and also enhancing operational procedures based on compliance with recognized Palestinian criteria and patient's serviceability (WHO, 2009).

The main concern of this study is to evaluate the effectiveness of the medical equipment management cycle that currently in use in Governmental Health Facilities in Gaza Strip, and to suggest simple methods of improving equipment management.

1.2 **Research Problem**

In Palestinian health care system, medical equipments are one of the main resources that governmental health facilities are annually provided with (MOH, 2005).

It is necessary to improve the performance of managing the cycle of procuring, distributing, using, and maintaining of medical equipments in Palestinian health facilities –Gaza Strip. Because of centralized decisions and routine bureaucratic managerial channels, the procurement does not necessarily match medical needs, standards and staff satisfaction. Also

many of the clinical staff are not involved in the selection process. Most of the clinical staff have inadequate experience of using new medical equipments which will lead to operational problems it will put the patients at risk. In addition, there is a lack of current and updated information about the location and the work status. Also, there is no appropriate strategy for regular periodic inspections and maintenance due to lack of spare parts and documentation in general and especially for donated equipments which are usually delivered incomplete, inoperative, and/or out of needs and standard. So, it important to evaluate medical equipment management in governmental health facilities from line managers perspectives at each departments because those field workers can assess this cycle and can identify areas of strength and weakness of its management.

1.3 **Justification of the Study**

There is little published literature on equipment management in service sector - less so about management of hospital equipment internationally and at the Palestinian level (Fitzsimmons, et al, 1994).

A WHO report states that in most countries there is lack of adequate repair and maintenance facilities, infrastructure, professionally trained staff and logistics support resulting in wastage of limited resources and/or in their ineffective use (WHO, 1991).

Properly working essential equipment is equally important as the readiness of staff, physical facility and supplies in providing timely EMOC (Zafarullah, 2000).

Although many international projects provide equipment to improve the functioning of primary health centers and hospitals, not much attention is directed to the management of the equipment. A World Bank study showed that in a state in India, only 2-5% of district/town hospital budget was earmarked for "machinery and equipment". While maintenance budget was next to nothing - a mere 0.02-0.06% of the hospitals annual budget. Rural secondary hospitals (at sub-district level) had no maintenance budget at all (World Bank, 1997).

In Palestine, a limited resources country, there is an urgent need to improve the health services and to decrease the wastage of resources on the health sector in general and on medical equipments in particular. Medical equipments is considered an integral part of patient's treatments and essential components of Palestinian health system so it is of key importance to control the wastage and identify the main gaps in the management cycle to be more effective. To the best knowledge of the researcher, no previous studies were conducted on management of medical equipments in Palestinian health facilities. This study is conducted to assess the current medical equipment management situation from clinical staff perspective at each of the governmental health facilities in Gaza governorates. The results of this study could be used to inform the decision makers in the Palestinian MOH and other related organizations to help in recognizing the areas of strength and improve them, and in identifying areas of weakness, and deal with them through strategic plan for future development.

1.4 Research objectives

1.4.1 General objective:

To evaluate the effectiveness of the medical equipment management cycle that currently in use in Governmental Health Facilities in Gaza Strip, and to suggest simple methods for the improvement of equipment management.

1.4.2 Specific objectives:

1. To appraise the strengths and weaknesses encountered in the medical equipment management cycle in governmental health facilities.
2. To assess the degree of staff involvement in selecting, procuring, and distributing of medical equipment.
3. To ascertain users perspectives about the four phases of equipment management cycle.
4. To assess the influence of operating staff, maintenance staff and medical staff skills and expertise on the four phases equipment management cycle.
5. To suggest recommendations for decision makers in MOH to adopt a better equipment cycle management practices based on the results of the study.

Research questions

1. What are the strengths in medical equipments management cycle?
2. What are the weaknesses points in medical equipments management cycle?
3. Do clinical staffs participate in selecting, procuring, and distributing of medical equipments?

4. To what extent the decisions of purchasing and distributing of equipments are centralized?
5. Are there adequate spaces for storing and installing equipments?
6. Do operating staff, maintenance staff and medical staff skills and expertise have proper training for using and keeping equipments operational?
7. To what extent are the donated equipments standardized?
8. What are the main obstacles that facing repair and maintenance process?
9. What training in term of medical equipment repair and maintenance is needed?
10. What should be done to make medical equipments management more effective?

1.6 Context of the study

In order to understand the health care system in an appropriate way and to be aware of the settings of services provided in the Gaza Strip, we introduce the following characteristics that may influence health care system in public sector.

1.6.1 Socio-demographic context:

"Palestine constitutes the southwestern part of huge geographical unity in the eastern part of the Arab world, which is Belad El Sham. In addition to Palestine, Belad El Sham contains Lebanon, Syria, and Jordan. So, Palestine has common borders with these countries, in addition to Egypt. The entire area of Palestine is about 27000 sq. kilometers (Annex 1). Now, the remaining part of historical Palestine comprises two areas separated geographically: West Bank and Gaza Strip "(MOH, 2005). Although comparatively small, in fact the equivalent of a medium-size region in a typical European country or one of the smallest states in the United

States, Palestine comprises a significant variation of morphological and climatic regions, and this is making it of important geographic position (Dellapergola, 2001).

The population size in Palestine was estimated at 3,662,205 in 2007. Out of the total number, 2,274,929 in the West Bank and 1,387,276 in the Gaza Strip with percentages of 62.1% and 37.9% respectively. Al Khalil governorate had the highest rate of population at 13.9% of the total population, followed by Gaza governorate at 13.2%. Jericho governorate had the lowest rate of population at 1.2% (PCBS, 2007).

Although the Gaza Strip (Annex 2) is a narrow piece of land that is located on the coast of Mediterranean sea, its position on the crossroad from Africa to Asia made it strategic for occupiers over centuries (MOH, 2005).

Gaza Strip is a crowded place with area of 365 Sq. km. and considered as the second most populated place on the earth after Hong Kong (World Bank, 2002). Gaza Strip comprises five main governorates which are: North of Gaza (17% of Gaza Strip total area), Gaza City (20.3% of Gaza Strip total area), Mid-Zone (15% of Gaza Strip total area), Khan-Younis (30.5% of Gaza Strip total area), and Rafah (16.2% of Gaza Strip total area) (MOH, 2005).

After Oslo Accords, it was expected that the Palestinian economy will go through a period of steady and rapid growth (World Bank, 2007). Gross National Product (GNP) in Palestine had been subjected to fluctuations since 2000. GNP was US $ 5,454 million in 1999 and dropped to US $ 4,169 million in 2005 (MOH, 2005). In 1999, the Gross Domestic Product (GDP) was US $ 4,512 million. But since 2000, when Israel imposed a strict closure on Palestinian

territories as a response to the second Intifada, it decreased to US $ 3,557 millions in 2002 . In 2004, the GDP recovered slightly and continue in this recovery for nearly two years. But, due to continued growth in settlements and the cut off in the direct aid as a result of last parliament elections, GDP fell again in 2006. GDP is expected to be about US $ 3,901 million in 2007 (World Bank, 2007).

According to the World Bank, the unemployment rate increased from 11.8% in 1999 to 32% in 2005. The poverty rate in Palestine was 40% , and this is largely due to Israeli restrictions on Palestinian territories (MOH, 2005). In general, the unemployment rate in the Gaza Strip was higher than it in the West Bank (World Bank, 2003).

According to the education indicators in Palestine, we can conclude that Palestinian community is a well- educated one and that Palestinians have always highly appreciated education (MOH, 2005).

1.6.2 Health Care System and health indicators:

Palestinian MOH has been fully responsible of the management of health services in the Palestinian Territories since the transfer of responsibilities from the Israeli Civil Administration to the Palestinian Authority in 1994. Gaza and Jericho were transferred to the Palestinians in May 1994, while the health systems in the remaining areas of West Bank were transferred in December 1994 (World Health Assembly, 2005). Now MOH is the main health care provider in Palestine. MOH is the only health authority responsible for supervision,

regulation, licensure, and control for all health services. United Nations Relief and Works Agency (UNRWA), Medical Services for Police and general security, and other Nongovernmental Organizations (NGOs) are considered as second hand providers of health care services in Palestine (MOH, 2003).

Palestinian health care system mainly includes eight components which are Primary Health Care, Laboratories and Blood Banks, Hospitals, Health Human Resources, Health Finance, Governmental Health Insurance, Treatment Abroad, and Health Projects. Primary Health Care (PHC) is one of the most important components of the Palestinian health care system. PHC centers provide accessible and affordable health services for all Palestinians, especially for children and other vulnerable groups. MOH is working with other health sectors in providing the primary health services, mainly UNRWA and NGOs. It is worth mentioning that private sector plays an important role in providing PHC services to the Palestinians. Hospitals and the other for mentioned components of Palestinian health care system are also of key importance for the effective and complementary performance of the Palestinian health care system (MOH, 2005).

In Palestine, the crude death rate is 2.7 per 1000 population. The Infant Mortality Rate is 24 per 1000 live births (62 in Turkey, 41 in Egypt, 40 in Tunisia, 21 in Jordan, and 7 in Israel) (Hamad, 2001).

The leading causes of adult death are similar to developed countries including cardiovascular diseases and cancers with a high prevalence of stress and psychological trauma related diseases. On the other hand, diseases of poverty are still prevalent such as respiratory

infections and diarrhea diseases that remain important causes of child mortality and morbidity (MOH, 2005).

Thus, it could be said that despite the harsh difficulties facing Palestinians, their health status is relatively good compared with other countries at a similar level of economic development.

1.6.2.1 Hospitals in Palestine:

In Palestine, the secondary healthcare services are provided by governmental, non-governmental, UNRWA, and private sectors. MOH is the main provider of secondary healthcare services and some of the tertiary care . In Palestine, there are 78 hospitals. The population/hospital ratio is 47,920. In the Gaza Strip, there are 24 hospitals with population/hospital ratio 57,098. In West Bank and Jerusalem, there are 54 hospitals with population/hospital ratio 43,844. The average bed capacity per hospital in the Gaza strip is 79.88 bed, while it is 51.15 bed in the West Bank (MOH, 2003).

According to hospitals categories, they are divided into 45 general hospitals with 3726 beds, 10 specialized hospitals with 812 beds, 19 maternity hospitals with 322 beds, and 4 rehabilitation centers with 165 beds. Despite the availability of maternal departments in the general hospitals, MOH doesn't own any obstetrics or gynecology hospitals. All rehabilitation centers are owned and operated by NGOs. In general, Access to Palestinian hospitals is considerably good . The MOH owns and operates 22 hospitals (10 in the Gaza Strip and 12 in West Bank, furnished with 2,815 beds (1,499 in the Gaza Strip and 1,316 in the West Bank). The non-MOH hospitals constitute 71.1% of the total hospitals in Palestine (about 63.6% of

the total hospitals in the West Bank and 54.5% of the total hospitals in Gaza Strip), they are furnished with 44% of the total hospital beds (MOH, 2005).

1.6.2.2 Primary Health Care in Palestine

Primary health care system (PHC) is a major component of Palestinian health care system; this system has provided health care to all Palestinian people especially for children and other venerable groups. Primary health care centers in Palestine provide primary and secondary health care services as well as tertiary services. In the Last five Years and after the uprising of second Intifada (Al Aqsa), PHC centers in Palestine have been developed in a dynamic way to face the instability of Palestinian situation were Israeli occupied Forces (IOF) tends to divide Palestinian localities into isolated geographical areas. PHC centers try to offer accessible and affordable health services for all Palestinians regardless the geographical locations. According to MOH policy, PHC centers classified from level I to level IV. They offer different health services according to clinic level, theses services include maternal and child health, care of chronic diseases, daily care, family planning, dental, mental services and other services according to center level.

The MOH is working with other health sectors in providing the primary health services mainly with UNRWA, and NGOs sector. At the end of 2005, there are 654 PHC centers in Palestine; these centers are cared for about 3.7 million people (129 centers in Gaza and 525 centers in West Bank). The total number of PHC centers in the Gaza Strip is 56 in comparison with 43 centers in 2000, with an increase of 30.2%. The PHC centers provide special health care services in different aspects, 42 centers provide immunization and antenatal care and family planning services, in addition to 107 specialized clinics and 30 dental and oral clinics. About 35 centers have laboratories and 13 centers have x- Ray units (MOH, 2005).

1.7 Procurement and Maintenance of Medical Equipment in Palestine

The Palestinian planning team has identified procurement, storage, distribution, and maintenance as areas needing development and further improvement. Thus, the MOH for example, has been working with UK Department for International Development (DFID) to provide technical assistance in these particular areas. Prior to the establishment of the MOH, procurement, and storage were limited to the NGOs, UNRWA and other charitable organizations. With the exception of UNRWA, there has been no system in Palestine for organized procurement and storage. Currently, the MOH has two central departments for procurement and maintenance in the Gaza Strip and the West Bank with full- time staff, in addition to a number of affiliated operational procurement functions, and maintenance services including hospital and PHC-based units. Tenders and procurement processes for the acquisition of medical equipment are totally centralized, and the MOH has a tender committee representing relevant departments that makes the recommended choice of supplier, followed by notification and purchase orders. The two departments of engineering and maintenance are currently managing maintenance of hospital facilities equipments, but these departments operate as separate entities and, so far, there has been no effective communication between them (MOH,2003).

1.8 Importance of Medical equipment

In Palestine MOH medical equipments constitute a major part of the investment in the health care facilities. The MOH spends millions of dollars annually to equip, replace, or maintain their medical technology. In 2004, MOH expenditure on medical equipment procurement was about 1.7 millions dollars, from (2005-2006) was 1.6 millions dollars, while in 2007 the MOH expenditure was about 3.5 millions dollars (MOH, 2008).

Also the need of medical equipment for diagnosis and disease management is increasing. Medical equipment play a vital role in early diagnosis, intervention, and prolonging and improving the quality of life (WHO, 2003).

1.9 Medical Equipment Management

Hospitals rely heavily on medical technologies to provide diagnosis, treatment, and monitoring in patient care. Managing these devices from acquisition through the actual use of equipment in patient care is a formidable task. Hospitals must act to maximize the benefits of medical devices while minimizing adverse side effects which can be achieved by effective medical equipments management (Baretich, 2002).

1.10 Consequences of the Long Siege on Health Services on Gaza Strip

As a result of the long siege imposed by Israeli occupation on Gaza strip since 2006 and the last war which started in December 2008, the situation for 1.5 million population became worse now than it has ever been since the start of the Israeli military occupation in 1967. The consequences of the war and the siege had manifested itself in thousands of casualties, demolition of thousands of houses, destruction of health facilities and civil institutions. Additionally, health facilities greatly experienced shortage of essential items, such as drugs, medical equipment, essential supplies, medical consumables, spare parts and fuel supply for power generators. Moreover, maintenance services were severely disrupted, ordinary work systems were widely disturbed, access to health services inside and outside Gaza had remarkably diminished, developmental related activities were all frozen and the capacity building related activities were suspended. All the previously planned constructions, extensions and developmental plans were all not implemented (PNGO, 2009).

1.11 Operational Definitions

Evaluation: It is a tool for determining the points of strengths and weaknesses of medical equipment management cycle for equipment selection, installations, use, and maintenance (David, and Jahnke, 2005).

Medical equipment: is designed for prevention, diagnosis, treatment, or in the creation of the necessary comfort for the patient and medical personnel when performing therapeutic, diagnostic, and prophylactic measures (Kabatov, 1970).

Medical Equipment Management: is described as strategic planning, evaluation, procurement, asset management, management systems, maintenance, sources of service and service management, and replacement planning (Dyro, 2004).

Effectiveness: doing the right things that will help the organization reach its goals (Robbin, and Coulter, 2003).

Clinical Engineer: A Professional who supports and advances patient care by applying engineering and management skills to healthcare technology (Al Dalaan, 2006).

Medical Equipment manager: The Medical Equipment Manager is a person who is responsible for establishing a system to hold an inventory and service log of all diagnostic and therapeutic equipment used within the organization (Rice, 2007).

Procurement and Selection: is the process of purchasing and selecting appropriate and sustainable equipment, in the right quantity and quality, at the right time. The selection takes into consideration factors such as operating and running costs, system requirements, and installation of equipment (Bravar, et al, 2004).

Installation: designing and planning all the requirements for effective operation of medical equipment including water supply installations, mechanical and special installations, electrical and communication installations (Gutierrez, 2004).

Use of Equipment: Demonstrating the proper use and application of medical devices serves to improve the quality of care received by patients as well as providing more efficient use of medical devices and reducing the clinical staff's fear of technology (Cram, 2004).

Staff Training: The planned and systematic modification of clinical staff levels of knowledge, skill and competence to carry out their work effectively.

Maintenance and Repair: Equipment maintenance involves all activities relating to providing an adequate level of service and limiting down time of medical equipment in hospital facilities (Cram, 2004).

Chapter II

Literature Review

This chapter discusses the conceptual framework and the main concepts and variables related to the study. These concepts include medical equipment, the four phases of medical equipment management cycle, and the main operational problems that influence the management cycle. Additionally, this chapter presents some previous studies concerning the medical equipment management in health facilities.

2.1 Conceptual framework

The study framework identifies the most common points that are associated with medical equipments management cycle according to the World Health Organization (WHO, 2008) cycle which consists of four major phases as follow:

1. Selection and procurement of equipments.
2. Distribution and installation of the equipments.
3. Use of equipments.
4. Repair and maintenance of equipments and disposals.

Each phase of the cycle is influenced by different factors that should be considered to carry an effective equipment management cycle in the governmental health facilities. The factors can be summarized as follow:

2.1.1 Factors affecting the cycle

- Selection and procurement of equipments

Equipment is long lasting and hence the selection of equipment and the purchase decisions have long-term implications affecting the capacity to deliver services and the cost of running the services. Some key issues that influence the selection and procurement of equipments include usefulness of the equipment, suitability of the equipment, staff and training to operate the equipment, centralized procurement, and timing of equipment arrival.

- Distribution and installation of the equipment

After being procured the equipment has to be distributed, installed at several locations and proper documentation done. Several important issues regarding the distribution and installation of equipment include appropriate distribution of equipments, proper installation of equipment**,** and good documentations**.**

- Use of equipments

Equipment, if used carefully and properly cared for, can last a long time. Proper care also includes cleaning and appropriate storage when not in use. Recently Skeet and Fear have written a book on care and safe use of hospital equipment which gives general principles for

improving equipment use. But there are many poor practices in equipment use that reduce their life and utility (Skeet, and Fear, 2009).

- Repair and maintenance of equipment

Working equipment is vital for any hospital. For equipment to last and provide uninterrupted service, a proper system for repair and maintenance is vital. Unfortunately repair and maintenance (R&M) is one of the most neglected areas of hospital management in the developing world. Lack of R&M is very common and old problem in all public services. World Development Report 2008, observed, "inadequate maintenance has been an almost universal (and costly) failure of infrastructure providers for developing countries" (World Bank, 2008).

WHO has published a book on maintenance and repair of lab and diagnostic equipment But unfortunately this problem is still not adequately addressed (WHO, 2008).

