

Assessment of Operational Maintenance in Public Hospitals Buildings in the Gaza Strip

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Abstract

The issue of public hospitals buildings' maintenance in Palestine is regarded as a challenging issue. The lack of attention to maintenance management in hospitals has led to deterioration of buildings and reduced the health care services. The aim of this paper is to assess the current practice of maintenance process and management in public hospitals buildings in the Gaza Strip. A questionnaire survey that distributed to 13 public hospitals, which are administered by the Ministry of Health (MoH) in the Gaza Strip, was used to collect the primary data for this study. The results of this study present an overview of the current situation of the maintenance process in public hospitals buildings in the Gaza Strip. The findings indicated that while the corrective maintenance is implemented in all the 13 public hospitals, preventive maintenance is employed along with corrective maintenance, only in three hospitals. In addition, the findings indicated variances in responding to maintenance requests, while 50% of the maintenance departments took few hours to respond to maintenance requests, the rest took a few days to respond, this can be explained due to lack of spare parts and qualified staff. The study showed also that there is a shortage in training the hospital facility's users on how to report maintenance problems. The results of this study indicated that most hospitals in the Gaza Strip have no maintenance plan for medical equipment; they do not have quality control system for repair and preventive maintenance. It is recommended to employ experience maintenance staff in order to prepare adequate maintenance plan and detailed check list, which is required for preventive maintenance. The MoH should organize specialized training courses in maintenance management for their staff in order to improve their effectiveness and efficiency. Hospitals in Gaza should make sure that all spare parts available in their storages for immediate action when required.

Keywords: Maintenance, public hospitals, strategy, budget, training

1. Introduction

Hospitals and health care buildings are regarded as the most complex indoor facilities with numerous end users of indoor spaces and functions. Hospitals are considered as one of the most difficult indoor facilities among public sector buildings to maintain, partly because of their complex engineering services [25]. Since poor maintenance practices could lead to more frequent breakdowns, which may cause inconvenience to catastrophe, therefore, maintenance has to be more reliable, more efficient, and more cost effective [14]

It is impossible to produce buildings, which are maintenance free. However, maintenance work can be minimized by good design and proper workmanship, in addition to, a proper management of the process that involves assessing performance, and maintenance management of buildings [1]. In the past few decades, researchers had realized the importance of maintainability of buildings in achieving cost savings and better functioning of facilities [24]. A prime aim of the maintenance process is to preserve a building in its initial effective state, as far as practicable, so that it serves its purpose effectively. The best way to achieve good maintenance is to have an effective maintenance management, which capable to meet the expected requirements of the end user [26].

Gaza Strip is located at the southwestern part of Palestine with a total area of 360km². According to Palestinian Central Bureau of Statistics [21] figures in 2012, Gaza Strip has a total population of 1,588,691 capita and natural increase of population rate (3.3 %). These numbers indicates that health sector must cover all the patients in Gaza Strip governorates (North, Gaza, Middle, Khanyonis and Rafah). Ministry of health care facilities classified as follows: primary health care represented in clinics, secondary health care represented in hospitals. Ministry of Health (MoH) in the Gaza Strip is the main provider of health services including primary and secondary health care. MoH believes that the Palestinian people deserve sustainable and adequate health services in all health facilities. However, to ensure this, the MoH should improve the quality of the medical staff, maintain the health facilities buildings in good status and expand the capacity of health facilities.

The health sector in Palestine has five main providers that are involved in supervision or in regulating the work and services, those include; the Ministry of health (MoH), United Nations Refugee Works Agency (UNRWA), Non-Governmental Organizations (NGOs), the Palestinian Military Medical Services (PMMS) and the Private sector. However, amongst that provider, the MoH has the main responsibilities [18]. In the West Bank there are 669 primary health centers operated by four main providers. On The other hand, in the Gaza Strip there are 147 primary health centers, which are supervised and operated by four providers, where the MoH operates 54 primary health care centers, UNRWA operates 20 primary health care centers scattered in eight refugee camps in the Gaza Strip. The NGOs sector operates 66 primary health care centers and general clinics in Gaza Strip, and PMMS operate 7 primary health care centers and clinics in Gaza Strip. The hospital services are operated by the government and non-government organization. There are 81 hospitals in Palestine; 51 in West Bank and 30 in Gaza Strip. Table 1 shows the health services providers and hospitals beds capacity in Gaza Strip.