- Donated equipments

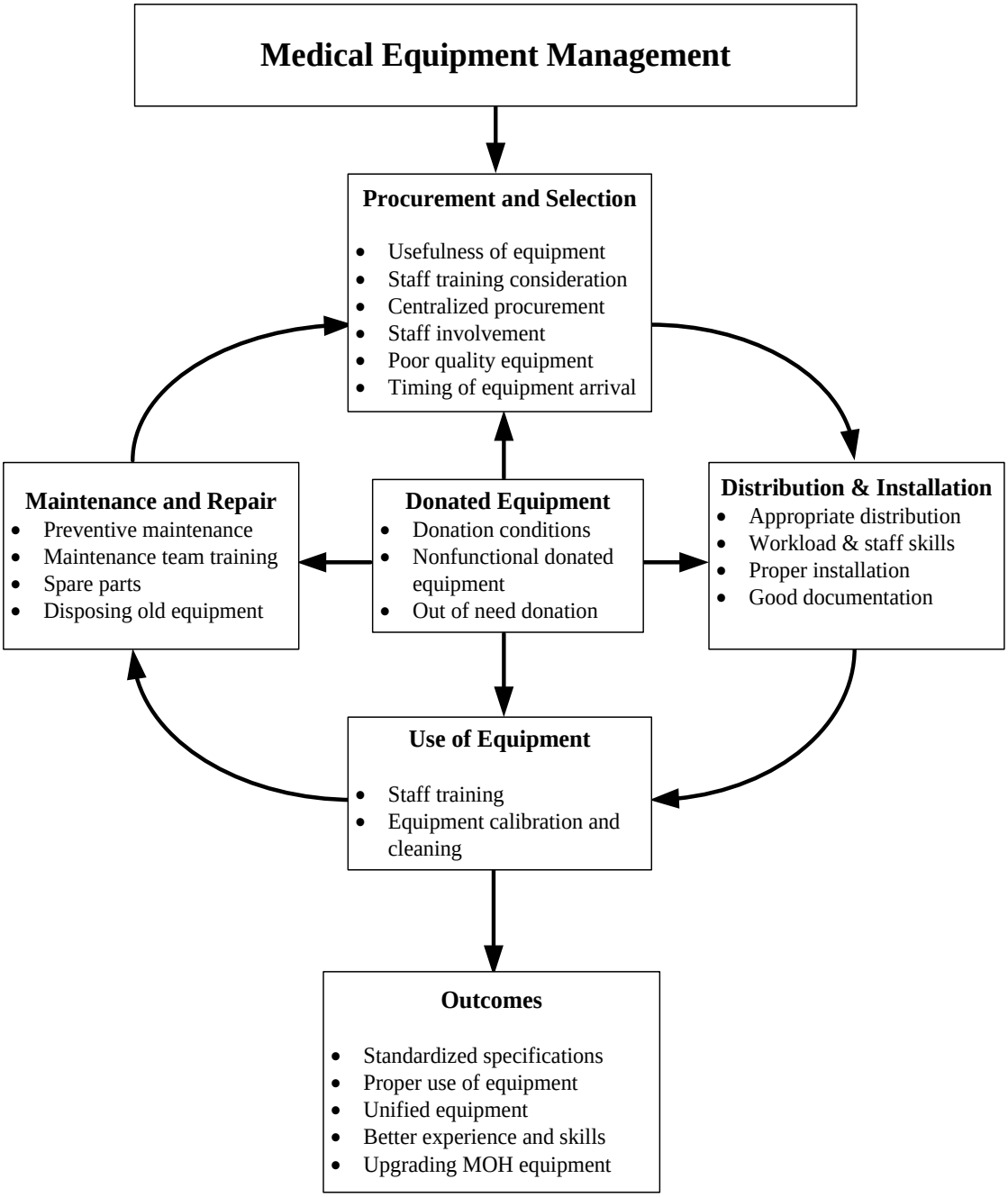
Most of the equipment in Palestinian health facilities comes as donations from various countries. Some issues regarding the donation of equipment include the standardization of equipment.

2.1.2 Outcomes of an effective cycle management

Some hospital administrators are aggressively pursuing innovative, cost saving strategies that significantly extend the capital equipment life cycle and, at the same time, improve the

administrative hassles and hefty expenses that accompany equipment/supply purchasing and maintenance. This can be achieved by having a an effective medical equipment management cycle, and when the management of equipment is effective, the hospitals will have standardized equipment that are used better, and operated, and maintained correctly.

Figure 2.1: Conceptual framework



A self Developed Conceptual framework

2.2 Medical Equipment

2.2.1 Definition of Medical Equipment

Medical devices include medical instruments, apparatus, implement, and machine, and appliance, implant, to be used, alone or in combination, for human beings. Medical devices can be used for diagnosis, prevention, monitoring, treatment disease or compensation for an injury, or replacement or support of the anatomy or of a physiological process (Al-Badr, 2006).

Medical devices are used to obtain an effect required for medical purposes. This effect can be expressed in prevention, diagnosis, treatment, or in the creation of the necessary comfort for the patient and medical personnel when performing therapeutic, diagnostic, and prophylactic measures. The aggregate of medical technical devices is called medical equipment (Kabatov, 1970).

Vranić, (2003) referred that medical equipments contribute significantly to the quality and effectiveness of the health care system. It is necessary to commit scientifically sound regulatory environment that will provide consumers with the best medical care.

2.2.2 Medical Equipment Management

Wang, et al, (2006) presented that improving the management of supplying medical equipments, it is necessary to setup an assessment on suppliers which include lots of criteria such as quality, cost, service and delivery capabilities.

New medical devices are developed continuously, so through assessment of needs, verification of safety and efficacy, rational procurement, proper installation, preventive maintenance, rational use and quality assurance, a better use of resources is accomplished, particularly in countries with limited budget (WHO, 2008).

The lack of medical equipment management might be the cause of many problems as unavailable qualified service personnel, unrecognized importance of the role of the clinical engineer in the medical technology management, low medical expenditures for renewing old medical equipment, uninterested physicians in adapting new medical technologies, and unavailable modernized management information systems which facilitate and control the data storing and retrieval (Amer, and Ammari, 2006).

Therefore Chien, (2006) addressed that the management of the medical equipment emphasized in the purchase and the maintenance management in early days, and cost down now is import factor for medical equipment management. Another important subject in medical equipment management is patient safety.

Evaluation of medical equipment management is an important process to determine the value and need for existing, new, and alternative equipment that the organization must consider in order to provide clinical care to the patient (Harding, et al, 2004).

To get the best out of equipment, a management programme must be initiated in all institutions in both the public and the private sectors. This will increase the life and performance of the equipment and have less down-time (WHO, 2003).

Soller, (2004) specified that medical equipment management including equipment assessment, equipment specification, purchase requisition review, bid analysis, and vendor selection. And it also includes installation planning, acceptance testing, defect resolution, user in-service education, selection of service provider, product recall and alerts, incident investigation, and equipment replacement cost analysis and disposal.

The information collected in the databases files was delivery to the regional health authorities and to the managers of each hospital which enables the hospital staff to improve planning processes and to manage the investments that are required in order to offer health services of the highest quality and also fundamental to maintenance services (Gutierrez, 2004).

The MOH hospitals in Gaza Strip and the West Bank continued to purchase the Magnetic Resonance MRI services, despite the fact that the MOH owns one MRI machine allocated in AlShifa hospital, but there aren't technicians who can manage it (MOH, 2005).

Mavalankar, et al, (2004) noted that each health department should have a record and database of all the medical equipment and this should periodically be verified by the supervisor. In addition, the functional status of each piece of equipment should be indicated in equipment registers.

2.3 Factors Affecting Medical Equipment Management

2.3.1 Procurement and Selection

Medical equipment purchase is a complex process and should not be underestimated, so it should have a regulatory system that insures technical support for a period of at least 10 years in fields of maintenance and supply of spare parts as well as user and technical training. That will guarantee the smooth functioning of the purchased medical equipments for long time (Andijani, 2006).

Harding, et al, (2004) presented that the procurement process is not complete till monitoring of medical staff satisfaction, equipment performance, provision of technical services (e.g., preventive maintenance and quality control), and calculation of life cycle costs must be performed.

Many factors make the procurement and selection process so complex, the wide variety of equipment purchased and used in hospitals, the various applications where equipment are used, and the many different types of users of the equipment (Keller, 2004).

Khateeb, (2006) showed that in centralized tendering for supplying ministries of health and public sectors hospitals with effective medical equipments, apart from procurement, specifications of equipments should be unified to ensure quality standards.

The medical technology management program participates in the organization effort early on and throughout the equipment life cycle by assessing equipment performance. Impact of risk and quality are monitored prior to purchase decision; during installation, maintenance and repair; and as indicators for disposition or replacement (David, et al, 2004).

Dyro, (2004) presented that after the medical equipment purchase, it is needed for planning, coordination, and implementation of the installation, training, incoming inspection and acceptance testing, and ongoing support planning for the operational system.

The process of medical equipment procurement includes identification of equipment needs, selecting the equipment specifications and vendor, demonstrating the equipment to the users, purchasing the equipment, preparing it for use, staff training, and installation (Smith et al, 2004).

Harding, et al, (2004) listed many important issues that should be considered in the procurement process of the medical equipment, staff skills that will use of the equipment, the current status of the equipment, a description of the actual equipment, options, and accessories that will be necessary for the organization, and a description of the special considerations including training, installation, and manuals.

2.3.1.1 Usefulness and suitability of the equipment

In a study that took place in United States about how hospitals and physician can conduct assessment of medical technology performance. Physicians' selection of medical devices lacks an evidence base on the comparative clinical effectiveness of these equipments from different

vendor's offers. Evaluations covered multiple performance dimensions, including ergonomics, functionality, clinical acceptability, and vendor preference which assist physicians and hospitals in making cost-effective purchases of devices. These evaluations provide robust information on the performance of products routinely used by clinicians (Burns, et al, 2007).

Sometimes equipment is purchased which is not of any proven value. For example in Cairo, Egypt expensive imported hand washing machines were purchased instead of installing simple washbasins for the scrub area outside the Operating Theatre (Malike, and Anam, 2008).

Standardizing of medical equipment vendors, models, characteristics, and the service responsibilities make the equipment management more practical and effective (Harding, et al, 2004).

Although medical devices provide an opportunity for a better service, the lack of a national system for selection, procurement, use and management may lead to unsuitable health care services provided (WHO, 2006).

Sometimes governments tend to buy the least expensive equipment in order to save money that leads to the purchase of very poor quality equipment, which is unreliable and easy to be damaged (Mavalankar, et al, 2004).

In some seen instances non-vital equipments are purchased for emergency and obstetric care services (EMOC). For example purchase of ultrasound machines under a project focusing on. Ultra-sound is a useful tool but not vital for EMOC services. This type of problem is not very

frequent for EMOC equipments but seen for other general equipments also (Malike, and Anam, 2008).

World health organization reported that all health care equipment should meet or exceed existing safety and performance specifications provided by the manufacturer, and also should meet standards promulgated by international bodies such as International Organization for Standardization (ISO) and International Electrotechnical Commission (IEC). Equipment that has not been approved by international standards should not be purchased or accepted especially for donated equipments (WHO, 2000).

Revision of medical equipment specifications is often necessary for the procurement process that may include identification of the preferred vendor(s), specific options, accessories, features, training, or service (Harding, et al, 2004).

Procurement of expensive medical devices needs to be based on a clear strategy and actual needs assessment based on comparisons with countries of similar socioeconomic conditions. so irrational procurement leads quickly to oversupply, lack of standardization, unclear vision to maintain these equipments, and increased health care delivery costs (WHO, 2006).

Mcclain, (2004) noted that standardization of medical equipment may provide significant cost savings and also may reduce costs for training and maintenance throughout the equipment life cycle.

Standardization of medical equipment requires that manufacturers provide updated equipment options that meet the needs and provides many benefits in maintenance and use the equipment (Maputo, 2008).

2.3.1.2 Staff and training to operate the equipment

Sometimes very useful equipment is acquired but not used because there is no staff, who can use it or staff does not have the skills needed. The equipment should match with the skills of the staff. Also , it may be necessary for the staff to receive training on the use and care of the new equipment before its arrival at the facility. An example of this occurred in one Cairo when very good quality imported vacuum extractors were acquired through an international program. Unfortunately, vacuum extraction no longer was taught in the medical colleges in that country and vacuum extraction was not practiced in the district hospitals regularly. In the same country high quality surgical equipment for Cesarean Section were given to many hospitals where there were no doctors trained to do this operation. (Wield and Malike, 2008).

The WHO field offices in three countries noted that neonatal resuscitation equipment remained unused due to lack of staff and training. In more than one country WHO staff have seen the situation that at some locations there are skilled staff but no or little equipment. Thus this problem of mismatch of equipment and skills is quite common. Hence the equipment remains unused, wasting the resources invested (WHO, 2008).

David, and Jahnke, (2005) stated that hospitals are continuously faced with demands for new medical equipment and are asked to manage existing inventory for which they are not well

prepared. Clinical engineers can identify technological solutions based on the matching of new medical equipment with hospital's objectives. Clinical engineers can determine strengths and weaknesses, develop equipment-selection criteria, supervise installations, train users and monitor post procurement performance to assure meeting of goals.

Mavalankar, et al, (2004) showed that it may be necessary for the staff to receive training on the use and care of the new equipment before its arrival at the facility.

Few counties of WHO regions have committed and coordinated national policies and strategies specially relating to procurement, use, maintenance and repair of healthcare equipments. Therefore they may not be directed to determine priority needs or may take too little account of capabilities, skills, and resources available (WHO, 1986).

Larios, et al, (2000) presented that the most appropriate biomedical equipment should ideally be decided upon considering a series of demographic and social parameters of the hospital and international regulations and standards. This information should ultimately be distilled to proper technical specifications. The new management process aims to increase the efficiency of the experts involved in the definition of the most appropriate level of equipment and its technical specifications. It also addresses all aspects of the biomedical equipment-selection cycle, including the evaluation of the bids submitted by the equipment suppliers.

During the purchase of new equipment, suppliers can be requested to train in-house technicians in maintenance; this condition should be included in the tender or purchase order

to ensure that equipment suppliers are obliged to provide comprehensive warranty and maintenance services (WHO, 2009).

Dyro, (2004) presented that provisions for training the operator of the medical equipment must be established in the purchasing agreement. It is preferable to begin training during the course of installation for large equipments that have a long installation period.

2.3.1.3 Centralized Procurement

Centralized purchases have some advantages such as lower costs, uniformity, ease of procurement etc. However, centralized purchases can delay procurement by several months to years. Also, the supply of uniform sets of equipment from a central level can lead to duplication and wastage, as some of the equipment may already be present at the facilities. (Wield, and Malike, 2008).

To increase the healthcare standards, effective management of medical equipment must take place, which can be achieved by enrolling both medical staff and clinical engineer in the critical decision-making processes related to management of these equipment including, the fields of acquiring new medical equipment, evaluating medical equipment specifications, tendering of medical equipments, pre-purchase evaluation, pre-market evaluation, efficacy and cost analysis, life expectancy analysis, acceptance tests, training medical staff, handling and controlling the maintenance of medical equipment, and much more administrative management (Amer, and Ammari, 2006).

WHO reported seeing procurement being delayed by years in a large externally aided project in an Asian country, and also seen delay in procurement due to donor agencies centralized procurement system. Many times maintenance agreements are not developed at the time of purchase and often present a problem later when the equipment needs servicing. For example, in Egyptian hospitals repair under warranty is not done because suppliers from national capital are unwilling or unable to provide that service in rural areas. Another drawback of central procurement is that the hospitals' staff or local managers do not feel the ownership of the equipment and hence sometimes are not interested to open, install and use the equipment. On the other hand, if the facility identified the need for a particular piece of equipment and purchased it locally, the equipment would be put to use immediately (Wield, and Malike, 2008).

Mavalankar, et al, (2004) noted that in more than one country in Africa and Asia centralized purchases can delay procurement by several months to years and the supply of equipment from a central level can lead to duplication and wastage, as some of the equipment may already be present at the facilities. Also centralized distributed equipment kept lying in the stores of the hospitals for several months to years before it is installed or used and some times it is never used at all.

In many resource-limited countries, there is a diversity of medical equipment policies due to lack of standardization, regulations that promote competition, donated equipment, and decentralized procurement systems (Maputo, 2008).

2.3.1.4 Staff involvement

Participation of medical staff in the medical equipment purchasing committee make them more aware of the problems that their hospitals face, and become expert in considering equipment maintenance, training, and cost containing through purchasing orders (Landgarten, 1979).

Paradishi, (2005) showed that the administrators should follow the procurement procedures strictly because many of the sophisticated electrical and electronic equipment are highly sensitive and require specific environmental support, therefore the procurement of equipment, availability of trained staff and adequate infrastructure should be synchronized with respect to time.

Staff involvement in medical equipment procurement, help in selecting the best equipment considering maintenance, consumables, latest specifications, and other requirements for operation, and also making the purchasing process easier (Warren, et al 2000).

The Medical Equipment Procurement Committee is multidisciplinary in nature and includes representation from nursing, medical and surgical teams, clinical engineering, hospital management, finance, purchasing, technical services, and information technology. And the role of this committee is:

• To comply with national and European legislation where applicable to the selection and safe use of medical equipment.

• To ensure that the hospital has access to the best medical equipment technology available, and is enabled and assisted to utilize such medical technology in a safe and efficient manner (Grainge, 2008).

2.3.1.5 Inexpensive and poor quality equipment

Sometimes governments tend to buy the least expensive equipment in order to save money. This leads to the purchase of very poor quality equipment, which is unreliable and easily breaks. In Egypt, stethoscopes of poor quality were purchased at a cost of only 38 US cents apiece probably to save money. Also, labor tables with tops of regular steel instead of stainless steel. The stainless steel tables may cost more but they last longer and are easy to clean than the less expensive regular steel tables. The regular steel tables rust quickly and as a result harbor dirt, making cleaning very difficult. In the long run, inexpensive equipment can become costly, as they need to be replaced more often than that of better quality one (Anam, and Malike, 2008).

In Cairo, surgical instrument of poor quality being purchased because they are cheap. They make surgery difficult and dangerous. Lifetime purchase cost plus running and maintaining costs of the equipment should be estimated while deciding about equipment. It is better to spend somewhat more initially on the purchase of equipment, which is of higher quality (not necessarily more sophisticated), more durable and require minimal maintenance rather than purchasing the cheapest available equipment, which may need much more maintenance (Najeeb, et al, 2008).

2.3.1.6 Timing of equipment arrival and other inputs

Procurement planning should take into account lead-time required in the purchase process. It is important that when the equipment arrives at the facility, the other inputs such as training, infrastructure renovation (site preparation) etc. is completed. Equipment arriving much earlier or later than the other inputs can lead to non-provision of services and consequently wastage of resources. This problem was seen by WHO staff in several countries and across projects. In one country in Asia equipment arrived more than 18 months after training. In other large project training never happened for certain category of staff who were to use the equipment. In one country in Africa equipment arrived more than one year after training (WHO, 2008).

2.3.2 Distribution and Installation

Inventory management establishes the numerical and financial value of the stock of biomedical equipment held by the health care facility and data are analyzed according to specific statistical processes, such as type of appliances installed, distribution per purchasing year (Bravar, et al, 2004).

Often, progress is equated by doctors and managers to the acquisition of the most sophisticated and the latest models of equipment, regardless of whether or not they are essential or could be maintained in the locations. Some studies showed that in several countries the selection and procurement of equipment were done at the national level, by the government or the donor agencies. Frequently equipment is selected and purchased without consideration to the location - needs and resources of the facility, where it will be installed and used. For example, some remote hospitals in Egypt acquired very sophisticated anesthesia machines even though there were no systems in place for maintenance or repairs for such

equipment. Even if an equipment is found suitable the level of technology acquired might not be appropriate at the level of service delivery due to lack of maintenance support. The study observed that sophisticated machines are two to four times more expensive than similar simple equipment (Wield, and Malike, 2008).

Amer, and Ammari, (2006) stated that adaptation of new medical equipment in Jordan will affect the medical equipment distribution among all the sectors and in all of the governorates. It can be realized that the majority of the available medical equipment especially the capital and sophisticated ones are concentrated in the capital city Amman.

Mavalankar, et al, (2004) showed that in some countries, the equipment is not well distributed in the facilities, some facilities have more equipment than others and the type and amount of equipment does not correspond with the workload or staff or skills of staff in the facility.

2.3.2.1 Appropriate distribution of equipment

The World Health Organization (WHO) estimates that in some developing countries, up to 50% of the medical equipment is unusable at any given time. In some hospitals, up to 80% of their medical equipment is inoperative and is stored in hallways or patient rooms. This situation results in the neglect of patients and an increased risk of harm to them and to health workers (Teninty, 2006).

A hospital also must allocate space for the delivery, storage, and distribution of medical equipment to the health department. So Large devices, such as anesthesia machines, and X-ray

equipment, must be stored in accessible locations where they will not clutter or obstruct hallways (Smith, et al, 2004).

Studies showed that in several countries the selection and procurement of equipment done by the government or the donor agencies. Frequently equipment is selected and purchased without consideration to the location - needs and resources of the facility, where it will be installed and used (Mavalankar, et al, 2004).

Medical equipment inventory and documentation systems can provide information to support different aspects of medical equipment management that should be considered for standardization and include accessories, spare parts, and operating and service manuals which should be distributed to the users and stored at the technical document library for safekeeping (Dyro, 2004).

Mavalankar, et al, (2004) noted that in some facilities in Africa it was difficult to find a register or a permanent record of the equipment in each department and storage area.

2.3.2.2Workload and Staff Skills

The information collected about the distribution of medical equipment of medium- and high-technical complexity by hospital medical and administrative units is important to identify each functional unit and enables technical departments to define priorities and to plan maintenance actions (Gutierrez, 2004).

Currently, one of the main factors by which medical equipments can be identified in Estonia hospitals that new equipment purchased which now carry most of the workload in hospitals –

latest technology, improved quality, and well supported by private companies, poorly supported by in-house technicians who have limited access to technical documentation (Aid, et al, 2004).

The WHO staff observed that in some countries, the equipment is not well distributed in the districts. Some facilities have more equipment than others. Sometimes the type and amount of equipment does not correspond with the workload or staff or skills of staff in the facility. For example, in one Asian country, the sub-district hospitals with low numbers of deliveries per year received equipment for EMOC and neonatal care while the district hospitals with far more deliveries and complications were not given such equipment (WHO, 2008).

David, et al, (2004) presented that to accomplish effective management of medical equipment, the workload and budget allocations per unit must be developed and established for the organization according to clinical engineers and operators skills, because medical assets management consists of a variety of tasks, individual impact and alternatives should be studied and presented to management, and this resulted in risk mitigation, cost containment, and customer satisfaction.

Lack of management expertise and technical competence may adversely affect decisions concerning location, installation, and distribution of medical equipments (WHO, 1986).

Rice, (2007) defined the Medical Equipment Manager that he will be responsible for establishing a system to hold an inventory and service log of all diagnostic and therapeutic equipment used within the organization.

Training of users and operators is important in ensuring the safety and effectiveness of medical equipment, because operator error leading equipment malfunctions and maintenance problems. Therefore in developing countries, physicians should receive training before the use of complex equipments (David, et al, 2004).

The extent of staff training required to effectively participate in the process and the workloads of various department containing complicated medical technologies to be aware about rational utilization of medical equipment (Harding, et al, 2004).

The WHO staff in one Asian country observed that equipment was distributed without taking into consideration the workload or the skills available among the staff. This was also observed in one country in Africa. In this country the staff saw many equipments in a hospital, which had almost no staff and in a not-so-far hospital there was staff but lack of equipment. Sometimes location of equipment is decided by politicians, bureaucrats or donors rather than technical managers who know the need or utility. WHO recommends that for each district there should be mapping of the key equipment along with workload and staffing of the facilities in that district. This will help the district level managers identifying gaps and mis-matches, which lead to poor utilization of the facilities. District level managers should have freedom to transfer equipment to match the needs i.e. staff skills (WHO, 2008).

2.3.2.3 Proper installation of equipment

Observational studies in Africa and Asia showed that in many developing countries the electrical current has lot of fluctuations in voltage, which can easily damage the equipment,

and in several hospitals there most of sensitive electrical equipments are not connected through voltage stabilizers to protect against voltage fluctuations (Mavalankar, et al, 2004).

The safe and effective operation of medical equipment depends on the physical plant and its utilities and support systems such as heating, ventilation, and air conditioning, electrical distribution systems, medical gas systems, sanitation systems, and water supply that should be designed before installing the equipment (Dyro, 2004).

Before purchasing the medical equipment, installation requirement should be considered for proper use of the equipment such as installation location, safety requirements (such as shielding), accessibility, floor loading capacity, space and electrical power (voltage, frequency, phase, and dissipation), water volume and pressure needed, and environmental conditions, also care should be taken to identify any unusual extremes of temperature, humidity, dust and electrical power fluctuations that could adversely affect the equipment's operation (WHO, 2000).

Care should be taken to identify any unusual extremes of temperature, humidity, dust, and power fluctuations that could adversely affect the equipment’s operation (Dyro, 2004).

Hospital architecture and physical infrastructure should be designed and planned well before purchasing medical equipment including water supply installations, mechanical and special installations, electrical and communication installations; and the medical equipment inventory program (Gutierrez, 2004).

Sumalgy, (2004) showed that clinical engineering in Mozambique should cover not only the maintenance of infrastructure and vehicles but also the management of all of its physical assets. Physical assets include equipment (medical and general), vehicles, infrastructure, and other installations.

Power quality and voltage stability can be particularly critical for certain analytical and imaging devices and extensive testing may be required before device installation to ensure adequate quality of health care technology (Baretich, 2004).

Experienced and qualified personnel should install all sensitive electrical instruments with proper protective devices such as voltage stabilizers depending upon local electric supply conditions. The location of equipment should be carefully decided depending on workflow and space available. The WHO staff have seen in many countries that there is substantial time lag between distribution of equipment and its installation. Sometimes equipment is never installed at all and kept lying in the stores. For instance, in one large externally aided project in Asian country much of the equipment remained in the store, uninstalled for years. Similarly in an African country the WHO staff observed lot of uninstalled equipment in stores. Thus it is a common problem. It is recommended that a system of installing the equipment immediately after its delivery should be developed. The regional and national managers as well as the hospital directors should keep a record of equipment delivered but not installed and follow up closely the reasons for the same. A visual display of such data in the regional manager's office would prompt faster action (WHO, 2008).

2.3.2.4 Good documentations

It is observed that generally, after the installation the user manuals of the equipment and information on maintenance warranties are not kept in an easily accessible but secure place. The availability and content of such manuals is not widely known to the staff and managers in the facility. Hence when the equipment needs servicing, the company responsible for the warranty and maintenance is not immediately contacted. In some instances, we have seen that even though equipment is under warranty due to lack of proper documentation the equipment is not repaired. The accompanying manuals are usually in English or French and the lower level staff, who, use the equipment may not be able to read them. Developed countries have good documentation of the equipment. For example United Kingdom NHS has its own booklets on equipment management for providing guidelines to all the maintenance staff - eg Health Equipment Information (HEI) booklet titled "A code of practice for acceptance testing of Medical Electronic Equipment" and " Management of Equipment" (WHO, 2008).

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But we have not observed such practices in any developing country we visited. Another important aspect of equipment management is keeping good records and inventories of equipment. In some facilities in Jordan it was difficult to find a register or a permanent record of the equipment in each department and storage area. Sometimes there were records but were not readily accessible. Hardly any of the facilities visited had a system of periodic analysis of the equipment records and prompt action to repair or replace them. It is recommended that each department keep a file of the user manuals of the equipment along with the copies of the service contracts and warranties. The key information of the service contract or warranty such as name, address, telephone numbers of the responsible company and date of validity of the contract should be written on a small card and pasted on the equipment at a prominent place so

that everybody using the equipment knows about the maintenance arrangement. Each department should keep a record of all the equipments in their department and this should periodically be verified and countersigned by the supervisor. In addition, the functional status of each piece of equipment should be indicated in equipment registers. The key points (Dos and Don'ts) of the user manual should be translated in the local language and pasted on the wall near the equipment so that the staff using the equipment can follow these instructions easily.(WHO, 2008).

2.3.3 Use of Equipments

2.3.3.1 Staff Training

All staff have a professional responsibility to ensure they are competent to use medical devices in a safe and effective manner, therefore staff must not use medical equipment until they have had the appropriate training required to ensure patient safety (Rice, 2007).

Operators and service manuals should be obtained with delivering the medical equipment for safe and proper use of the equipment (Dyro, 2004).

Training of staff who will operate and maintain the equipment is an important aspect of the preparation that should be considered before medical equipment provision either through purchasing procedures or through donation, therefore if their difficulty in organizing training for operators and maintenance team the donor should suggest alternatives (WHO, 2000).

(Amer, and Ammari, 2006) showed that one of the main reasons usually make the management of medical equipment not as desired that the medical team either of physicians or nurses does not have the enough knowledge, experience and sense to deal with such sophisticated equipment or did not get the proper training on them which leads to the misuse of medical equipment, and causing frequent malfunctions result in system damages.

Teninty, (2006) reported that time and resources are wasted on the purchase of sophisticated and duplicate biomedical technology equipment, which is underutilized or never used due to the lack of operator training and a qualified maintenance staff. The inexperience of operators and the lack of repair and maintenance capabilities drastically reduce the functioning life of equipment, limiting access to life-saving care for the most vulnerable segments of society.

Service training is important not only for clinical engineering, but also for the equipment users each time that provided by vendors within hospital departments in order to assist the clinical staff to solve some equipment problems through operation (Soller, 2004).

One of the main factors that contributing to the wastages of medical equipment resources Mallouppas, (1986) reported that about from 20- 40% of sophisticated purchased equipment never used due to lack of operating staff, maintenance staff, and medical staff to support and use it.

2.3.3.2 Equipments calibration and cleaning

Dyro, (2004) stated that test equipment and calibration standards often are required to ensure performance and accuracy of the medical equipment operation. Therefore any required

operator training should be stated clearly before donating, or purchasing any equipment. In many cases in some Asian facilities, damages of medical equipment are due to rough and careless handling, improper cleaning, exposure to heat and dust.

There are no universal guidelines for cleaning and disinfecting large items of medical equipment. Washer/disinfectors provide one method of making medical equipment safe for staff and patients (Miles, 1991).

Medical equipment must be maintained in working order and must be calibrated periodically for effectiveness and accuracy (Dyro et al, 2004).

In order to keep medical equipment working properly and safely, periodic parts replacement, lubrication, recalibration, or other routine maintenance should be performed regularly (Cohen, et al, 2004).

Staff members must be available to perform the scheduled inspections of medical equipment, and the hospital should plan to have sufficient staff available to meet the workload associated with equipment use, and repair (Hertz, 2004).

In some Egyptian facilities, the labour tables were rusted because they were not dried after washing in between deliveries. Instead, the moist surface of the labour table was covered with a piece of mackintosh, which trapped the moisture and increased the rate of rusting (World Bank, 2008).

In many cases, equipment deteriorates because of improper use and lack of care. We have seen in several facilities rubber parts rendered unusable because of exposure to heat, rusting of legs of beds and other furniture due to careless wet mopping of the wards, cracking of ceramic wash basins because of heavy instruments being tossed into them, etc. Rural areas of many countries are very dusty. Dust can also damage sensitive equipment such as lab equipment, anesthesia machines etc. (Malike, and Anam, 2008).

2.3.4 Repair and maintenance

Mavalankar, et al, (2004) suggested that each facility should have proper maintenance plan with an adequate budget for the repair and maintenance of equipment which should be decentralized and the rules should be simplified for its use.

Proper maintenance of medical equipment is essential in order to obtain sustained benefits and to preserve capital investment (Dyro, et al, 2004).

Quality control and maintenance services are two important points that should be considered when want to purchase the most advanced medical equipments. The quality of maintenance and the reliability of services are important points considering quality control and safety for our patients. and malfunctions and inadequate repair services could be a threat for our patients, therefore the legal responsibility could rely on hospital and medical doctors if services and maintenance have not been carefully planned (Rey, 2008).

McCauley, (2004) referred that planning of medical equipment maintenance is important which requires detailed knowledge of maintenance requirements and the resources that are required to perform maintenance as, labor, parts, materials, and tools.

Computerized maintenance management systems can provide the technology management staff with a wealth of information to help manage the very large workload on medical equipment (Cohen, et al, 2004).

Studies in developing countries observed that generally after the installation the user manuals of the equipment and information on maintenance warranties are not kept in an accessible place and the availability and content of these manuals is not known to the staff and managers in the facility (Mavalankar, et al, 2004).

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2.3.4.1 Preventive Maintenance

Due to lack of preventive maintenance such as routine cleaning, oiling and painting, many furniture items such as patients' beds, labor tables and examination tables are rusted or nonfunctional. Lack of policy, funds, priority and systems for R & M are the key reasons for such neglect of this important management function. World Bank observed, "Curbing capital spending is justified during periods of budgetary austerity, but reducing maintenance spending is false economy. Such cuts have to be compensated for later by much larger expenditures on rehabilitation or replacement." It is recommended that each hospital develop a schedule for the inspection and preventive maintenance of all the major equipment. The persons operating the equipment should be trained for simple maintenance such as cleaning, caring, oiling. Hospital furniture should be regularly repaired and painted so that it lasts longer. A good approach is to keep one fixed week, once in every year, when workload is relatively low, for carrying out such a drive for thorough cleaning, repair and disposal of old non-working equipment. In armed forces in many countries there are fixed inspection days every year before which each

piece of equipment is cleaned, repaired and maintained. Such system should be started in health services (WHO, 2008).

De Vivo, et al (2004) addressed that managing medical equipments is a formidable task that has to be pursued maximizing the benefits within a highly regulated and cost-constrained environment. Clinical engineers are uniquely equipped to determine which policies are the most efficacious and cost effective for a health care institution to ensure that medical devices meet appropriate standards of safety, quality and performance. Part of this support is a strategy for preventive and corrective maintenance.

Medical equipment should be registered into an inventory management system along with related information such as manufacturer, vendor, date of purchase, purchase price, model number, serial number, and preventive maintenance frequency (Dyro, 2004).

In an effort to reduce maintenance, repair, and reorder costs associated with the wide range of capital equipment necessary for the operation of most healthcare facilities, some healthcare organizations are turning to third-party capital equipment management companies. These companies can help reduce costs by providing the high-level technical expertise many facilities lack, reducing response time when equipment servicing is necessary, and developing effective preventive maintenance programs (Tudor, and Gemmill, 1994).

The preventive maintenance procedure consists of a set of equipment type and model-specific procedures identifying the tasks and parts that are required to perform periodic inspections,

preventive maintenance, and periodic parts replacement according to the equipment service manual (Cohen, et al, 2004).

In study about computer aided planed maintenance system for medical equipments. A software package is introduced, which has been developed to monitor and administer preventive maintenance activities for healthcare devices. This software with its object-oriented nature aims to standardize preventive maintenance activities (Muldur, 2003).

Gomez, (2004) presented that medical equipment inventory must be conducted to determine the operating condition of every piece of equipment in each health facility and to schedule the resulting rehabilitation, preventive maintenance, and repair activities. There also must be ongoing training for operators and maintenance staff, using equipment in these facilities.

Cram, (2004) showed that equipment maintenance is associated with duties that include unscheduled corrective maintenance of medical equipment and scheduled preventive maintenance (PM) of medical equipment. And the documentation of equipment maintenance is an important to these maintenance activities.

2.3.4.2 Maintenance team training

Varieties of Biomedical Equipment (BME) are now used for quick diagnosis, flawless surgery and therapeutics. So use of a malfunctioning BME could result in faulty diagnosis and wrong treatment and can lead to damaging or even devastating. To make BME maintenance efficient the study in India suggested the following measures: (i) design and development of comprehensive computerized database for BME (ii) cadre of Clinical engineers (iii) online

maintenance facility and (iv) farsighted managerial skill to maximize accuracy, functioning and cost effectiveness (Sahay, and Saxena, 1996).

Cheng, (2004) noted that the maintenance of the wide range of equipment requires a correspondingly wide range of technician skill levels, and the cost or time to train a technician increases with the level of skills required.

The maintenance of medical equipment requires a wide range of technical abilities, and high level of technician's skills, so users of equipment should also be trained to do routine simple maintenance on equipment to increase the care of equipment and cooperate with maintenance technicians (WHO, 2009).

Galvan, (2004) showed that many medical equipment and facilities are frequently out of service or malfunctioning for various reasons such as: lack of infrastructure, equipment, human resources for maintenance, Low levels of standardization, leading to a high degree of diversity of equipment and physical plant, and inadequate training of equipment operators and maintenance technicians.

It has been in most of the North African countries visited that trained and well skilled bio-medical equipment repair technicians are not available. The repair of bio-medical equipment has not developed as a profession since there are no training programs available and there are no posts for such persons in hospitals (Skeet and Fear, 2009).

2.3.4.3 Spare parts

The quality of health care has been further affected by deterioration in the functionality of medical equipment due to the lack of maintenance and spare parts, and restricted training opportunities for medical staff that were already at poor levels. And significant amounts of equipment and spare parts waiting for delivery from the West Bank and Israel, but it were very difficult to get Israeli approval to bring it into Gaza (WHO, 2009).

(WHO, 1992) report presented the most common factors contributing to high wastage of national health resources in most developing countries are Purchase of sophisticated medical equipments, which is never used due to lack of operating and maintenance staff and medical expertise to support and use it, limitation of useful life time of equipment due to inexperience of operators and lack of maintenance and repair, additional purchase of accessories, extras, and specialized spare parts due to lack of expertise in choosing appropriate systems, lack of standardization result in increased spare parts costs and extra workload on the limited number of competent staff, excessive down time of equipments in which they remain inoperative, due to lack of spare parts and inexperience in repair and absence of preventive maintenance, and lack of manpower development and appropriate training for medical staff within ministries of health inhibit them fro fulfilling their mission .

Unavailable qualified maintenance team and unavailable management system which insure proper inspections, calibrations and maintenance or insure the availability of disposables and spare-parts which are important to keep these equipments running make, will reflect the level of effectiveness of repairing medical equipment (Amer, and Ammari, 2006).

Simple inventory management techniques should be used to ensure that critical spare parts are always in stock (WHO, 1986).

Other major problem is the lack of availability of spare parts for some of the imported equipment. For example, It has been observed in some North African countries that, many expensive operation rooms lamps required specific bulbs, which were not easily available locally and there was no system to import them hence the expensive OT laps were unusable. Hydraulically operated operation rooms tables were not working due to non-availability of small parts for the hydraulic mechanisms. Electrical equipment such as cattery machines is usually non-functional also due to lack of spare parts. As a result, much of the past investments in equipment are unusable (WHO, 2008).

2.3.4.4 Disposing Equipments

When repairing medical equipment using inappropriate parts causes severe problems. And expiry dates for medical equipment may prevent unsatisfactory repair, especially when original parts are unavailable. So renewing medical equipments is necessary to keep patient safety (Tavakoli, et al, 2007).

Heimann, et al, (2004) defined health care technology as Organizational and physical infrastructure, including health facilities and buildings; their installations and plant; energy sources and water and gas supplies; and supportive and logistical systems, whose components are supply systems, information systems, communication and transport systems, and waste disposal systems.

(Mavalankar, et al, 2004) noted that a common problem that has observed in Asia and Africa hospitals is not disposing old and non-functioning medical equipment, and broken furniture. So the procedure for disposal of the equipment should be simplified and each supervisor should know and follow the procedure.

A common problem we have observed in hospitals in Asia and Africa is not disposing old and non-functioning equipment, broken furniture and even empty cartons and broken glass items. These items are many times stored in some of the vital areas of the hospital such as operation theaters, labour rooms and wards. In government hospitals disposal of such items usually involves long and complicated procedures. And disposal is within no one's priority list, hence never gets done. The procedure for condemnation and disposal of the equipment should be simplified and each supervisor should know the procedure so that they can follow it expeditiously. The higher-level supervisors should make it a routine agenda during their review visits to check on removal and disposal of such old and unusable equipment (WHO, 2008).

It has been observed in Egypt that even broken glass items such as syringes and fluorescent tubes are stored for many months due to such stringent audit for disposal. Even the local supervisors (district and regional medical officers) generally do not expedite the removal of these non-functional items. What is surprising is the simple step of removing such equipment from vital and functional areas of the hospital, such as from labor rooms to a storage room or a garage, also is not commonly done. This is clearly due to poor management and perhaps due to non-realization of the threat such equipment poses to the health of the patients (Skeet and Fear, 2009).

2.3.5 Donated Equipment

Appropriate donations of medical equipment can be of benefit to hospitals in resource-poor settings, but recipients and donors need to actively manage donations to ensure that the donations are beneficial. This requires planning, technical expertise and local participation (Hill, et al, 2008).

It is observed that many donor assisted-programs assume that various pieces of equipment are not available at the facilities and proceed to help in purchasing new equipment. The observations show that in many instances this is not the case. Unfortunately donors and national government rarely invest time and resources in repairing the existing equipment or setting up systems for maintenance and repair. Improving maintenance systems does not have the same visibility for politicians and donors as the purchase of new equipment. Even the hospital managers and doctors, many a times want new equipment rather than repairing existing one. This wastes lot of resources. It has been observed that in some of the North African countries there are small repair and maintenance units within the MOH. But they are only at a very high level (national or state), they are generally understaffed, under-funded, under-skilled, under-motivated and unmonitored. It was reported in Egypt that due to an economic down turn such unit was disbanded. In Jordan, a large donor assisted equipment supply project. During the project period the supplies had contracts to maintain the equipment, but after the project was over the government has not renewed the maintenance contracts for several months jeopardizing the functioning of the equipment (World Bank, 2008).