Table 1: Health services providers and hospitals beds capacity in Gaza Strip

Service Provider	No. of hospitals	No. of beds	% of total number of beds
MoH	13	1937	70%
NGO	14	655	23.7%
PMMS	3	177	6.3%
UNRWA	0	-	0
Private	0	-	0
Total	30	2769	100%

(Source: Ministry of health annual report [18])

Table 2 illustrates the hospitals' location and its corresponding beds capacity in Gaza Strip Governorates. The health sector in Gaza Strip faces several challenges due to lack of budget and siege since 2007, in addition, the repeated and continuous war in 2008, 2012, and 2014 contributed to the challenges and put a negative effect on the health sector. This has put pressure on the working teams, who were exhausted and less effective to provide adequate service to the Palestinian people. Effective health services maintenance plays a crucial role in improving the quality of the health care. Therefore the objective of this paper is to assess the maintenance condition in public hospital buildings in the Gaza Strip, in order to help in paving the way for sustainable and better health services and health care

Table 2: Hospital location and hospital beds in Gaza Strip Governorates

Governorate	Population	Total Hospitals	
		No.	Capita/hospital
North	303,351	6	60,670
Gaza	543,195	14	38,799
Middle	226,778	2	113,389

Governorate	Population	Total Hospitals	
		No.	Capita/hospital
Khan yonis	296,438	5	59,287
Rafah	192,144	3	94,048

(Source: Ministry of health annual report 2011)

1 Literature review

Maintenance is defined as the combination of technical and administrative actions, including supervision that intends to retain an item, or restore it to a state in which it can perform a required function [22]. Chanter and Swallow [6] defined maintenance as a combination of any actions carried out to retain an item in, or restore it to an acceptable condition. Horner et al [13] proposed more specific definition of building maintenance as work undertaken in order to keep, restore or improve every part of a building, its services and surrounds, to a currently accepted standard, and to sustain the utility and value of the building. Lind and Muyingo [17] stated that maintenance can be classified into planned maintenance and corrective maintenance. On the other hand, Dennis [10] classified maintenance into four categories according to its purpose and process as follow:

- Preventive maintenance is carried out to prevent an item failing or wearing out by providing systematic inspection, detection and prevention of incipient failure. Preventative maintenance is usually programmed.
- Statutory maintenance is when plant such as lifts, fire systems, fume hoods and air conditioning systems are serviced and maintained in accordance with legislative requirements.
- Corrective maintenance is maintenance that is required to bring an item back to working order when it has failed or worn out.
- Backlog maintenance is maintenance that is necessary to prevent the deterioration of an asset or its function but which has not been carried out.

The main responsibility of maintenance unit is to maintain all the facilities and infrastructures, and to ensure the effectiveness of the supporting system for activity and work process in the office. The main supporting system such as lift system, air conditional system, air intake and outlet, electrical system, firefighting system, plumbing and sanitary system, cleaning services, civil and structural building, landscape, safety security, pest control, and telecommunication system, should be working properly without any disturbance that could affect the entire office work process [5].