2.3.5.1 Donation standard and conditions

Often, progress is equated by doctors and managers to the acquisition of the most sophisticated and the latest models of equipment, regardless of whether or not they are essential or could be maintained in the locations. The observations showed that in several countries the selection and procurement of equipment were done at the national level, by the government or the donor agencies. Frequently equipment is selected and purchased without consideration to the location - needs and resources of the facility, where it will be installed and used. For example, some remote hospitals in Africa and Asia acquired very sophisticated anesthesia machines even though there were no systems in place for maintenance or repairs for such equipment. Even if an equipment is found suitable the level of technology acquired might not be appropriate at the level of service delivery due to lack of maintenance support. It has been also observed that sophisticated machines are two to four times more expensive than similar simple equipment (World Bank, 2008).

Dyro, (2004) referred that it is important after donated equipment installation and operation, the donor and the recipient should assess the level of operational success or failure of the medical equipment donated. This assessment fosters communication between donor and recipient, encourages the continued support of the donor, and allows both parties to learn to improve from previous experience.

Many problems common to developing countries could be helped by actions or coordination at international level. Guidance could be prepared on appropriate equipments, standardization of equipments, specifications, procurement, tendering, and maintenance procedures (WHO, 1986).

The donor should specify the installation location, accessibility, floor-loading capacity, space and power requirements (i.e., voltage, frequency, phase, and power consumption) and environmental conditions. And the donor should also ensure that detailed installation instructions are provided in the equipment's operating or service manual (Dyro, 2004).

Experience has shown that equipment donation may cause the recipient more problems than benefits; therefore many of consideration that donors should take and respect before performing the donation as communicate with the recipient to make sure that the potential recipient has provided a comprehensive description of the equipment required, supply fully functional equipment and test the equipment and make sure all necessary spare parts and supplies are included in the package before making shipment, supply all technical documents for installation, operation, maintenance and repair manuals and diagrams should be made available in a language understood by the users and the technicians, supply enough consumables and spare parts to last at least two years include a complete list of spare parts and indicate the name and address of the authorized dealer, ensure proper packaging and shipping including a comprehensive packing list (MOH, 2008).

The donor should provide detailed maintenance requirements, such as technician training, special tools, preventive maintenance materials, and test and calibration equipment needed, as well as necessary documentation, including such information about preventive maintenance (WHO, 2000).

The problem of malfunctioning equipment is complex, and it involves issues such as the capital and recurrent cost of equipment; the low level of development of maintenance systems;

the lack of standardization; the donation of medical equipment; and a shortage of professional and technical staff in public hospitals (Gomez, 2004).

In pre-donation planning, the donor must provide the recipient with detailed information regarding the installation, operation, and maintenance of the equipment. This information will enable the recipient to begin pre-installation tasks, including the training for operation and maintenance (Dyro, 2004).

(WHO, 2000) listed that donors should consider a lot of characteristics for each donated equipment to be supplied to developing countries as, simplicity of operation, minimal number of accessories required, availability of necessary operating supplies (particularly disposable), recipient country, at affordable cost, standardization with other equipment in the locale, low energy consumption, does not use environmentally hazardous substances, ease of maintenance, and tolerance to hostile electrical and physical environment.

Maputo, (2008) listed the WHO guidelines that recommended and should be considered before medical equipment donation as, donated countries should have clear policies at the central level with a list of equipment, donors should send equipment specifications prior to delivery, donated equipment should have at least 80% useful life remaining at time of donation, donated equipment should follow normal supply management processes to assure adequate supplies; service, maintenance and training systems must be available, and vendors should be pre-qualified where possible within the country.

2.3.5.2 Non functional Equipments

In Sub-Saharan Africa, up to 70% of donated equipments are non functional due to mismanagement of the technology acquisition process, lack of user training, lack of effective technical support, and lack of available spare parts, documentation, supplies, and operator training in the recipient country (Dyro, 2004).

Donation of used equipment sometimes presents overwhelming problems, especially to the recipient, so many of equipments never work for long time. Even when it does work, it can't be supported with adequate local arrangements for the necessary training, maintenance, spare parts, and users and service manuals (WHO, 2000).

2.3.5.3 Out of need

Many of donated medical equipments are unused due to lack of donor support for supplying spare parts, accessories, and maintenance documentations. So it necessary for identifying criteria's and requirements for donation (WHO, 2000).

There is general lack of understanding that the cost of making equipment available for use is greater than the cost of purchase. Through useful lifetime of the equipment, the expenditure on maintenance and repair may greatly exceed the purchase price. So it is important that donor countries ensure that their financial support of health care equipments without any additional resource expenditure (WHO, 1986).

Excessive donations of medical equipment leading to serious operating and maintenance problems, because of the lack of manuals and parts and the absence of regulations and standards controlling the quality and efficiency of these equipments (Gomez, 2004).

Chapter III

Methodology

This chapter illustrates the research methodology which was used to conduct this study. The chapter presents the study design, study population, study setting, and the ethical procedures that were considered in the study. Tools and instruments that were used in the study, their validity and reliability, piloting, data collection and analysis processes are also presented in this chapter. The chapter also presents the selection criteria and the limitations of the study.

3.1 Study design

This is analytical cross sectional study, as this study is considered suitable in describing the variables, their distribution patterns, and examining associations between them. In this research, the cross sectional study design can help in giving an overview of the management system of medical equipment in governmental health facilities in Gaza. On the other hand it can help in examining some associations between the study variables. Cross-sectional design was chosen because it is cheap, easy, and enables the researcher to meet the study objectives over a short period of time. Although cross-sectional design is weak in indicating causation relationships, it is highly useful and sometimes used for comparison purposes (Cherry, 2007).

3.2 Study population

The study population is diverse and included two sub-populations; the first sub-population is the medical equipment line managers who are responsible for receiving, keeping, and establishing a system to hold an inventory and service log of all diagnostic and therapeutic equipment used within the organization. These managers are the department head, and the department senior nurse from each of the medical departments at the MOH facilities (Hospitals and PHC clinics). The second population is medical equipment that belongs to selected departments in order to determine the usage rate of equipments and the needs within selected departments.

3.3 Study settings

The study was conducted in all governmental health facilities in Gaza Strip which are supplied periodically with medical equipment. The checklist was done in the x-ray departments in all major hospitals because x-ray equipments are the most commonly used equipments and can be found at all hospitals regardless of the hospital size.

3.4 Selection criteria

3.4.1 Inclusion criteria

3.4.1.1 Inclusion criteria for the questionnaire:

- All formally employed physicians, senior nurses and technicians who have direct responsibilities and experience on managing medical equipments in the departments of MOH hospitals and clinics in Gaza Strip.

3.4.2 Exclusion criteria

3.4.2.1 Exclusion criteria for the questionnaire:

- All Clinical staff who didn't have direct responsibilities and experience in managing medical equipments within a department.

3.5 Ethical and administrative measures

The study respected the research ethical principles. So before conducting the study, the researcher obtained an ethical approval from the Helsinki Committee (Annex 3). The researcher also obtained an administrative approval from both the General Directorate of Hospitals (Annex 4). The researcher attached an explanatory letter in Arabic (Annex 5), and an English translation was attached Annex 6), that clarifies the purpose of the study, study confidentiality, and the voluntary right of participation in the study to each person who was eligible to participate.

3.6 Period of the study

The study was conducted in the year 2009, started with the literature review in February 2009. The proposal was approved by the School of Public Health-Al Quds University in May 2009. An administrative approval from the General Directorate of Hospitals and an ethical approval from Helsinki Committee were obtained in June 2009. Pilot study was conducted in June 2009, while actual data collection took place in July 2009. Data analysis was completed by September 2009 and the final results were available by November 2009. The total duration of the study was 8 months.

3.7 Study instruments

3.7.1 Self- Administered Questionnaire

The questionnaire was designed in Arabic language to avoid language difficulties that might interfere with data collection (Annex 7), and an English translation was also provided (Annex 8) . The questionnaires had both close-ended and open-ended questions to identify gaps and weakness in the life cycle of medical equipments management. It was designed to be self-administered questionnaire.

3.7.2 Checklist:

The observational checklist is attached in English language (Annex 9). The checklist was used to monitor the status of imaging equipment at all MOH imaging departments-Gaza strip. The checklist consisted of the following data:

- Status of imaging equipment.
- Reasons for non functioning equipment.
- Number and type of donated equipment.
- Inventory card and the documentations of the equipment.
- Preventive maintenance.

Some of the questionnaire questions were used again in the checklist for verification purposes.

3.8 Construction of the study instruments

In this study more than one instrument were designed in order to meet the study objectives and these were self- administered questionnaire, and observational checklist. All these tools were self-constructed and designed to meet the objectives of the study. The questionnaire was developed based on literature review, field observation, and consultation with experts in both medical equipment and public health fields. The questionnaire consisted of 68 questions that were categorized into 6 main parts. The first part included the characteristics data of the respondents like gender, age, current and previous place of work, marital status, title, qualifications and experiences. The second part was about the procurement and selection process that include the questions related terms and conditions that should be considered before purchasing the medical equipment. The third part was about installation and distribution of medical equipment. This part includes questions related to all requirements that should be prepared before delivering and installing the equipment. The fourth part was about the stage of using of medical equipment. The fifth part was about the donated equipment. This

part includes questions about the advantages and disadvantages of medical equipment donation. The last part was about repair and maintenance of medical equipment. In this part the questions were specific to the main obstacles that facing proper repair and maintenance of equipment. The checklist was developed and included some repeated questions to observe the status of imaging equipment management and to ensure the validity and reliability of the study.

3.9 Pilot study

After revision and modification of the study questionnaire and checklist by field-related specialists, a pilot study was conducted on 15 interviewees to determine its suitability and appropriateness and to determine if there is a need for modifications. Participants of the pilot study were asked about any ambiguities and their opinion about the questionnaire and the other tools. Some vague questions in the questionnaire were changed to be more accurate after the pilot study which was a helpful exercise for the later data collection process. Then actual data collection began at all governmental health facilities.

3.10 Data collection

Two instruments were used to collect the data, the self-administered questionnaire and a checklist. The self-administered questionnaire answered by physicians, senior nurses and technicians of medical departments who are responsible for medical equipments management was collected by the researcher himself at MOH facilities (Hospitals and PHC clinics) in Gaza Strip. The collected questionnaires were checked and overviewed for completeness, then entered into the computer for statistical analysis. The researcher completed the checklist in

unannounced visits to the imaging departments in all major hospitals, then all collected data entered into the computer to undergo statistical analysis.

3.11 Response rate for the questionnaire

The response rate in this study was as (92.2%) agreed to participate in the study. This was in part because the instrument used in this study encouraged the target group to participate.

3.12 Data management

3.12.1 Data entry

Filled questionnaires were checked and overviewed again. Then after that, data was entered into the computer using SPSS software version 11.0 to be analyzed. After finishing the data entry process, data cleaning was done to guarantee that all data were entered accurately and in appropriate way. Data cleaning was conducted through selecting and checking out a random number of the filled questionnaires, and also through operating frequencies and descriptive statistics for most variables.

3.12.2 Data analysis

After collecting and revising the filled questionnaire and checklist, the next step was coding the questionnaires and the checklist using the computer software statistical package for social science (SPSS) version 11.0. Then, the coded questionnaires and checklist were entered into the computer by the researcher with the help of the supervisor and statistical advisor. Data cleaning was done through checking out a random number of the questionnaire and through

exploring descriptive statistic frequencies for all variables. Means and standard deviations were computed for the continuous numeric variables and then coded. Reliability was tested to ensure the internal validity of the findings. Scores were computed individually based on the specified study domains. Means were appropriately calculated. In addition, to examine the potential relationships between the different variables, and independent t-test and one way ANOVA test were used. t-test were used to examine the differences in the mean scores for variables with two possibilities. ANOVA test was used to examine differences in the mean scores for variables with more than two possibilities.

3.13 Reliability and validity

3.13.1 Reliability

Reliability of an instrument is the degree of consistency and stability with which it measures the attribute it is supposed to be measuring (CSU, 2009). However, the researcher had also tested these tools again to ensure that the reliability in this study high and congruent with previous studies. The reliability coefficient for the five parts of the medical equipment management cycle as a whole was 0.760 (Table 3.1) which indicating a good reliability.

Table 3.1: Reliability of the five parts of the management cycle

No.	Item	Alpha
1.	Procurement and Selection	0.790
2.	Distribution and Installation	0.753
3.	Use of Equipment	0.609
4.	Donated Equipment	0.784
5.	Maintenance and Repair	0.776
	Total	0.760

3.13.2 Validity

Validity of an instrument is considered to be an important issue that has been discussed and stressed out by many researchers. Before data collection, the questionnaire has been reviewed by eleven different experts (Annex 10) with different background, academic, managers, and researchers, in order to ensure its face and content validity.

Face validity is the extent to which the items of a test or procedure appear superficially to acceptable and appealing to the subject. So, face validity is concerned with popularity or common acceptance rather than scientific truth and doesn't depend on established theories for support. In contrary, content validity refers to the degree to which an instrument adequately covers the items it is supposed to be measuring (CSU, 2009).

The previously mentioned eight experts reviewed the instrument and consensus about the questions was reached. Additional validity measures were implemented and included training of the researcher assistant, standardization of implementation, standardization of tools, reviewing the filled questionnaires and data cleaning.

3.14 Limitations of the study

The researcher considered the following points as limitations he faced during conducting his study:

- The unsettled general political situation in the Gaza Strip and political conflict between Palestinian factions which influenced the health sector may affect the way in which some employees responded to the questionnaire.

- Limited scientific resources and few literatures on medical equipment management at hospitals faced the researcher during the literature review writing.

- The design is Cross-Sectional and the situation could vary from time to time, therefore further assessment may be needed

Chapter IV

Results and Discussion

This chapter presents the results of the study and discusses its key findings. This chapter shows the descriptive analysis of the study findings in general and of the respondent's characteristics in particular. Also, it presents current evaluation for medical equipment management in governmental health facilities in Gaza governorates.

4.1 Respondents perceptions about the five phases of the cycle

Table (4.1): The Means of the Five Phases of Medical Equipment Management Cycle

No	Item	No. of questions	Mean	STd
1.	Procurement and Selection	13	2.88	0.62
2.	Distribution and Installation	11	2.89	0.69
3.	Use of Equipment	8	3.31	0.57
4.	Donated Equipment	9	2.76	0.69
5.	Maintenance and Repair	9	2.87	0.66
	Total	50	2.88	0.48

As elucidated from table 4.1, which show the study population perceptions and evaluation for the five parts of medical equipment management cycle starting from procurement and selection, distribution and installation, use of equipment, donated equipment, and maintenance and repair. The participants perception of the way in which the equipment were used (mean = 3.31). There is similarity in the respondent’s perceptions toward the procurement, distribution,

and maintenance with mean score (m= 2.88), (m= 2.89), and (m= 2.87) respectively. Followed by the donated equipment which had the lowest mean score (m = 2.76), which means that the perceptions is that donated equipment do not match their needs and they

were not satisfying.

4.2 Subjects characteristics

The total number of medical equipment managers of physicians, senior nurses and technicians was 208. Out of them, 190 (92.23%) responded and filled the study questionnaire. The study respondents were from a diverse socio-demographic characteristic. As illustrated in Table 4.2, the greater proportion of the study respondents were males who represented about 81.1% of the total respondents while females represented only 18.9%. This result indicates that males are more involved in the working force than females in hospitals and PHC especially at managerial levels, as with other sectors in the Palestinian health care system where males usually constitutes the greater portion of the workforce and this is somewhat consistent with the level of women involvement in workforce (11.5%) in Gaza Strip (PCBS, 2007).

Table (4.2): Distribution of the study respondents by their characteristics

No.	Item	No.	%
1.	**Sex**		
	Male	154	81.1
	Female	36	18.9
	Total	190	100.0
2.	**Age**		
	30 Yrs and less	21	11.4
	From 31 to 40 yrs	61	33.0
	From 41 to 50 Yrs	78	42.2
	More than 50 Yrs	25	13.5
	Total	185	100.0
Mean = 41.9, MD=42 , Std= 8.4			

As seen in table 4.2, the age range of the study respondents varied from 28 to 59 years and the vast majority of the respondents were in the 41 to 50 years age group which represented about 42.2% of the total respondents. 33% of respondents were in the 31 to 40 years age group, and about 11.4% of the respondents were less than 30 years in age, while 13.5% of them were above 50 years old. This is an indication that most head physicians, nurses, and technicians were below 50 years in age, and the mean of study population age (m= 41.9 years old). So that reflects the expansion trend in the health services especially after the establishment of the Palestinian National Authority in 1994. The expansion in the health services was associated with the recruitment of relatively young human resources. This generation provides an opportunity for the health care system in term of building capacity because of the relatively young generation that make a good investment in terms of sustainability.

4.3 Participants' work-related characteristics

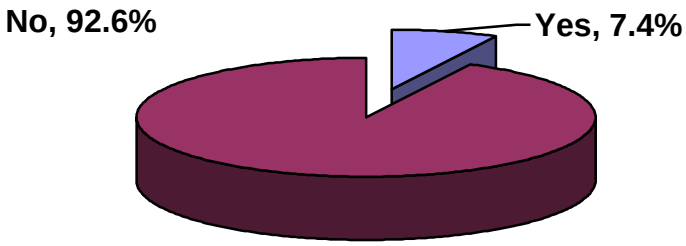
As shown in table 4.3, 87.8% of respondents were from Hospitals, while 12.2% were from PHC. This difference goes with the size of work in hospitals which provide different health services that need more medical equipment than in PHC.

Table (4.3): Distribution of the study respondents by work-related variables

1.	**Work Place**	**No**	**%**
	Hospital	166	87.8
	PHC	23	12.2
	Total	**189**	**100.0**
2.	**Qualification**		
	Diploma	29	15.3
	Bachelor	100	52.6
	Master	57	30.0
	Doctorate	4	2.1
	Total	**190**	**100.0**
3.	**Experience**		
	5 Yrs and less	22	12.0
	From 6 to 15 Yrs	86	47.0
	More than 15 Yrs	75	41.0
	Total	**183**	**100.0**
Mean = 15.1 , MD=14.0 Std = 8.2			
4.	**History of previous work in the same field**		
	Yes	68	36.2
	No	116	61.7
	Don't Know	4	2.1
	Total	**188**	**100**

In the study 52.6% of the study respondents had a bachelor degree, and 30% had a master degree. About 15.3% of respondents had a diploma, while only 2.1% of them had a doctorate degree. In table 4.3, about 12% of the respondents were employees with limited experience as they have been working in their organizations for less than 5 years, while 88% of the respondents have been working in their organizations for more than 5years. About 36.2% of the respondents reported that they were working in other organizations before working in their current ones, while 61.7% didn't.

Figure (4.1): Distribution of the study respondents by receiving training courses on medical equipment management



Distribution of participants by receiving training courses on medical equipment management

As seen in figure 4.1, about 92.6% of respondents didn't receive any training in the last three years which is far from that reported by Mavalankar, et al, (2004) about staff training in health facilities. They reported that, it may be necessary for the staff to receive training on the use and care of the new equipment before its arrival at the facility.

According to the researcher observation there is a problem in the governmental health facilities in using and managing medical equipment especially the more advance technology equipment, so lack of staff training can negatively affect the management of medical equipment.

About 35.1% of respondents reported that there are available guidelines and clear policy for procuring and ordering medical equipment, and 47.9% of them said that there are no guidelines and policy, while 17% of respondents don't know about it as seen in table 4.4. This is not congruent with what was reported by the WHO (2006), about procurement of medical equipment which reported that procurement of expensive medical devices needs to be based

on a clear strategy and actual needs assessment based on comparisons with countries of similar socioeconomic conditions. So, irrational procurement leads quickly to oversupply, lack of standardization, unclear vision in equipment maintenance and increased health care delivery costs.

Table (4.4): Distribution of respondents by the availability of policy and guidelines

No.	Items	Yes		No		Don't Know		Total	
		No.	%	No.	%	No.	%	No.	%
1.	There are guidelines that are available and there is a clear policy in your department for procuring and ordering new medical equipment	66	35.1	90	47.9	32	17.0	188	100.0
2.	Regular supervision is made to review the equipment management in your department	155	81.6	28	14.7	7	3.7	190	100.0
3.	You have a maintenance checklist for essential equipment in your department	71	37.2	102	53.4	17	9.4	190	100.0
4.	If yes, did you use it	61	85.9	5	7.0	5	7.0	71	100.0
5.	Do you have an inventory system for the medical equipment within your department?	143	75.3	35	18.4	12	6.3	190	100.0
6.	Do you have database for all used and unused medical equipment in your department?	85	44.7	92	48.4	13	6.8	190	100.0

About 81.6% of respondents reported that there is a regular supervision done on medical equipment, while about 14.7% reported no. The managers as well as the hospital department directors should keep a record of equipment delivered but not installed and follow up closely the reasons for the same. (WHO, 2008).

When mangers were asked if they have maintenance checklist for essential medical equipment in their department and also if they use it about 37.2% of respondents reported Yes they the

checklist and 85.9% of them use it, while 53.4% reported No they don't have the checklist and 7% of them didn't use it, while 9.4 % of respondents don't know about the checklist.

It was observed that medical equipment managers have to reinforce their follow up and supervision activities to ensure the appropriateness of medical equipment management cycle within the department by activating the staff in cleaning and calibrating the equipment, to ensure that they use the equipment in appropriate way, and to register the status of the equipment either it is functioning or need maintenance.

More than 75.3% of the respondents reported that they have inventory system for medical equipment within their department, but 18.4% of them reported that they don't have an inventory system as seen in table 4.4.

With regard to inventory, it is a good indicator that 75.3% of the facilities have inventory system for medical equipment within their department, and that is congruent with Dayro (2004) who reported that medical equipment inventory systems can provide information to support different aspects of medical equipment management. Also, Medical equipment inventory systems can provide information to support different aspects of medical equipment management that should be considered for standardization and include accessories, spare parts, and operating and service manuals which should be distributed to the users and stored at the technical document library for safekeeping (Dyro, 2004).

About 44.7% of the respondents reported that there is a database for all used and unused medical equipment within their department, 48.4% reported that there is no such database, while 6.8% of them did not know. This means that the information about lost, used, and unused medical equipment in hospitals and PHC is incomplete. That is far from what was

reported by Mavalankar (2004), who reported that each health department should have a record and database of all the medical equipment and this should be periodically verified by a supervisor. In addition, the functional status of each piece of equipment should be indicated in equipment registers. The information collected in the databases files enables the hospital staff to improve planning processes and to manage the investments that are required in order to offer health services of the highest quality and also fundamental to equipment maintenance services (Gutierrez, 2004).

4.4 Evaluation of medical equipment management cycle

4.4.1 Procurement and selection

4.4.1.1 Staff involvement

It was found that 52.7% of the study participants do not always participate in preparing the specification of the newly ordered medical equipment, while 40.5 of them participate as illustrated in table 4.5.

About 61.4% of the study participants reported that they are not involved in the procurement committee activities to select the suitable medical equipment, while only 28.6% of them reported that they are involved in the committee activity. Additionally more than 72.4% of the participants reported that they have good experience in selecting the most suitable equipment while about 13.3% didn't. Also about 67.5% of the participants share in identifying the needs of their department, while 26.1% didn't share.

This is an indication that many of medical equipment get purchased without the staff involvement in the purchasing process which may result in supplying equipment that out of staff and patients needs or they might not match the health and technology standards. This is far from that reported by Warren, et al (2000) about the staff involvement in the selection process of medical equipment. Warren reported that staff involvement in medical equipment procurement helps in selecting the best equipment considering maintenance, consumables, latest specifications, and other requirements for operation, and also making the purchasing process easier. In my opinion, participation of medical staff in purchasing committee is very important and they should be permanent member of all the procurements committees to comply with national and European legislation where applicable to the selection and safe use of medical equipment, and To ensure that the hospital has access to the best medical

equipment technology available, and is enabled and assisted to utilize such medical technology in a safe and efficient manner (Grainge, 2008).

4.4.1.2 Specifications and standards:

More than 53.1% of the study participants reported that the specifications of medical equipment are not usually updated by the technical committee, while 27.4% reported that the specification is usually updated. Also, 28.3% reported that the selection process does not take into consideration the international standards as seen in table 4.5. That is in contrary with what WHO (2000) reported that all health care equipment should meet or exceed existing safety and performance specifications and also should meet standards promulgated by international bodies such as International Organization for Standardization (ISO). Also, our study findings are far from what Maputo (2008) reported that standardization of medical equipment requires updated equipment options that meet the needs and provides many benefits in maintenance and use the equipment.

4.4.1.3 Training and Purchasing process:

About 56.5% of the study participants think that staff training should be considered as a pre condition for purchasing any equipment in their departments, while 36.6% of them reported that training should not be considered as seen in table 4.5, but Dyro (2004) reported that provisions for training the operators of the medical equipment must be established in all the purchasing agreements. The process of medical equipment procurement includes identification of equipment needs, selecting the equipment specifications and vendor, demonstrating the equipment to the users, purchasing the equipment, preparing it for use, staff training, and installation (Smith et al, 2004). Sometimes very useful equipment is acquired but not used

because there is no staff, who can use it or staff does not have the skills needed. The equipment should match with the skills of the staff. And, it may be necessary for the staff to receive training on the use and care of the new equipment before its arrival at the facility.

4.4.1.4 Decentralized decisions:

More than 73% of the respondents reported that the procedures of purchasing medical equipment is reasonably slow and is not practical, while 13.4% said that it was fast and practical. With regard to the general procurement laws and conditions about 43.5% reported that it doesn't help in selecting the latest medical equipment, while 32.8% reported that it helps as seen in table 4.5. This is congruent with the fact that the procurement process in MOH is very complex and takes long time which causes delays. Also, these processes increase the staff and the patients suffering due to equipments and supplies shortages. Mavalankar et al (2004) reported that more than one country in Africa and Asia centralized purchases can delay procurement by several months to years and the supply of equipment from a central level can lead to duplication and wastage. Also, WHO (2008) report showed that procurement being delayed by years in a large externally aided project in an Asian country, and also seen delay in procurement due to donor agencies centralized procurement system. The Palestinian general procurement procedures were modified in 1998, and we think that more modifications are needed to make the selection and the procurement process more flexible, effective, and rational.

Table 4.5: Distribution of respondents related to procurement and selection process.

Items	Strongly Disagree		Disagree		No Opinion		Agree		Strongly Agree	
	No	%	No	%	No	%	No	%	No	%
When you order new medical equipment, you always participate in preparing its specification.	40	21.1	60	31.6	13	6.8	61	32.1	16	8.4
You usually involved in the procurement committees to select the suitable equipment.	44	23.3	72	38.1	19	10.0	47	24.9	7	3.7
You have good experience in selecting the most suitable equipment.	4	2.1	21	11.2	27	14.3	112	59.6	24	12.8
Do you usually share in identifying the needs of your department regarding medical equipment?	14	7.3	36	18.8	12	6.4	108	56.5	21	11.0
The technical specifications are usually updated by technical committee.	35	18.4	66	34.7	37	19.5	46	24.2	6	3.2
Most of the purchased medical equipments are suitable for future upgrading.	14	7.4	51	27.1	46	24.5	68	36.2	9	4.8
Staff training is considered a pre condition for purchasing any equipment in your department.	34	17.8	36	18.8	13	6.9	64	33.5	44	23.0
Procedures for purchasing medical equipment reasonably fast and practical.	47	25.1	90	48.1	25	13.4	22	11.8	3	1.6
The general procurement laws help in selecting the latest equipment.	19	10.2	62	33.3	44	23.7	50	26.9	11	5.9
There is good coordination among MOH departments for supplying your department with the needed equipment.	30	15.8	69	36.3	41	21.6	46	24.2	4	2.1
Enough consumables are usually supplied to keep the equipment running.	25	13.2	62	32.8	18	9.6	80	42.3	4	2.1
In your opinion, the selection process for medical equipment is efficient and integral.	19	10.0	53	27.9	56	29.4	56	29.5	6	3.2
Selection of medical equipment takes into consideration the international standards.	12	6.3	42	22.0	60	31.4	70	36.6	7	3.7

As shown also in the table 4.5, regarding the coordination among MOH directorates in supplying the different departments with needed equipment, about 52.1% reported that there is an insufficient coordination, while 26.3% of them reported that there are good coordination. Without effective coordination within the MOH directorates, the cycle of managing medical equipment at all ministry facilities will be badly affected. According to the researcher observation there is a problem in the coordination among MOH directorates with relation to medical equipment procurement, distribution, installation, and others. That is due to the centralized decisions that may not allow for an effective communicating between the operational staff and the decision makers. This is congruent with what was reported by Mavalankar et al (2004) that the centralized distribution of equipment normally leads to keeping the equipments at storage facilities for several months to years before it is installed or used and sometimes they are never used at all.

About 46% of respondents reported that there are shortages in consumables supplies that are needed to keep the equipment running, while 44.4% of them reported that there are no shortages. This result indicates that some of the medical equipment in different departments might be non functional due to lack of consumables that should be available to ensure the equipments operation. MOH (2008) reported that enough consumables and spare parts should be usually supplied to last at least two years to keep the equipment running and functional. It is recommended that a strategic plan and a periodic needs-assessment reports need to be available to identify the shortage and supply all health facilities with enough consumables within their departments stores.

4.4.2 Distribution and installation

4.4.2.1 Space

Table 4.6: Distribution of participants' perceptions about their department space

Items	Strongly Disagree		Disagree		No Opinion		Agree		Strongly Agree	
	No	%	No	%	No	%	No	%	No	%
Within your department, there are adequate spaces to keep equipment ready for use.	43	22.5	61	31.9	8	4.2	66	34.6	13	6.8
Within your department, there are unused equipment due to space limitations.	33	17.6	73	39.0	11	5.9	59	31.6	11	5.9
Appropriate room for storing equipment and consumables is available within your department.	61	32.4	67	35.6	11	5.9	40	21.3	9	4.8

About 54.4% reported that the space within the medical departments is inadequate to keep medical equipment ready for use, while 41.4% said that there is enough space as illustrated table 4.6. Additionally, 68% of respondents reported that the there is limited availability of appropriate room for storing equipment and consumables within their department and that there are many unused equipment due to space limitations. Also, 55.6% reported that there were no unused equipment within their department due to space limitations, while 37.5% of them reported there were unused equipment.

This result go with what was reported by Teninty (2006) study that concluded that in many developing countries up to 80% of their medical equipment is inoperative and is stored in hallways or patient rooms due to limited spaces and this situation results in the neglect of patients and an increased risk of harm to them and to health workers. A hospital also must allocate space for the delivery, storage, and distribution of medical equipment to the health department. So Large devices, such as anesthesia machines, and X-ray equipment, must be

stored in accessible locations where they will not clutter or obstruct hallways (Smith, et al, 2004).

According the researcher observation there is a problem in the space available for keeping the medical equipment at most of MOH facilities, and also most of equipment are not stored in accessible and safe locations to be ready for use. Also, it was observed that many of the medical equipment existed in patient rooms and in hallways which make it susceptible to damage and theft. So, appropriate spaces should be provided before supplying any equipment and also appropriate storage rooms need to be available to store unused equipment and all of the parts and consumables needed for the equipment in the department.

4.4.2.2 Staff skills

About 42.1% of respondents reported that the staff skills are not taken in consideration when medical equipment is distributed, while 36.3% of them reported that it was taken in consideration as seen in table 4.7. This result is congruent with what Mavalankar et al (2004) reported about the distribution of medical equipment that some facilities have more equipment than others and the type and amount of equipment does not correspond with the workload or staff or skills of staff in the facility. So, in my perspective, before distributing any medical equipment the staff manager should participate in the decision making process to determine the location and type of equipment that will be delivered in the facility.

Staff training on how to operate and maintain new equipment is necessary and important before using the equipment, but the study result show about 59.6% of the staff didn't receive any training on using the new delivered medical equipment as shown in table 4.7.

This is congruent with what was reported by MOH (2005) that the hospitals in Gaza Strip and the West Bank purchased the Magnetic Resonance (MRI), one MRI machine allocated in

ALShifa hospital, but there are no technicians who can manage it. Also, the same congruency was reported by David et al, (2004) who reported that in developing countries, physicians should receive training before they can use complex equipments.

Table 4.7: Distribution of participants' related to staff skills and workload consideration equipment before equipment distribution

Items	Strongly Disagree		Disagree		No Opinion		Agree		Strongly Agree	
	No	%	No	%	No	%	No	%	No	%
Staff skills and experience determine the mechanism of distributing equipment on hospitals.	19	10.0	61	32.1	41	21.6	65	34.2	4	2.1
You usually receive training courses on using new purchased medical equipment.	31	16.5	81	43.1	13	6.9	59	31.4	4	2.1
Workloads for hospitals are considered in distributing medical equipment.	33	17.4	35	18.4	41	21.6	69	36.3	12	6.3
Do you share in decisions related to medical equipment distribution	29	15.3	63	33.3	22	11.7	64	33.9	11	5.8

4.4.2.3 Workload

The workload in health facilities 42.6% reported that the workload was considered in distributing the medical equipment, while 35.8% said that it was not considered as seen in table 4.7. The study result showed that about 35.8% of respondents did not think that the distribution process of medical equipment considers the workload and the size of work in MOH facilities. The distribution of medical equipment by hospital and administrative units is important to identify each functional unit and enables technical departments to define priorities and workloads (Gutierrez, 2004).

Some facilities have more equipment than others, and the amount of equipment does not correspond with the workload or staff or skills of staff in the facility. (WHO, 2008).

The researcher observed that there is mismanagement and lack of coordination in the distribution of medical equipment, because some facilities have more equipment than others, and the type and amount of equipment does not match the workload and the size of work. So, many aspects should be considered before distributing the medical equipment as the type, size of work, workload and staff skills.

4.4.2.4 Pre installation

More than 43.1% reported that there are pre-installation required activities before the actual delivery take place, while 42.1% of them said that there are no such activities. About 42.8% of the respondents reported that precautions and measures to protect the medical equipment from electricity fluctuations were not considered, while 39.6% of respondents reported that precaution and measures took place as shown in table 4.8.

Table 4.8: Distribution of participants related to pre installation requirements

Items	Strongly Disagree		Disagree		No Opinion		Agree		Strongly Agree	
	No	%	No	%	No	%	No	%	No	%
Pre installation requirements are usually made before delivering equipment.	23	12.1	57	30.0	28	14.8	77	40.5	5	2.6
Precautions for protecting equipment from electricity fluctuations are considered before installation.	21	11.2	59	31.6	33	17.6	65	34.8	9	4.8
Upon installation, do you receive the user manuals of the equipment?	9	4.8	27	14.5	6	3.3	115	61.8	29	15.6
The provided manuals in English language are easy to read and include proper illustrations.	6	3.2	27	14.4	16	8.5	117	62.2	22	11.7

The present study results are congruent with what was reported by the WHO (2000) regarding the pre-installation and safety measures, which reported that before purchasing medical equipment, installation requirement should be considered for proper use of the equipment such as installation location, safety requirements, space, and electrical power. The researcher observed that there is a continuous problem in the hospitals electricity and this resulted from continues cutting and fluctuation of electricity due to the siege exposed on Gaza Strip which resulted in damaging many medical equipment and affect patient safety. So, precautions and safety measures should be taken before purchasing and installing the hospitals with equipments. These measures include supplying the hospitals with UPS and Voltage stabilizers to ensure safety and to decrease the risk for both equipment and patients.

And related to user manuals and documentations about 77.4% of them said that they received the user manuals of equipment of the delivered equipment, while about 19.3% of them didn't receive. That is in contrary with the results of the observational checklist (Annex 7) done at hospitals imaging departments which found that only 27.3% of the departments had instruction manuals, while 73% of them didn't have any manual for the equipment, far from what was reported by WHO (2008) regarding the user manuals of equipment, which observed in developing countries that after installation the user manuals of the equipment and information are not kept, and many equipment under warranty were not repaired due to lack of proper documentation. It recommended each department keep a file of the user manuals of the equipment along with the copies of service contracts and warranties.

4.4.3 Use of equipment:

Table 4.9: Distribution of participants related to their skills on using the equipment

Items	Strongly Disagree		Disagree		No Opinion		Agree		Strongly Agree	
	No	%	No	%	No	%	No	%	No	%
Administration usually tries to provide training for your staff in using received medical equipment.	49	25.8	87	45.8	26	13.6	26	13.7	2	1.1
Within your department, your staff face problems in using latest medical equipment.	17	9.0	71	37.6	21	11.0	64	33.9	16	8.5
You usually read the equipment instruction manuals carefully before using it.	4	2.1	24	12.6	12	6.4	111	58.4	39	20.5
In your opinion, damages of medical equipment are usually due to lack of knowledge and misuse of equipment operators.	21	11.1	60	31.7	14	7.5	62	32.8	32	16.9
You usually take proper care and cleanliness needed for preserving and prolonging the equipment life.	4	2.1	8	4.2	6	3.2	110	57.9	62	32.6
Regular needed calibrations for medical equipment are usually done.	3	1.6	16	8.5	16	8.4	127	67.2	27	14.3
Within your department, there is a good tracking system for keeping medical equipment accessible for staff.	9	4.8	32	17.2	13	7.0	109	58.6	23	12.4
Each installed medical equipment in your department has inventory card.	18	9.5	52	27.5	47	24.9	55	29.1	17	9.0

4.4.3.1 Staff training:

As shown in table 4.9, the study found that 71.6% of the manager did not think that the administration usually tries to provide training for staff on using medical equipment, while 14.8% of them thought the administration tries to provide training. Also, 46.6% of the

respondents reported that the staff did not face problems in using medical equipment, while 42.4% of them did.

These results are congruent with the study results of the Jordon study by Amer and Ammari, (2006) which showed that one of the main reasons that usually influence the efficacy of medical equipment is that the medical team of physicians or nurses do not have the enough knowledge, experience and sense to deal with sophisticated equipment. Also, this study results is far from the Rice (2007) recommendations that staff must not use medical equipment until they have had the appropriate training required to ensure patient safety. Staff training is important each time that provided by vendors within hospital departments in order to assist the clinical staff to solve some equipment problems through operation (Soller, 2004).

Therefore, lack of staff training on appropriate use of medical equipment will lead to lack of knowledge which usually results in problems that affect the patient health negatively.

4.4.3.2 Misuse

About 49.7% of the respondents thought that the damage of medical equipment usually happens due to lack of knowledge and misuse of equipment operators, while 42.8% of the respondents disagreed as seen in table 4.9.

This result is congruent with Amer and ammari, (2006) study who reported that if staff did not get the proper training on using the medical equipment, this leads to the misuse of equipment, and causing frequent malfunctions result in system damages. Also, Teninty (2006) reported that the inexperience of operators and the lack of repair and maintenance capabilities reduce the functioning life of equipment. Therefore, it is recommended to implant a training program before the actual use equipment and it is recommended to have a regular supervision program to ensure that the equipments are used in appropriate way.

4.4.3.3 Equipment calibration and cleaning

More than 90.5% of the study population reported that they follow the care and cleanliness guidelines needed for preserving the equipment life. Also, 81.5% of respondents said that the regular needed calibrations for medical equipment is usually done as shown in table 4.9

These results agree with the Dyro (2004) recommendations that equipment calibration is required to ensure performance and accuracy of medical equipment operation, but the results are not congruent with what was reported by Mavalankar et al, (2004) studies which showed that in many cases in some Asian facilities, damages of medical equipment are due to rough and careless handling, improper cleaning, and exposure to heat and dust. In many cases, in several facilities equipment deteriorates because of improper use and lack of care. Dust can also damage sensitive equipment such as lab equipment, anesthesia machines etc. (Malike, and Anam, 2008).

According to the researcher observation about this issue, there is some cases of carelessness from many of facilities staff as they didn't clean and calibrate the equipment. So, it is recommended to have a department management monitoring tool and an external evaluation supervisor to ensure the compliance of the staff.

4.4.4 Donated equipment

4.4.4.1 Donation standard and conditions

About 59% of the departments' managers did not have an indication about any incoming donated medical equipment, and 22.6% reported that they did. Also, 63.7% of the respondents reported that the donors do not normally communicate with the departments' managers before supplying any needed equipment, while 22% of them reported that they actually do as seen in table 4.10. Also, 75.3% reported that the donated equipment within the departments were not

unified and they did not have the same general specifications, while 12% of them reported that the equipment were unified.