Maintenance can be implemented in three stages: planning and design stage, construction stage, and maintenance stage [4]. Bin Hashem [5] listed some factors that influence maintenance in the design stage for building maintenance such as: deterioration, future needs and faulty of choice materials. Cooper and Jones [9] reported that the key factors that contributed to high levels of dissatisfaction of the approach to maintenance programs are: poor specification of initial requirements; unclear aims and objectives and inappropriate frameworks; an inability to predict long term cost requirements; variations in levels of experience of those conducting surveys; unrealistic claims by consultants selling survey services; inappropriate or unusable data; poor links to organizational objectives; and a lack of fit of survey data. Shah Ali et al [23] stated that the most dominant factors affecting maintenance cost were building materials, building services, building age and failure to execute maintenance at the right time. Cobbinah [8] showed another type of factors as being responsible for the poor maintenance of public buildings, those include: the age of the buildings, lack of maintenance culture, inadequate funds and high maintenance cost, pressure on building facilities by number of users and poor construction work and maintenance work done by maintenance personnel of the institution.

Maintenance is regarded as tool to promote sustainability in buildings. However, historically, in both public and private sectors, the maintenance process and management that involves assessing performance, and maintenance management of buildings are neglected, and avoidable, which is regarded as adding little to the quality of the working environment and expending scarce resources, which would be better utilized [20]. In addition, Dhillon [11] stated that since the industrial revolution, maintenance of engineering equipment in the field has been a challenge. Although impressive progress has been made in maintaining equipment in the field in an effective manner, maintenance of equipment is still a challenge due to factors such as size, cost, complexity, and competition. Recent research states that buildings that neglect maintenance may fall into several defects which may lead to structural failures [2].

Common types of building defects include: structural defects resulting in cracks or collapse; defective or faulty electrical wiring and/or lighting; defective or faulty plumbing; inadequate or faulty drainage systems; inadequate or faulty ventilation, cooling or heating systems; inadequate insulation or sound proofing; and inadequate fire protection/suppression systems. Additionally, dry rot, wood rot, mold, fungus, or termite or vermin infestation may also be the result of a building defect [2]. Humidity is a major source of problems in buildings worldwide. Moisture can damage the building structure, the finishing and furnishing materials, besides being a direct cause of human discomfort, high indoor humidity promotes mould growth, which can have adverse health impacts on the occupants.

Hospital buildings are considered as sophisticated public areas, due to their functional organizations complexity and architectural configuration [12]. The increase in sophistication and complexity of medical services within the health service is reflected in the sophistication and complexity of buildings, their finishes, fittings, contents and services [3]. According to Ching et al. [7], there are factors such as an increase in patient numbers, demands for more hospital beds, and expansion of hospital divisions, make the original hospital configuration inadequate, therefore, additions or alterations must be performed to the building in order to meet both current and future needs. Because hospitals cannot suspend all medical practices or reject patients, the reconstruction of hospital building must coincide with its normal hospital hours. According to Kennett [15], hospitals are constantly renovating, whether they are just adding electrical outlets or communications cables, or engaging in more complex projects that involve moving functions and building additions to the existing structures. Therefore, maintenance process and management of hospitals should be given high priority in day to day activities.

2 Methodology

The public hospitals are selected as the population of this study because of its importance and the large role that hospitals play in Palestinian people's life. There are 30 hospitals in the Gaza Strip, 13 of them are public hospitals which are administrated by Ministry of Health (refer to Table 4). The hospitals are categorized into small size, large size and complex according to the MoH.

The 13 hospitals are distributed into 5 governorates in the Gaza Strip, these are: North, Gaza, Middle, Khanyonis and Rafah. The hospitals are grouped into three types: general, specialized and maternity. Three hospital size are exist: small means hospital capacity in beds equal or smaller than 100 bed, large means hospital capacity in beds equal greater than 101 bed, while complex indicates that there are more than specialized hospital. Maintenance departments are located in five main governorates, each department is responsible for the maintenance services in the nearby geographic location hospitals and primary health care centers in the governorates. Each hospital has a representative for the maintenance department which has its residence staff. Table 3 shows the maintenance department in the Gaza strip.