Table 4.10: Distribution of participants perceptions related to donation standards

Items	Strongly Disagree		Disagree		No Opinion		Agree		Strongly Agree	
	No	%	No	%	No	%	No	%	No	%
In your department, you have a guideline for further donated medical equipment.	29	17.3	70	41.7	31	18.4	35	20.8	3	1.8
Donors communicate with you before supplying any needed equipment.	35	20.8	72	42.9	24	14.3	34	20.2	3	1.8
Instruction manuals and spare parts for donated medical equipment are available and easy to be supplied.	21	12.9	76	46.6	32	19.7	32	19.6	2	1.2
In your department, donated medical equipment usually match department needs and based on Need Assessment Report conducted by your staff.	13	7.9	40	24.4	31	18.9	74	45.1	6	3.7
Within your department, most of the donated equipment are unified and have the same range of specifications.	35	21.1	90	54.2	21	12.7	16	9.6	4	2.4

The results are far from the WHO (2008) recommendation to donors about the necessity of Communication with the recipients to make sure that the recipients have provided a comprehensive description of the equipments required. Also, Dyro (2004) recommends that the donor should provide detailed maintenance requirements, such as technician training, preventive maintenance materials, and test and calibration equipment needed.

The MOH especially in Gaza Strip is highly dependent on supplying its health facilities with medical equipment from different donor countries. The absence of clear information and previous communication and coordination before the actual delivery of equipment usually badly influence the donation process. Also, because the donors do not provide detailed

information about the availability of spare parts and maintenance of medical equipment, the MOH would be expected to maintain and provide spare parts for the donated equipment. Therefore to avoid these problems a guideline should be considered for the medical equipment donation (Maputo, 2008).

Also, 59.5% of respondents reported that the instruction manuals were not supplied with the donated equipment, while 20.8% of them reported that the manuals were supplied. Many of consideration that donors should take and respect before performing the donation as Communicate with the recipient to make sure that the potential recipient has provided a comprehensive description of the equipment required, supply fully functional equipment and test the equipment and make sure all necessary spare parts, technical documents for installation, operation, maintenance manuals, and consumables are included in the package before making shipment. (MOH, 2008).

4.4.4.2 Out of need

Additionally, 48.4% of the respondents reported that the delivered donated equipment are valuable and match their needs, while 32.3% of them reported that the delivered donated equipment are out of need and that they do not match the operational objectives, and 49.7% of the participants reported that the donated equipment were delivered incomplete, and these results are congruent with what was reported by WHO (2000) that many of the donated medical equipments in developing countries are unused due to lack of donor support for supplying spare parts, accessories, and maintenance documentations. Add to that, 61.1% of the respondents reported that donors do not provide detailed information about the availability of spare parts and the maintenance needs of medical equipment, while only 15% of them reported that they do as shown in table 4.11.

This present result is not congruent with the Khateeb (2006) study recommendations, who reported that when supplying ministries of health and public sectors hospitals with effective medical equipment, specifications of equipments should be unified to ensure quality standards. It was also observed that in most of the MOH hospitals and clinics, a wide variety of medical equipment of different models and specifications existed which causes operational difficulties for the medical staff as well as the medical engineers who are in charge of the maintenance of theses equipment.

4.4.4.3 Non functional equipment

Table 4.11: Distribution of participants' about the non functional donated equipment

Items	Strongly Disagree		Disagree		No Opinion		Agree		Strongly Agree	
	No	%	No	%	No	%	No	%	No	%
Most of the donated equipment are delivered with complete accessories and meet your department standards and specifications.	17	10.4	64	39.3	18	11.0	60	36.8	4	2.5
Most of the donated equipment are delivered brand new and work properly.	9	5.4	32	19.2	15	8.9	105	62.9	6	3.6
Staff skills and qualifications are suitable for operating latest donated equipment.	10	6.1	32	19.6	20	12.4	92	56.4	9	5.5
Donors usually provide detailed information about maintenance and spare parts of the equipment.	24	14.4	78	46.7	40	23.9	24	14.4	1	0.6

More than 66.5% reported that the donated equipment were functional, while 24.6% of them said that they were functional as seen in table 4.11. Also, 61.9% of them reported that their qualifications and skills are suitable for operating the latest donated equipment, while about 25.7% said were not qualified. This result is far from what was reported by Dyro (2004), who

reported that in Sub-Saharan Africa, up to 70% of donated equipments were non functional due to lack of available spare parts, documentation, supplies, and operator training in the recipient country.

According to the checklist (Annex 7) findings which was done to evaluate the equipment in imaging departments at MOH hospitals, the results shows that most of study population said that spare parts were the main reason for equipment malfunctioning, followed by having old equipment that need to be disposed, then lack of staff experience and training either in use or maintains of the equipments, and many of the equipments were delivered incomplete as a donation.

The donated medical equipment problem goes in line with the WHO explanation for the donated equipment problems. As developed countries usually upgrade their hospitals by disposing their old equipments through sending them to the developing countries as donations, and donation of used equipment sometimes presents overwhelming problems, especially to the recipient, so many of equipments never work for long time (WHO, 2000).

4.4.5 Repair and maintenance

Table 4.12: Distribution of participants perceptions related to repair maintenance

Items	Strongly Disagree		Disagree		No Opinion		Agree		Strongly Agree	
	No	%	No	%	No	%	No	%	No	%
Regular inspections and periodic maintenance for medical equipment are implemented .	48	25.3	68	35.8	14	7.4	55	28.9	5	2.6
In your opinion, maintenance technicians and engineers are qualified for repairing complicated medical equipment.	24	12.6	78	40.8	25	13.1	58	30.4	6	3.1
Clinical engineers receive proper training in maintaining and repairing the different medical equipment	8	4.3	52	27.8	103	55.1	20	10.7	4	2.1
Repairing the essential medical equipment in your department is carried out quickly and efficiently.	34	17.8	77	40.3	12	6.3	62	32.5	6	3.1
Spare parts needed for repairing medical equipment in your department are usually available in a proper storehouse.	73	38.2	87	45.5	19	10.1	10	5.2	2	1.0
There is a decision for disposing nonfunctional equipment and upgrading equipment of your department.	21	11.2	45	23.9	46	24.5	66	35.1	10	5.3
Maintenance manuals are usually delivered with equipment.	17	8.9	47	24.6	41	21.5	75	39.3	11	5.8
Unstable electricity is one of the causes that damage medical equipment in your department.	9	4.7	28	14.7	13	6.8	85	44.7	55	28.9
There is an efficient reporting system between your department and medical equipment maintenance department.	8	4.2	25	13.2	9	4.8	122	64.6	25	13.2

4.4.5.1 Preventive maintenance

As elucidated in table 4.12, about 61.1% of the respondents reported that the preventive maintenance of medical equipment is not implemented, while 31.5% of them reported that it is

implemented. Also, more than 73% of them reported that unstable electricity is one the causes that damage medical equipment, while 19.4% didn't think that.

A high majority (61.1%) of respondent reported that the preventive maintenance program for medical equipment is implemented by untrained technicians, and this raises lots of questions about the status of medical equipment at governmental health facilities because the strategy of preventive and corrective maintenance for medical equipment should be implemented by trained clinical engineers to meet appropriate standards of safety, quality and performance De Vivo, et al (2004) and this might be helpful in explaining the reasons behind the malfunction of many of the medical equipment. It is recommended to implement a pre-scheduled preventive maintenance program to keep and preserve the medical equipment at all the MOH facilities. The questionnaire findings were confirmed through the study observation checklist (Annex 7) in the imaging departments, which shown that 100% of study population said that there is no preventive maintenance and inspection done for the equipment. Also the study result is congruent with what was reported by Mavalankar, et al, (2004), about unstable electricity, which showed that in Africa and Asia many developing countries the electrical current has lot of fluctuations in voltage, which can easily damage the equipment. So care should be taken to identify any unusual extremes of power fluctuations that could adversely affect the equipment's operation (Dyro, 2004). So it is recommended that each hospital develops a schedule for the inspection and preventive maintenance of all the major equipment WHO (2008).

4.4.5.2 Qualifications of maintenance team

Add to that, 53.4% of the respondents thought that the maintenance technicians and engineers are not qualified to do the required equipments repair, and 58.1% of them thought that the repair was not carried out quickly and efficiently, while 35.6% of them reported that the maintenance carried out efficiently as shown in table 4.12.

This result is congruent with what was reported by Galvan (2004) study in Paraguay which showed that many medical equipment and facilities are frequently out of service or malfunctioning due to lack of maintenance team skills and abilities. According to the researcher observation, most of the of MOH Clinical engineers are not trained, or are not qualified to maintain the most sophisticated medical equipment, so lots of equipments are non-functioning due to the lack of engineers experience and skills. The WHO recommends the training of engineers and maintenance technicians to develop there skills in the maintenance activities and processes (WHO, 2009).

4.4.5.3 Spare parts

Regarding the availability of spare parts needed for repairing medical equipment, 83.7% of the respondents reported that spare parts are unavailable as seen in table 4.12. So, there are major problems in the availability of the spare part needed for repairing the non-functioning medical equipment due to borders closure by Israel occupation.

The questionnaire results are congruent with the result of the result of the observational checklist (Annex 7), which shows that most of the respondents said that spare parts and consumables of imaging equipment are usually unavailable.

These results are congruent with what was reported by WHO (2009) that the quality of health care in Gaza Strip is affected by deterioration in the functionality of medical equipment due to

the lack of maintenance and spare parts and difficulties in delivering these parts from the West Bank and Israel. So major hospitals should have adequate quantities of commonly used spare parts to ensure that critical spare parts are always in stock.

4.4.5.4 Disposing of medical equipment

Regarding a decision for disposing nonfunctional and old equipment and upgrading equipment, 40.4% listed that there is a decision for disposing old nonfunctional equipment but did not go into effect, while 35.1% reported that there is no a decision as shown in table 4.12.

So, a lot of old medical equipments at MOH facilities need to be disposed because these equipment would lie in the storage rooms and patient rooms for many years and take large spaces from hospitals facilities which make the patient room not clean and risky, so renewing medical equipments is necessary to keep patient safety (Tavakoli et al 2007). The results of this study is congruent with what was reported by the Mavalankar et al (2004) study, who noted that a common problem that has been observed in Asian and African hospitals and that is, not disposing old and non-functioning medical equipment. Therefore, it is recommended that the decision maker need to put the decision of disposing the old and nonfunctioning equipment into effect. It is also recommended to upgrade the old equipment to assure health quality, international standards and specifications, cost-effectiveness, and patient's safety .

Table (4.13): Distribution of respondent's satisfaction rate about the status of medical equipment within their department

Satisfaction about the status of medical equipment management	No.	%
Strongly Disagree	37	19.5
Disagree	67	35.3
No Opinion	5	2.6
Agree	79	41.6
Strongly Agree	2	1.1
Total	**190**	**100.0**

This study result shows that more than half (54.8%) of the respondents were not satisfied with the status of the medical equipment management within their department. This can be because of many factors that affect the status of managing equipment such as lack of staff training, procured or donated equipment may be old or do not matching the medical staff need, inappropriate maintenance for malfunctioning equipment, and limitation of spaces within hospitals which make the status of managing the equipment more difficult.

4.5 The relationship between participants' gender and the cycle management

Table (4.14): Differences in perceptions about the different phases of the management cycle based on the staff gender

Items	Sex	N	Mean	SD	t	Sig.
Procurement and Selection	Male	154	2.87	0.61	-0.11	0.911
	Female	36	2.89	0.66		
Distribution and Installation	Male	154	2.90	0.69	0.36	0.718
	Female	36	2.85	0.66		
Use of Equipment	Male	154	3.29	0.59	-0.82	0.411
	Female	36	3.38	0.52		
Donated Equipment	Male	140	2.76	0.66	-0.31	0.759
	Female	27	2.80	0.86		
Maintenance and Repair	Male	154	2.91	0.64	1.65	0.100
	Female	36	2.71	0.73		
Total	**Male**	**154**	**2.90**	**0.47**	**1.05**	**0.293**
	Female	**36**	**2.80**	**0.49**		

As illustrated in table 4.14,which shows the differences in respondents perspectives by sex, there are no statistical differences between sex and the five parts of medical equipment management cycle procurement and selection, distribution and installation, use of equipment, donated equipment, and maintenance and repair, (t-test = 1.05 and P-value = 0.293). This means that sex has no effect on all parts of medical equipment management cycle and the

results showed that there were similarities in perspectives between male and female at the five parts of the study.

4.6 The relationship between participants' work place and the cycle management

Table (4.15): Differences in perceptions about the different phases of the management cycle based on the staff work place

Items	Work Place	N	Mean	SD	T	Sig.
Procurement and Selection	Hospital	166	2.92	0.62	2.99	0.005*
	PHC	23	2.59	0.49		
Distribution and Installation	Hospital	166	2.95	0.66	2.94	0.004*
	PHC	23	2.51	0.74		
Use of Equipment	Hospital	166	3.31	0.59	-0.08	0.935
	PHC	23	3.32	0.43		
Donated Equipment	Hospital	149	2.80	0.71	2.56	0.015*
	PHC	18	2.53	0.38		
Maintenance and Repair	Hospital	166	2.95	0.62	4.15	0.000*
	PHC	23	2.37	0.67		
Total	**Hospital**	**166**	**2.93**	**0.47**	**3.70**	**0.000***
	PHC	**23**	**2.55**	**0.39**		

As illustrated in table 4.15, which discusses the relationship between the five parts of medical equipment management cycle and the work place either in hospital or in PHC. The two means in the five parts of the study reached a statistically significance level (t= 3.7), P-value <0.001 with a mean of (2.93) for hospital and (2.55) for PHC. As shown also, there are differences between the two means of hospital and PHC in case of procurement, distribution, donation, and maintenance which reach to statistical level (P-value = 0.005, 0.004, 0.015, and 0.001) respectively. These differences can be explained by the fact that hospitals have more medical equipment with different models and applications than PHC. That makes the hospitals staff more experienced in managing the cycle through procuring new updated equipment, taking into consideration all issues related to distribution, installation, donated equipment, and become more aware to maintain and calibrate the repetitive faults through equipment

operation. According to the table 4.15, the difference between the work place and phase in the Equipment management cycle has the same mean in both Hospitals (m= 3.31) and PHC (m= 3.32) and the difference between the two means didn't reach to statistical significance level (t=0.08) and P-value = 0.935. This means that there are common patterns in using equipment by the staff at MOH facilities either in Hospitals or in PHC.

4.7 The relationship between participant's qualifications and the cycle management

As illustrated in table 4.16, which shows the differences in respondent's perspectives by their qualification toward the five part of medical equipment management. It showed that there is no statistical differences between the respondents qualifications and the five the parts of the cycle (t = 1.104), P-value = 0.349 except in the part of maintenance and repair. There is a difference among the study population qualification, which means toward the performance of maintenance done by maintenance team as Diploma (m=3.20), B.Sc. (m= 2.91), Master (m=2.64), and PhD (m=2.72) which reached statistical significant level t = 5.419 and p-value = 0.001.

Table (4.16): Differences in perceptions about the different phases of the management cycle based on the staff qualification

Items	Qualification	N	Mean	SD	F	Sig.
Procurement and Selection	Diploma	29	2.92	0.66	0.370	0.775
	B.Sc.	100	2.90	0.61		
	Master	57	2.80	0.63		
	PhD	4	2.92	0.60		
	Total	**190**	**2.87**	**0.62**		
Distribution and Installation	Diploma	29	2.97	0.53	1.944	0.124
	B.Sc.	100	2.97	0.71		
	Master	57	2.74	0.72		
	PhD	4	2.45	0.55		
	Total	**190**	**2.89**	**0.69**		
Use of Equipment	Diploma	29	3.24	0.51	0.717	0.543
	B.Sc.	100	3.36	0.57		
	Master	57	3.26	0.61		
	PhD	4	3.13	0.49		
	Total	**190**	**3.31**	**0.57**		
Donated Equipment	Diploma	23	2.77	0.65	0.554	0.646
	B.Sc.	87	2.82	0.68		
	Master	53	2.67	0.70		
	PhD	4	2.59	1.03		
	Total	**167**	**2.76**	**0.69**		
Maintenance and Repair	Diploma	29	3.20	0.80	5.419	0.001
	B.Sc.	100	2.91	0.59		
	Master	57	2.64	0.62		
	PhD	4	2.72	0.45		
	Total	**190**	**2.87**	**0.66**		
Total	Diploma	29	2.91	0.46	1.104	0.349
	B.Sc.	100	2.92	0.47		
	Master	57	2.78	0.49		
	PhD	4	2.78	0.50		
	Total	**190**	**2.88**	**0.48**		

The perspective among the respondents of different qualification toward maintenance and repair part varies, as shown the respondents who has diploma has a better perspective than others. Most likely, this is because they deal with maintenance department and technicians more than other groups as seen in table 4.16. They often prepare and calibrate the equipments before using them, and the managers usually delegate to them the task of dealing with the maintenance department. So, it is recommended that all employees regardless of their qualifications go through preventive maintenance training.

4.8 The relationship between participants experience and the cycle management

Table 4.17, illustrates the differences in respondents' perspectives according to years of experience in the medical field. The respondents were divided into three groups according to experience in years: the first group is 5 Yrs and less, the second group is 6 to 15 Yrs, and the third group is more than 15 Yrs. The third group members have better perspective than others in procurement and selection, use of equipment, distribution and installation, and maintenance and repair with mean=2.97, m=2.92, m= 3.38, and m= 2.90 accordingly.

The difference among the experience groups means didn't reach a statistical significance (F = 1.434), (P-value = 0.241) which means that the years of experience in the departments has no effect on the management cycle of medical equipment.

Table (4.17): Differences in perceptions about the different phases of the management cycle based on the staff years of experience

Items	Experience	N	Mean	SD	F	Sig.
Procurement and Selection	5 Yrs and less	22	2.89	0.66	2.005	0.138
	From 6 to 15 Yrs	86	2.78	0.64		
	More than 15 Yrs	75	2.97	0.55		
	Total	183	2.87	0.61		
Distribution and Installation	5 Yrs and less	22	2.79	0.56	0.327	0.722
	From 6 to 15 Yrs	86	2.89	0.74		
	More than 15 Yrs	75	2.92	0.68		
	Total	183	2.89	0.69		
Use of Equipment	5 Yrs and less	22	3.37	0.57	1.012	0.365
	From 6 to 15 Yrs	86	3.25	0.67		
	More than 15 Yrs	75	3.38	0.46		
	Total	183	3.32	0.58		
Donated Equipment	5 Yrs and less	18	3.00	0.74	1.376	0.256
	From 6 to 15 Yrs	72	2.77	0.68		
	More than 15 Yrs	71	2.70	0.70		
	Total	161	2.76	0.70		
Maintenance and Repair	5 Yrs and less	22	2.81	0.85	0.163	0.850
	From 6 to 15 Yrs	86	2.86	0.66		
	More than 15 Yrs	75	2.90	0.60		
	Total	183	2.87	0.66		
Total	5 Yrs and less	22	2.87	0.56	1.434	0.241
	From 6 to 15 Yrs	86	2.82	0.46		
	More than 15 Yrs	75	2.95	0.47		
	Total	183	2.88	0.48		

4.9 The relationship between participants work history on the cycle management

Table (4.18): Differences in perceptions about the different phases of the management cycle based on the staff location of experience

Items	Working in other Place	N	Mean	SD	F	Sig.
Procurement and Selection	Yes	68	2.94	0.57	2.192	0.115
	No	116	2.83	0.62		
	DK	4	2.35	0.65		
	Total	188	2.86	0.61		
Distribution and Installation	Yes	68	3.00	0.65	2.199	0.114
	No	116	2.83	0.70		
	DK	4	2.45	0.84		
	Total	188	2.88	0.69		
Use of Equipment	Yes	68	3.33	0.67	2.940	0.055
	No	116	3.32	0.50		
	DK	4	2.63	0.68		
	Total	188	3.31	0.58		
Donated Equipment	Yes	60	2.84	0.69	0.681	0.507
	No	101	2.72	0.70		
	DK	4	2.56	0.75		
	Total	165	2.76	0.69		
Maintenance and Repair	Yes	68	2.83	0.64	0.465	0.629
	No	116	2.89	0.67		
	DK	4	2.64	0.74		
	Total	188	2.86	0.66		
Total	Yes	68	2.93	0.48	1.752	0.176
	No	116	2.85	0.47		
	DK	4	2.52	0.47		
	Total	188	2.87	0.48		

As illustrated in table 4.18, the attitude of population who had previous work in other places was better than whose experience is limited to MOH. The respondents who had worked in other places have better perspectives in procurement and selection, distribution and installation, and donated equipment. The two groups, who worked and who didn't work in other place, have the same attitude in the use of equipment phase with a mean (3.33) and (3.32) respectively, and the difference between the two means didn't reach a statistical significant level (F=2.940), P-value= 0.055 which means that the patterns of equipment use is nearly the same in MOH and non – MOH organizations.