Table 3: Maintenance department in the Gaza strip

Maintenance department location	Hospitals served
North	Kamal Odwan and Bait Hanoon hospitals
Gaza	Shifa, Al Naser for Pediatrics, Ophthalmic, Psychiatric hospital, Rantisi Specialized Pediatrics, and Dorra hospital
Middle	Al Aqsa hospital
Khanyonis	Nasser complex
Rafah	EGH, Abo Yosef Al Najjar and Tal sultan

A Questionnaire survey was adapted in this study, the questionnaire was sent to the head of maintenance department in each of the 13 public hospitals. The questionnaire was designed based on previous literature review and it was modified according to the pilot study. The pilot study was conducted by distributing the prepared questionnaire to ten experts who have an average of 15 years' experience in maintenance. Eight experts were from the MoH maintenance departments and one expert was from UNDP and one expert from private engineering consultation office. The experts have got the Bachelor degree in civil engineering, electrical engineering, mechanical engineering, and two of them have master degree in the engineering fields like: bio medical engineering and electrical engineering. Experts' notes have been taken into consideration and incorporated into the questionnaire.

3 Results and discussion

3.1 Location and Number of Beds of Public Hospitals

According to MoH reports, Gaza Strip contains 30 hospitals distributed in the Gaza Strip governorates, 13 hospitals is governmental which is under the responsibility of MOH. Table 4 shows the geographical location, number of beds, hospital area, category and types of public hospitals. In 2011 bed occupancy rate was 82.5% and an average length of stay for patients was 2.9 day. According to Table 4, Gaza governorate has the majority of hospitals that include Shifa hospital which is considered the largest hospital in west bank and Gaza strip. Figure 2 illustrates the geographical location of the public hospitals.

Table 4: Location, no. of beds, category and types of public hospitals

No	Hospital Name	Geographic Location	No. of Beds	Hospital Area in sq. m.	Category	Type
1	Bait Hanon	North	45	2,500	Small	General
2	Kamal Odwan	North	104	5,000	Big	General
3	Al Naser for Pediatrics	Gaza	136	4,400	Big	Specialized
4	Ophthalmic	Gaza	42	3,600	Small	Specialized
5	Psychiatric hospital	Gaza	29	6,000	Small	Specialized
6	Rantisi Specialized Pediatrics	Gaza	51	2,500	Small	Specialized
7	Dorra	Gaza	91	1,600	Small	Specialized
8	Shifa	Gaza	619	42,000	Complex	General
9	Al Aqsa	Middle	136	4,000	Big	General

No	Hospital Name	Geographic Location	No. of Beds	Hospital Area in sq. m.	Category	Type
10	Nasser	Khanyonis	322	5,000	Complex	General
11	European Gaza Hospital	Khanyonis	261	65,000	Big	General
12	Abo Yosef Al Najjar	Rafah	80	4,000	Small	General
13	Tal Sultan (Hilal Emarati)	Rafah	52	4,000	Small	Delivery (Maternity)

(Source: MoH report [18])

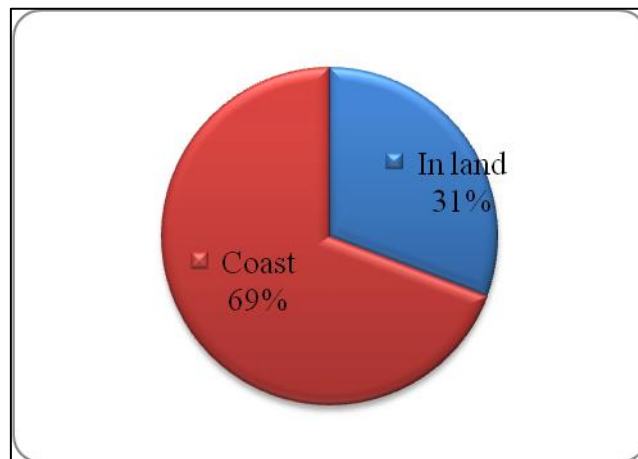


Figure 1: Hospital spatial locations types and their percentages

3.2 Hospital Spatial Region

Gaza Strip is considered as coastal region as it's located on the shore of the Mediterranean Sea; however the eastern part can be considered as in land area. Table 5 and Figure 2 illustrate the spatial location of the hospital buildings.

Table 5: Hospital spatial regions

#	Hospital	Spatial region
1	Shifa	coast
2	Dorra	In land
3	Rantisi	coast
4	Pediatric	coast
5	Ophthalmic	coast
6	Psychiatric	coast
7	Nasser complex	coast
8	European Gaza Hospital	In land
9	Al Aqsa	coast
10	Al Najjar	In land
11	Tal sultan	coast
12	Kamal Odwan	coast
13	Bait Hanoon	In land

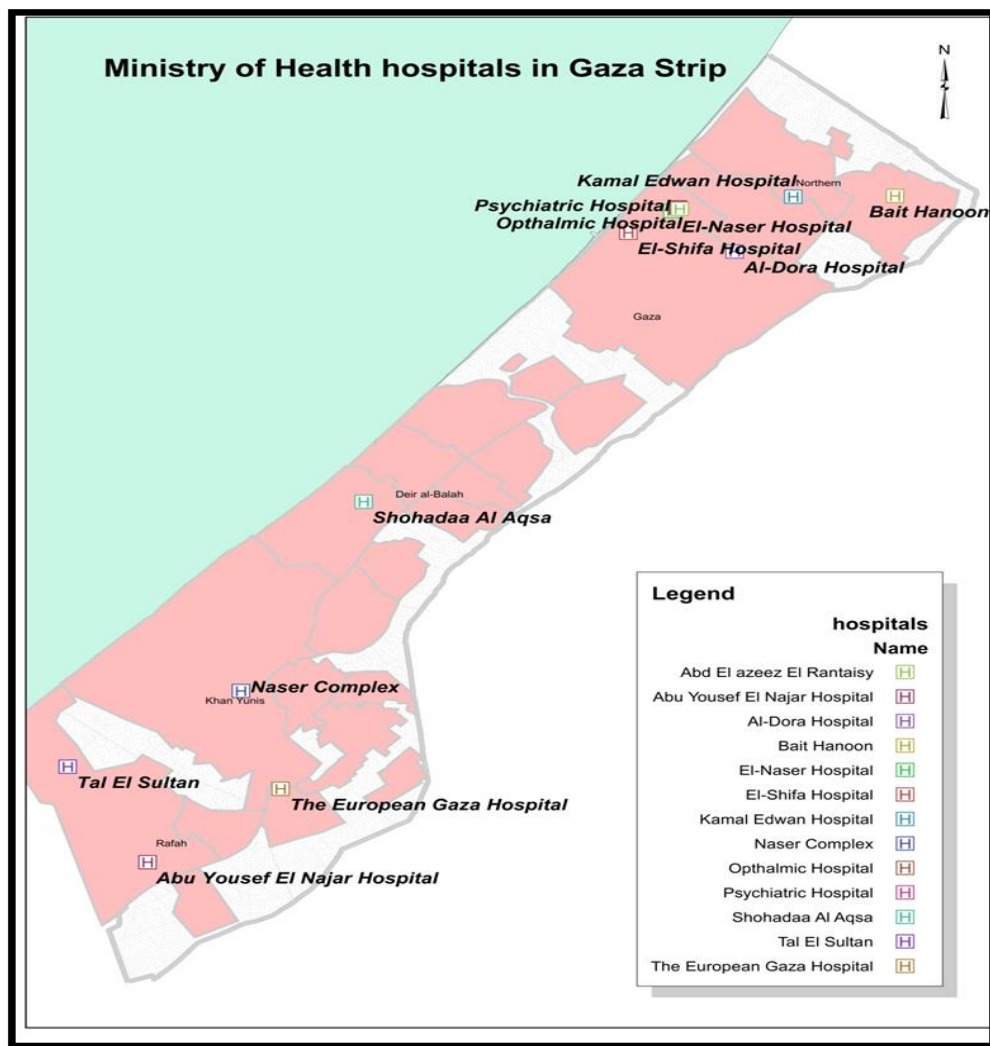


Figure 2: Public hospitals geographic location

3.3 Buildings Age

As shown in Table 6 the Gaza Strip hospitals' ages are ranged from 7 to 51 years since operation date, with an average hospitals' age of 21 years.