4.10 The relationship between guidelines availability and the cycle management

Table (4.19): Differences in perceptions about the different phases of the management cycle based on the availability of polices and guidelines

Items	Policy and guideline	N	Mean	SD	F	Sig.
Procurement and Selection	Yes	66	3.09	0.58	7.965	0.000
	No	90	2.71	0.61		
	DK	32	2.88	0.58		
	Total	188	2.87	0.62		
Distribution and Installation	Yes	66	3.11	0.63	6.338	0.002
	No	90	2.72	0.70		
	DK	32	2.93	0.68		
	Total	188	2.89	0.69		
Use of Equipment	Yes	66	3.45	0.46	3.681	0.027
	No	90	3.27	0.60		
	DK	32	3.14	0.69		
	Total	188	3.31	0.58		
Donated Equipment	Yes	60	2.85	0.72	1.100	0.335
	No	82	2.68	0.61		
	DK	24	2.80	0.85		
	Total	166	2.76	0.69		
Maintenance and Repair	Yes	66	2.96	0.53	1.218	0.298
	No	90	2.80	0.72		
	DK	32	2.92	0.71		
	Total	188	2.88	0.66		
Total	Yes	66	3.05	0.45	6.790	0.001
	No	90	2.78	0.48		
	DK	32	2.82	0.46		
	Total	188	2.88	0.48		

As elucidated in table 4.19, which shows the differences in the study population perspectives about the different phases of the management cycle based on the availability of polices and guidelines for the procurement of medical equipment . The results showed that the difference reached a statistical difference (F=6.790) and P-value (0.001), which indicates that the importance of the availability of clear policy and guideline for procuring new equipment that taking into consideration the other phases of the cycle through the procurement process such as installation, maintenance, and the use of these procured equipment. These results are in line with the Maputo (2008) recommendations of the need to take in consideration all of the WHO

recommended policies and procedures in all phases of the equipment management cycle process to assure adequate supplies, use, and maintenance.

4.11 The relationship between staff training and the cycle management

Table 4.20, shows the distribution of the study population perspectives about the different phases of the management cycle based on training received within the last three years. The difference between the two means (2.93), (2.87) didn't reach to not suitable a statistical significant level (t=0.420), P-value = 0.675. The perspectives is nearly the same for both who had received and hadn't received training toward the five parts of medical equipment management cycle. 92.6% of respondents didn't receive any training courses in managing the equipment within the last three years. So, the MOH need to implement a staff training program that aims at developing the skills and abilities of health staff through periodic training that concentrates on the different aspects of medical equipment management.

Table (4.20): Differences in perceptions about the different phases of the management cycle based on the training received

Items	Receiving training	N	Mean	SD	T	Sig.
Procurement and Selection	Yes	14	2.89	0.64	0.124	0.901
	No	176	2.87	0.62		
Distribution and Installation	Yes	14	2.98	0.84	0.509	0.612
	No	176	2.88	0.68		
Use of Equipment	Yes	14	3.28	0.44	-0.228	0.820
	No	176	3.31	0.58		
Donated Equipment	Yes	14	2.75	0.68	-0.051	0.960
	No	153	2.76	0.69		
Maintenance and Repair	Yes	14	2.73	0.60	-0.821	0.413
	No	176	2.88	0.66		
Total	**Yes**	14	2.93	0.54	0.420	0.675
	No	176	2.87	0.47		

Chapter V

Conclusion and Recommendations

This chapter provides the main conclusions of this study as well as some recommendations for decision makers that may help in adopting better medical equipment management in governmental health facilities.

5.1 Conclusion

Availability of working equipment is vital in providing health services to the hospitals and other health facilities. The proper management of equipment starting from selection, purchase, installation, use and maintenance are very important for ensuring ongoing readiness of the service facility. The purpose of this study was to evaluate the cycle of medical equipment management and to study the main factors which contribute to wastage of resources due to lack of proper equipment management. The problems within the medical equipment management cycle that were identified are generic. Some of the root causes of such problems are lack of decentralized planning and in adequate management capacity. In addition, within the health budget the proportion allotted for repair and maintenance is abysmally low which compounds the management problem. WHO had recently suggested that a separate Health Care Technical Services (HCTS) to be created for effective handling of these problems. WHO also formulated a global action plan on management, maintenance and repair of health care equipment (WHO, 2008). Our work shows that situation in equipment management in Palestine is far from satisfactory.

The perceptions of the study population of senior physicians, nurses, and technicians who have direct responsibilities on managing medical equipment within their department at MOH health facilities was assessed. The total number of target population was 208 of them 190 responded with a response rate of (92.23%) of them 81.1% were males. Around 44% of the respondents were less than 40 years old. The majority of participants 52.6% were holding bachelor degree and 30% of them have master degree. The respondents were distributed at the different sectors of MOH work as follow; 87.8% in hospitals, 12.2% in PHC. Regarding the work experience 41% of the respondents have actual experience in their departments of more than 15 years. 92.6% of the participants didn't receive any training course in the last three years. The study demonstrated that 54.8% of the respondents were unsatisfied about the status of medical equipment management in their departments.

The results showed that most of study population said that there are no guidelines for procurement and ordering new medical equipments with mean (m= 2.71), and the perception for whom said that there is available guideline and clear policy for procurement were better with mean (m = 3.09), and the difference between the two means reached to statistically significant (P = 0.001), which refer to the importance of the of the guideline availability in the procurement and selection stage.

The study revealed that 54.4% of the participants reported that there are no adequate spaces and suitable stores for keeping and using medical equipment within their department, and most of equipment lay in the hallways which increase the risk for both the equipment and patient safety. Also, the respondents showed that there is no coordination and good management for distribution and installation the equipment.

Regarding the use of equipment 59.6% of the study population didn't receive training before using the new delivered equipment which lead to misuse and equipment malfunctioning. The results showed that the perception of participants in hospitals (m= 3.32) is nearly equal to participants in PHC (3.31), which mean that the MOH staff have the same trends in using the equipment either in hospitals or in PHC.

Regarding donated medical equipment, the perception of respondents were negative toward the delivered donated equipment, the difference between the two means for who satisfied and dissatisfied were statistically significant (P = 0.001). Also they reported that bout 49.7% of donated equipment delivered incomplete, and 75.3% of the equipment are not unified and from different models and types. They didn't have guideline for further donated equipment and half of them don't know about it. WHO recommended that the guideline should be considered before medical equipment donation.

The study also revealed that most of target group were unsatisfied regarding maintenance and repair stage, so the difference between satisfied and dissatisfied reached statistically significant (P= 0.001). So about 61.1% of the respondents reported that there is no implementation for preventive maintenance on medical equipment in their department, 53.4% of them noted that the maintenance team are not qualified, and 83.7% of equipment malfunctioning due to lack of spare parts.

5.2 Recommendations

- Guidelines and clear policies about procurement of new medical equipment need to be implemented in the MOH. These guidelines should clarify and consider training, spare parts, and maintenance.
- Medical staff should be involved in the committee for selecting and procuring the most suitable medical equipment.
- Lifetime purchase cost plus running and maintaining costs of the equipment should be estimated while deciding about equipment.
- Workload, staff skills, actual need should be considered in the distribution of medical equipment.
- All precautions for electricity fluctuations and other installation requirements should be implemented before supplying the equipment.
- It is recommended to purchase uniform equipment for all the facilities so that maintenance becomes easier.
- Procurement planning should take into account lead-time required in the purchase process. It is important that when the equipment arrives at the facility, the other inputs such as training, infrastructure renovation (site preparation) etc. is completed.
- The MOH need to find adequate and suitable stores with good conditions to safely store equipment and its consumables.
- It is suggested to develop a system of regular calibration of measuring instruments.

- It is recommended that each level of facility should have proper maintenance plan with an adequate budget for the repair and maintenance of equipment. This budget should be decentralized and the rules should be simplified for its use.

- Specific and periodic training courses on the medical equipment management for proper use and maintenance need to given to the medical staff and maintenance team.

- Simple inventory management techniques should be used to ensure that critical spare parts are always in stock.

- It is recommended that each hospital develop a schedule for the inspection and preventive maintenance of all the major equipment.

- All donors must insist on repairing the existing equipment before supporting purchase of new equipment. This would be much more cost effective strategy. Donors and governments should help set up repair and maintenance systems for the hospitals.

5.2.1 Recommendations for future research

- Similar study to evaluate medical equipment management in governmental health facilities in the West Bank.
- Case studies of the equipment management in the different major hospital.
- It is recommended to apply this study at other health sectors (UNRWA, NGOs, and Private).
- Study to assess the medical equipment inventory system at the MOH stores.

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ANNEXES

Annexes

Annex 1

Map of Palestine

Source: MOH, 2000

Annex 2

Map of Gaza Strip

Source: www. Islamonline.net

Annex 3

Helsinki Committee Approval Letter

Palestinian National Authority
Ministry of Health
Helsinki Committee

السلطة الوطنية الفلسطينية
وزارة الصحة
لجنة هلسنكي

التاريخ2009/6/3

Name:

الاسم: عبد الرحمن خليل إبراهيم مراد

I would like to inform you that the committee has discussed your application about:

Evaluation of Medical Equipment Management in Governmental Health Facilities- Gaza Strip

نفيدكم علماً بأن اللجنة قد ناقشت مقترح دراستكم حول:-

In its meeting on June 2009
and decided the Following:-
To approve the above mention research study.

و ذلك في جلستها المنعقدة لشهر 6 2009
و قد قررت ما يلي:-
الموافقة على البحث المذكور عاليه.

Signature
توقيع

Member
عضو

Member
عضو

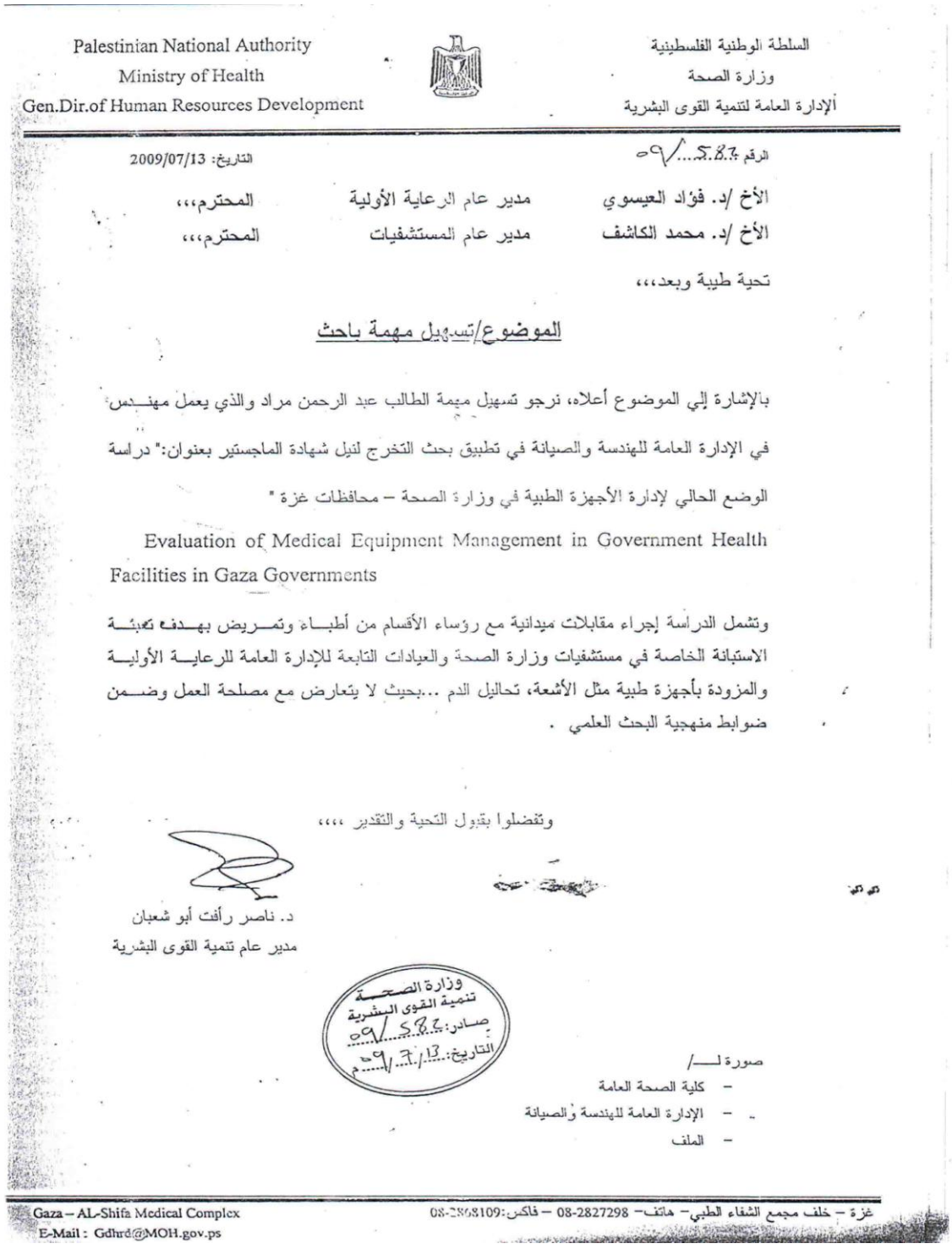
Chairperson

Conditions:-

- Valid for 2 years from the date of approval to start.
- It is necessary to notify the committee in any change in the admitted study protocol.
- The committee appreciate receiving one copy of your final research when it is completed.

Annex 4

Agreement Letter from the Ministry of Health



Palestinian National Authority
Ministry of Health
Gen.Dir.of Human Resources Development

السلطة الوطنية الفلسطينية
وزارة الصحة
الإدارة العامة لتنمية القوى البشرية

الرقم: ٥٩/٥٨٣

التاريخ: 2009/07/13

الأخ /د. فؤاد العيسوي — مدير عام الرعاية الأولية — المحترم،،،

الأخ /د. محمد الكاشف — مدير عام المستشفيات — المحترم،،،

تحية طيبة وبعد،،،

الموضوع/تسهيل مهمة باحث

بالإشارة إلي الموضوع أعلاه، نرجو تسهيل مهمة الطالب عبد الرحمن مراد والذي يعمل مهندس في الإدارة العامة للهندسة والصيانة في تطبيق بحث التخرج لنيل شهادة الماجستير بعنوان:" دراسة الوضع الحالي لإدارة الأجهزة الطبية في وزارة الصحة – محافظات غزة "

Evaluation of Medical Equipment Management in Government Health Facilities in Gaza Governments

وتشمل الدراسة إجراء مقابلات ميدانية مع رؤساء الأقسام من أطباء وتمريض بهدف تعبئة الاستبانة الخاصة في مستشفيات وزارة الصحة والعيادات التابعة للإدارة العامة للرعاية الأولية والمزودة بأجهزة طبية مثل الأشعة، تحاليل الدم ...بحيث لا يتعارض مع مصلحة العمل وضمن ضوابط منهجية البحث العلمي .

وتفضلوا بقبول التحية والتقدير ،،،،

د. ناصر رأفت أبو شعبان
مدير عام تنمية القوى البشرية

وزارة الصحة
تنمية القوى البشرية
صادر: ٥٩/٥٨٣
التاريخ: ٢٠٠٩/٧/١٣

صورة لـــ/
- كلية الصحة العامة
- الإدارة العامة للهندسة والصيانة
- الملف

Gaza – AL-Shifa Medical Complex
E-Mail : Gdhrd@MOH.gov.ps

غزة – خلف مجمع الشفاء الطبي– هاتف– 08-2827298 – فاكس:08-2868109

Annex 5

Explanatory latter (Arabic)

تقييم إدارة الأجهزة الطبية بمراكز الصحة الحكومية في محافظات غزة
استبيان

عزيزي المشارك / ة

تحية طيبة وبعد....

هذا الاستبيان هو جزء من دراستي في برنامج الماجستير في الصحة العامة بجامعة القدس- فلسطين، كمتطلب للحصول على درجة الماجستير.

يتضمن الاستبيان مجموعة من الأسئلة، تهدف إلى جمع المعلومات لدراسة الوضع الحالي لإدارة الأجهزة الطبية في وزارة الصحة في محافظات غزة بهدف تقييمها، ومن ثم المساهمة في تحسين نوعية الخدمات الصحية المقدمة.

عزيزي المشارك...

لا يوجد إجابة صحيحة أو إجابة خاطئة, أجب حسب ما تشعر به.

تعبئ الاستبيان لا تتطلب كتابة أسماء.

تعبئة الاستبيان يتطلب مدة لا تزيد عن 10-15 دقيقة من وقتك الثمين.

أتطلع لمشاركتكم في إتمام هذه الدراسة الممولة ذاتيا .

مع الشكر العميق لحسن تعاونكم

الطالب/ عبدالرحمن مراد

Annex 6

Explanatory Letter (English)

Evaluation of Medical Equipment Management in Governmental Health Facilities in Gaza Governorates

Dear Participant

Thank you for your participation in this research; you were selected because you met the selection criteria of participation.

This study is carried out as a part of the requirements for the master degree in Public Health/Health Management at Al Quds University-Palestine.

The overall purpose of the study is to evaluate the effectiveness of the medical equipment management cycle that currently in use in Governmental Health Facilities in Gaza Strip, and suggest simple methods of improving equipment management.

Your participation is voluntary, and you have the right to withdraw at any time during data collection. Your answers will be kept confidential and only it is requested from you to answer the questionnaire that may not take more than15 minutes of your time.

If you have any inquiry about the questionnaire, don't hesitate to call (0599561418).

Researcher: Abedalrahman Murad

Annex 7

Questionnaire (Arabic)

الجزء الأول:- ضع علامة √ داخل المربع

1. الجنس..... ذكر □ أنثى □
2. العمر.....
3. مكان العمل..... □ مستشفى □ رعاية أولية القسم.....
4. المؤهلات العلمية.....
5. عدد سنوات الخبرة في مجال استخدام وإدارة الأجهزة الطبية .....
6. هل عملت في مكان أخر في مجال إدارة الأجهزة الطبية نعم □ لا □ لا أدري □
7. هل يوجد سياسة واضحة لشراء وطلب أجهزة طبية جديدة في القسم الذي تعمل فيه نعم □ لا □ لا أدري □
8. هل التحقت بدورات تدريبية فيما يخص إدارة الأجهزة الطبية خلال أخر ثلاث سنوات نعم □ لا □
9. إذا كان الجواب نعم الرجاء اذكر أهم تلك الدورات

اسم الدورة	مكانها	تاريخ التدريب	المنظمة

10. هل تقوم بالإشراف الدوري لمتابعة استخدام وتنظيم الأجهزة الطبية بداخل القسم نعم □ لا□ لا أدري □
11. هل يوجد قائمة لفحص وتدقيق الأجهزة الطبية المهمة بداخل قسمك نعم □ لا □ لا أدري □
12. إذا كان الجواب نعم، هل تستخدمها نعم □ لا □ لا أدري □
13. □ هل يوجد نظام جرد للأجهزة الطبية المتواجدة بداخل قسمك نعم □ لا □ لا أدري □
14. يوجد في قسمك قاعدة بيانات خاصة بالأجهزة الطبية المستخدمة والغير مستخدمة نعم □ لا □ لا أدري □

الجزء الثاني:- تقييم النظام (ضع علامة √ داخل المربع)

أولاً:عملية الاختيار والشراء	غير موافق بشدة	غير موافق	لا أدري	موافق	موافق بشدة
15. تشارك دائماً في وضع المواصفات الفنية اللازمة عند طلبك لشراء جهاز جديد.					
16. تقوم اللجان الفنية بتحديث مواصفات الأجهزة الطبية بشكل منتظم.					
17. يتم توريد المستهلكات اللازمة لضمان عمل الأجهزة المتواجدة بقسمك باستمرار.					
18. تشارك دائماً في اللجان الفنية الخاصة باختيار الأجهزة المطلوبة للقسم الذي تعمل فيه.					
19. يوجد لديك خبرة كافية لإختيار أفضل الأجهزة التي يحتاجها القسم.					
20. تستغرق عملية شراء الأجهزة الطبية التي يحتاجها القسم فترة معقولة وعملية.					
21. تساعد قوانين وشروط الشراء في عملية إختيار أفضل وأحدث الأجهزة.					
22. يوجد تنسيق جيد وفعال بين دوائر الوزارة لتزويد القسم الذي تعمل فيه بالأجهزة الطبية اللازمة.					
23. هل تشارك في تحديد احتياجات القسم الذي تعمل فيه من الأجهزة الطبية اللازمة؟					
24. معظم الأجهزة التي يتم شرائها لقسمك قابلة للتحديث والتطوير.					
25. في رأيك، تتم عملية اختيار الأجهزة الطبية لقسمك بشكل فعال ونزيه.					
26. يُشترط تدريب الطاقم الطبي قبل شراء أي جهاز جديد لقسمك.					
27. يتم أخذ المعايير الدولية بعين الاعتبار عند اختيار الأجهزة الطبية للقسم به.					

ثانياً:عملية التوزيع والتركيب	غير موافق بشدة	غير موافق	لا أدري	موافق	موافق بشدة
28. يوجد مساحات مناسبة في القسم الذي تعمل فيه للاحتفاظ بالأجهزة الطبية لتكون جاهزة للاستعمال.					
29. تشارك عادةً في القرارات المتعلقة بتوزيع الأجهزة الطبية.					
30. يتم أخذ ضغط العمل في المستشفيات في عين الاعتبار عند توزيع الأجهزة الطبية.					
31. تحدد مهارة وخبرة طاقم العمل آلية توزيع الأجهزة الطبية على المستشفيات.					
32. يتم تنفيذ الاعمال اللازمة للتركيب قبل توريد الاجهزة الطبية لقسمك.					
33. يتم عمل الاحتياطات والإجراءات اللازمة لحماية الأجهزة من عدم استقرار الكهرباء قبل التركيب.					
34. يوجد في القسم الذي تعمل فيه أجهزة غير مُستغلة بسبب ضيق المكان.					
35. يوجد في القسم الذي تعمل فيه مكان مناسب لتخزين الأجهزة والمستهلكات الطبية.					
36. عادةً ما تتلقى تدريب على استخدام الأجهزة الطبية التي يتم شرائها.					
37. هل تستلم كُتيبات التشغيل الخاصة بالأجهزة الطبية بعد التركيب.					

38. تكون كُتيبات التشغيل المصاحبة للأجهزة الطبية باللغة الانجليزية وسهلة القراءة وتحتوي على الإيضاحات اللازمة.					

ثالثاً:استعمال الأجهزة	غير موافق بشدة	غير موافق	لا أدري	موافق	موافق بشدة
39. عادةً ما تقوم بالعناية والنظافة اللازمة للحفاظ على استمرارية عمل الأجهزة المتواجدة في قسمك.					
40. تقوم بالمعايير المنتظمة للأجهزة الطبية حسب إرشادات المُورد.					
41. في رأيك, تتعطل الأجهزة الطبية بسبب قلة المعرفة وسوء استعمال القائمين على تشغيلها.					
42. يوجد في قسمك نظام متابعة جيد للحفاظ على الأجهزة وجعلها متاحة للاستخدام من قبل الطاقم.					
43. تقوم عادةً بقراءة كُتيبات تشغيل الاجهزة الطبية بحرص قبل إستعمالها.					
44. يتم عمل بطاقة صنف (Inventory Card) لكل جهاز يتم تركيبه في القسم الذي تعمل فيه.					
45. عادةً ما تسعى الادارة لتوفير دورات تدريبية للطاقم الطبي فى استعمال الاجهزة الطبية.					
46. يواجه الطاقم الطبي في القسم الذي تعمل فيه مشاكل في استعمال أحدث الأجهزة.					

47. هل هناك أجهزة طبية متبرع بها في القسم الذي تعمل فيه نعم □ لا □

اذا كان الجواب نعم أكمل وإذا كان الجواب لا انتقل الى سؤال 58

رابعاً: تبرع الأجهزة	غير موافق بشدة	غير موافق	لا أدري	موافق	موافق بشدة
48. يوجد في القسم الذي تعمل فيه دليل إرشادي (Guidelines) خاص بالأجهزة الطبية المتوقع التبرع بها.					
49. يتواصل المتبرعون معك قبل تزويد القسم الذي تعمل فيه بالأجهزة الطبية اللازمة.					
50. تناسب الأجهزة المُتبرع بها احتياجات القسم الذي تعمل فيه كما وترتكز على تقرير تقييم الاحتياجات الخاص بالقسم.					
51. تصل معظم الأجهزة المُتبرع بها كاملة مع مستلزماتها وتطابق معايير ومواصفات القسم الذي تعمل فيه .					
52. تصل معظم الأجهزة الطبية المُتبرع بها لقسمك جديدة وتعمل بكفاءة.					
53. تتناسب مهارة وكفاءة الطاقم الطبي مع تشغيل أحدث الأجهزة التي تم التبرع بها.					
54. كُتيبات الاستعمال وقطع غيار الأجهزة المتبرع بها متاحة ويتم توفيرها بسهولة.					
55. يوفر المتبرعون معلومات تفصيلية عن صيانة وقطع غيار الأجهزة الطبية.					
56. معظم الأجهزة المتبَرع بها لقسمك موحدة ولها نفس المواصفات.					

خامساً: الصيانة والإصلاح والتكهين	غير م وافق بشدة	غير موافق	لا أدري	موافق	موافق بشدة
57. . يوجد صيانة دورية للأجهزة بواسطة طاقم صيانة مُدرب.					
58. في رأيك ، فنيو ومهندسو الصيانة مؤهلين لإصلاح وصيانة الأجهزة الطبية .					
59. يتلقى المهندسين دورات تدريبية على صيانة وإصلاح الأجهزة المتطورة.					
60. تتم عملية اصلاح الاجهزة الطبية التي تتعطل في القسم الذي تعمل فيه بشكل سريع وفعال.					
61. تتوافر قطع الغيار اللازمة لصيانة ومعايرة الأجهزة الطبية في مخزن مناسب بداخل القسم الذي تعمل فيه.					
62. يتم توفير كُتيبات الصيانة (Service Manuals) مع كل الأجهزة الموردة لقسمك.					
63. يُعد عدم استقرار التيار الكهربائي من أهم الأسباب التي تتسبب في تعطل الأجهزة المتواجدة بقسمك.					
64. يوجد اتصال جيد بين قسمك وقسم صيانة الأجهزة الطبية.					
65. يوجد قرار خاص بتكهين الأجهزة المعطلة وتحديث أجهزة القسم الذي تعمل فيه.					

66. هل أنت راض عن وضع الأجهزة الطبية المتواجدة في قسمك.					

67. ملاحظات أخرى مهمة تقترحها لجعل إدارة الأجهزة الطبية أكثر فاعلية:

.....

.....

.....

.....

Annex 8

Questionnaire (English)

Part one:

1. Gender

□ Male □ Female

2. Age _____

3. Place of Work

Hospital _____ Primary Health Care _____

4. Qualifications _____

5. Years of Experience _____

6. Have you worked in other organization before in the field of equipment management?

□ Yes □ No □ Uncertain

7. There are available guidelines and clear policy in your department for procuring and ordering new medical equipment?

□ Yes □ No □ Uncertain

8. Did you receive training courses in medical equipment management in the last three years?

□ Yes □ No

9. If yes, please list the main courses:

Course Name	Place	Date of training	Organizer

10. Regular supervision is made to review the equipment management in your department.

□ Yes □ No □ Uncertain

11. You have a maintenance checklist for essential equipment in your department.

□ Yes □ No □ Uncertain

12. If yes, did you use it?

□ Yes □ No □ Uncertain

13. Do you inventory system for the medical equipment within your department?

□ Yes □ No □ Uncertain

14. Do you have database for all used and unused medical equipment in your department?

□ Yes □ No □ Uncertain

Part two: Evaluation of the cycle

Section A "Procurement and Selection"	Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
15. When you ordering anew medical equipment, you always participate in preparing its specification.					
16. The technical specifications are usually updated by technical committee.					
17. Enough consumables are usually supplied to keep the equipment running.					
18. You usually involved in the procurement committees to select the suitable equipment.					
19. You have good experience in selecting the most suitable equipment.					
20. Procedures for purchasing medical equipment reasonably fast and practical.					
21. The general procurement laws and conditions help in selecting the latest equipment.					
22. There is good coordination among MOH departments for supplying your department with the needed equipment.					
23. Do you usually share in identifying the needs of your department regarding medical equipment?					
24. Most of the purchased medical equipment in your department are liable for future upgrading.					
25. In your opinion, the selection process for medical equipment is efficient and integral.					
26. Staff training is considered a pre condition for purchasing any equipment in your department.					
27. Selection of medical equipment in your department takes into consideration the international standards.					
Section B "Distribution and Installation"	Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
28. Within your department, there are adequate spaces to keep equipment ready for use.					
29. Do you share in decisions related to equipment distribution					
30. Workload for hospitals are considered in distributing medical equipment.					

31. Staff skills and experience determine the mechanism of distributing equipment on hospitals.					
32. Pre installation requirements are usually made before delivering equipment.					
33. Precautions and measures for protecting medical equipment from electricity fluctuations are considered before installation.					
34. Within your department, there are unused equipment due to space limitations.					
35. Appropriate room for storing equipment and consumables is available within your department.					
36. You usually receive training courses on using new purchased medical equipment.					
37. Upon installation, do you receive the user manuals of the equipment?					
38. The provided manuals in English language are easy to read and includes proper illustrations.					

Section C "Use of Equipment"	Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
39. You usually take proper care and cleanliness needed for preserving and prolonging the equipment life.					
40. Regular needed calibrations for medical equipment are usually done.					
41. In your opinion, damages of medical equipment are usually due to lack of knowledge and misuse of equipment operators.					
42. Within your department, there is a good tracking system for keeping medical equipment accessible for staff.					
43. You usually read the equipment instruction manuals carefully before using it.					
44. Each installed medical equipment in your department has inventory card.					
45. Administration usually tries to provide training for your staff in using received medical equipment.					
46. Within your department, your staff face problems in using latest medical equipment.					

47. Within your department, are there medical equipment delivered as donation? □ Yes □ No

If yes, continue and if No move to question 58

Section D "Donated Equipment"	Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
48. In your department, you have a guideline for further donated medical equipment.					
49. Donors communicate with you before supplying any needed equipment.					
50. In your department, donated medical equipment usually match department needs and based on Need Assessment Report conducted by your staff.					
51. Most of the donated equipment are delivered with complete accessories and meet your department standards and specifications.					
52. Most of the donated equipment are delivered brand new and work properly.					
53. Staff skills and qualifications are suitable for operating latest donated equipment.					
54. Instruction manuals and spare parts for donated medical equipment are available and easy to be supplied.					
55. Donors usually provide detailed information about maintenance and spare parts of the equipment.					
56. Within your department, most of the donated equipment are unified and have the same range of specifications.					

Section E "Maintenance and Repair"	Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
57. Regular inspections and periodic maintenance for medical equipment are implemented.					
58. In your opinion, maintenance technicians and engineers are qualified for repairing complicated medical equipment.					
59. Clinical engineers receive proper training in maintaining and repairing the different medical equipment					
60. Repairing the essential medical equipment in your department is carried out quickly and efficiently.					
61. Spare parts needed for repairing medical equipment in your department are usually available in a proper storehouse.					

62. Maintenance manuals are usually delivered with equipment.					
63. Unstable electricity is one of the causes that damage medical equipment in your department.					
64. There is an efficient reporting system between your department and medical equipment maintenance department.					
65. There is a decision for disposing nonfunctional equipment and upgrading equipment of your department.					

66. Are you satisfied with the status of medical equipment within your department?					

67. Write additional comments and suggestions for making the management of medical equipment more effective?

……
……
……
……
…….

Thank you for your participation.

Annex 9

Checklist

Evaluation of Medical equipment management checklist in imaging department

Hospital	
Department	
Number of employees	
Number of imaging equipment	
Equipment types	□ Basic X-ray □ Fluoroscopy □ Ultrasound □ CT □ MRI □ Cath Lab □ All
Number of functional equipment	
Number of non functional equipment	□ Spare parts □ lack of skills □ Old equipment
Reason for non functional	
Number of newly donated equipment (within 1 year)	
Number of functional donated equipment in the department	
Number of non functional donated equipment	
Instruction and operation manuals for equipments are available.	Yes ------ Some else ……. No -------
The equipment specifications are new and meet work objectives.	Yes ------ Some else ……. No -------
The equipment location is suitable and safe for staff and patients.	Yes ------ Some else ……. No -------
The equipment has inventory card.	Yes ------ Some else ……. No -------
Preventive maintenance and inspection done periodically.	Yes ------ Some else ……. No -------
Spare parts and equipment requirements are available.	Yes ------ Some else ……. No -------

Annex 10

Names of Experts

Dr.Bassam Abu Hamad	Al-Quds University
Dr.Yehia Abed	Al-Quds University
Dr.Abed Elshokry	Islamic University- Gaza
Dr.Salah Elsousi	AL-Azhar University-Gaza
Dr.Abdel Aziz Thabet	Alquds University
Eng.Bassam Hamadine	MOH-Gaza
Dr.Ashraf Aljedi	Islamic University-Gaza
Eng.Hossam Abu ELfateh	MMS – GAZA
Dr.Mona Abu Ramadan	ANERA-Gaza
Eng.Amine Elemam	Technoline company- West Bank
Eng.Hazem Khweis	Flagship-West Bank

Annex 11

Checklist analysis

No.	Item	No.	%
1.	**Employee Number**		
	Less than 10	5	45.5
	10 and more	6	54.5
	Total	**11**	**100.0**
2.	**Imaging equipment**		
	Less than 10	6	54.5
	10 and more	5	45.5
	Total	**11**	**100.0**

Equipment Type

No.	Item	No.	%
1.	**X-Ray**	**11**	**100.0**
2.	**Fluoroscopy**	**6**	**54.5**
3.	**Ultrasound**	**11**	**100.0**
4.	**CT**	**4**	**36.4**
5.	**MRI**	**1**	**9.1**
6.	**Cath Lab**	**1**	**9.1**

No.	Item	No.	%
1.	**Number of Functional equipment**		
	Less than 10	6	54.5
	10 and more	5	45.5
	Total	**11**	**100.0**
2.	**Number of non functional equipment**		
	Zero	3	27.2
	Two	4	36.4
	More than two	4	36.4
	Total	**11**	**100.0**
3.	**No. of new donated equipments**		
	0	4	36.4
	1	4	36.4
	2 and more	3	27.2
	Total	**11**	**100.0**
4.	**Number of Functional donated equipment**		
	0	5	45.5
	1	4	36.4
	2 and more	2	18.2
	Total	**11**	**100.0**
	Number of non functional Donated equipment		

	0	8	72.7
	1	2	18.2
	2 and more	1	9.1
	Total	**11**	**100.0**

No.	Item	No.	%
1.	**Causes of Equipment malfunctioning**		
	Spare parts	8	72.7
	Lack of skills	0	0
	Old equipment	3	27.2
	Total	**11**	**100.0**

No.	Item	No.	%
1.	**Instruction and operation manual**		
	Yes	3	27.3
	Yes else	7	63.6
	No	1	9.1
	Total	**11**	**100.0**
2.	**Equipment specification are new and meet work objectives**		
	Yes	4	36.4
	Yes else	7	63.6
	Total	**11**	**100.0**
3.	**Equipment location is suitable and safe`**		
	Yes	8	72.7
	Yes else	3	27.3
	Total	**11**	**100.0**
4.	**Equipment has inventory card**		
	Yes	5	45.5
	Yes else	6	54.5
	Total	**11**	**100.0**
5.	**Preventive maintenance and inspection done**		
	No	11	100.0
	Total	**11**	**100.0**
6.	**Spare parts and consumable of imaging equipment are available**		
	Yes	2	18.2
	Yes else	0	0
	No	9	81.8
	Total	**11**	**100.0**

ملخص الدراسة

تقييم إدارة الأجهزة الطبية في المراكز الصحية الحكومية في محافظات غزة

الأجهزة الطبية تلعب دوراً رئيساً في تزويد المستشفيات والمراكز الصحية الحكومية بالخدمات الصحية المختلفة . هدفت الدراسة بشكل عام الى تقييم إدارة الأجهزة الطبية في مراكز وزارة الصحة الحكومية بمحافظات غزة . قد تسهم نتائج الدراسة في تقديم اقتراحات لتحسين نوعية الخدمة المقدمة وتزود متخذي القرار بمعلومات قد تساعدهم في تبني سياسات داعمة لإدارة الأجهزة الطبية.

أهداف الدراسة الخاصة :

- تحديد نقاط الضعف والقوة في نظام إدارة الأجهزة الطبية في مراكز الصحة الحكومية.
- معرفة مدى مشاركة الطاقم الطبي في عملية اختيار وشراء وتوزيع الأجهزة.
- معرفة وجهة نظر مجتمع الدراسة على وضع الأجهزة الطبية المتبرع بها.
- تحديد المعوقات التي تؤثر على استخدام و صيانة الأجهزة الطبية.

منهجية الدراسة :

البحث عبارة عن دراسة مسحية مقطعية لجميع المسئولين عن إدارة الأجهزة الطبية بشكل مباشر في أقسام مراكز الصحية الحكومية من أطباء وتمريض وفنيين باعتبارهم الفئة المستهدفة . وقد استخدم الباحث أداتين للتقييم هي استبانه لمعرفة وجهة نظر مجتمع الدراسة عن وضع إدارة الأجهزة الطبية ، و قائمة تدقيق استخدمت لتقييم أجهزة الأشعة في المستشفيات . وقد كان العدد الكلي لمجتمع الدراسة 208 منهم 190 استجابوا بمعدل 92.2%.

تحليل البيانات:

تم استخدام البرنامج الإحصائي SPSS لتحليل المعلومات, و تم اختبار النتائج باستخدام كل من Cross tabulation لتوضيح الفروق بين المستشفيات عبر النسب المئوية و كذلك تم استخدام t-Test لإيجاد الفروق بين بعض المتغيرات.

نتائج الدراسة

أظهرت النتائج أن 92.2% من مجتمع الدراسة لم يتلقوا دورات تدريبيه خلال السنوات الثلاث الأخيرة. وبينت الدراسة أن 52.7% منهم لا يشاركون في عملية اختيار وشراء الأجهزة الطبية الوارده الى الاقسام ، و أفاد 54.4% أنه لا توجد مساحات مناسبة لاستخدام وتخزين الأجهزة من اجل الحفاظ عليها . وأفاد 63.7% بأن الجهة المتبرعة لا تتصل بهم لتحديد احتياجات أقسامهم من الأجهزة ، وأن 24.6% من الأجهزة المتبرعة بها تصل قديمة ومتعطلة و كذلك أظهرت الدراسة بأن 61.1% من المشاركين أشاروا بأنه لا يتم تطبيق برنامج الصيانة الدورية على الأجهزة الطبية بالاضافة الى انه 83.7% من الأجهزة متعطلة نتيجة نقص قطع الغيار اللازمة للإصلاح. وعن مستوى رضا مجتمع الدراسة عن وضع ادارة الاجهزة الطبية في الوزارة فقد أفاد 54.8% أنهم غير راضين.

التوصيات

توصيات الدراسة

- ضرورة تزويد الطاقم الطبي بالدورات التدريبية المتخصصة لاستخدام الأجهزة الطبية.
- أهمية مشاركة الطاقم الطبي في عملية شراء واختيار الاجهزة الوارد الى قسمة.
- أهمية تطبيق الصيانة الدورية على الأجهزة الطبية وذلك للحفاظ عليها لفترة أطول.
- عمل ورشات عمل خاصة بتقييم الاحتياجات اللازمة لتزويد مراكز الصحة الحكومية من أجهزة طبية.
- ضرورة اتباع دليل منظمة الصحة العالمية الخاص بتبرع الأجهزة الطبية.
- توفير مخزون من قطع الغيار اللازمة للإصلاح تحسباً من توقف عمل الأجهزة .

توصيات بحثية

- القيام بدراسة مماثلة على مراكز الصحة الحكومية في الضفة الغربية.
- تطبيق الدراسة على القطاع الخاص لمقارنة النتائج بنتائج الوزارة.
- عمل دراسة من أجل تحسين طريقة استخدام الطاقم الطبي للأجهزة.
- عمل دراسة لتقييم نظام جرد الأجهزة الطبيق في مخازن الوزارة.