Table 6: Hospital buildings age

Hospital	Building name	Buildings age (years)	Floor area sq-m
Shifa	Surgery	33	1652
	outpatient	33	2058
	Burn	8	700
Dorra	Main building	13	750
Rantisi	Main building	7	2500
Naser Pediatric	Main building	51	2000
Ophthalmic	Main building	17	940
Psychiatric hospital	Rehabilitation	51	230
	Departments	51	250

Hospital	Building name	Buildings age (years)	Floor area sq-m
Nasser complex	Tahreer building	18	1400
	Nasser building	51	2200
European Gaza Hospital	A	13	2000
	B	13	2000
	C	13	2000
Al Aqsa	Main building	13	1800
Al Najjar	Old building	13	950
	New building	8	800
Tal sultan	Main building	7	800
Kamal Odwan	Emergency	8	740
	Departments	17	750
Bait Hanoon	Main building	8	1090

Figure 3 depicts that about 43% of hospitals are in their second decade; this indicated that most of hospitals was built and operated since Palestinian MoH establishment in 1995 and about 29% of hospitals in their first decade especially after Al Aqsa Intifada in 2000. 19% of the hospitals were built more than 40 years ago.

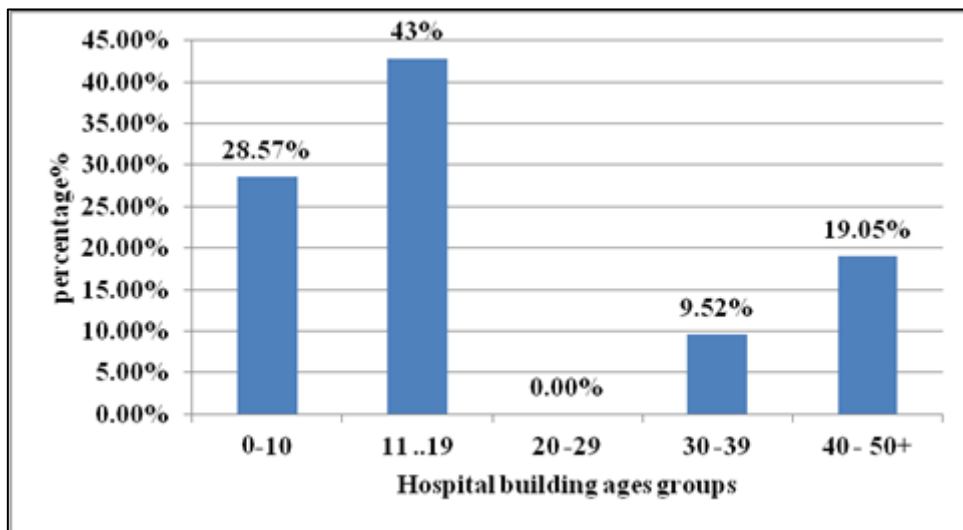


Figure 3: Building age categories

3.4 Total number of employees

Table 7 shows the numbers of employees and patients bed for each hospital according to MoH [18] report. Figure 4 illustrates that an average of 2.58 employees per patient bed, the highest was in Bait Hanoon hospital which was an average of 4.07 employees per patient bed, and the lowest was in Dorra hospital an average of 2.16 employees per patient bed.

Table 7: Hospitals beds and employees numbers

Hospital	No. of beds	No. of employees
Shifa	619	1487
Dorra	91	197
Rantisi	47	173
Pediatric	132	311

Hospital	No. of beds	No. of employees
Ophthalmic	40	109
Nasser complex	322	769
EGH	246	602
Al Aqsa	129	372
Al Najjar	80	247
Tal sultan	52	194
Kamal Odwan	103	310
Bait Hanoon	45	183

(Source: MoH report [18])

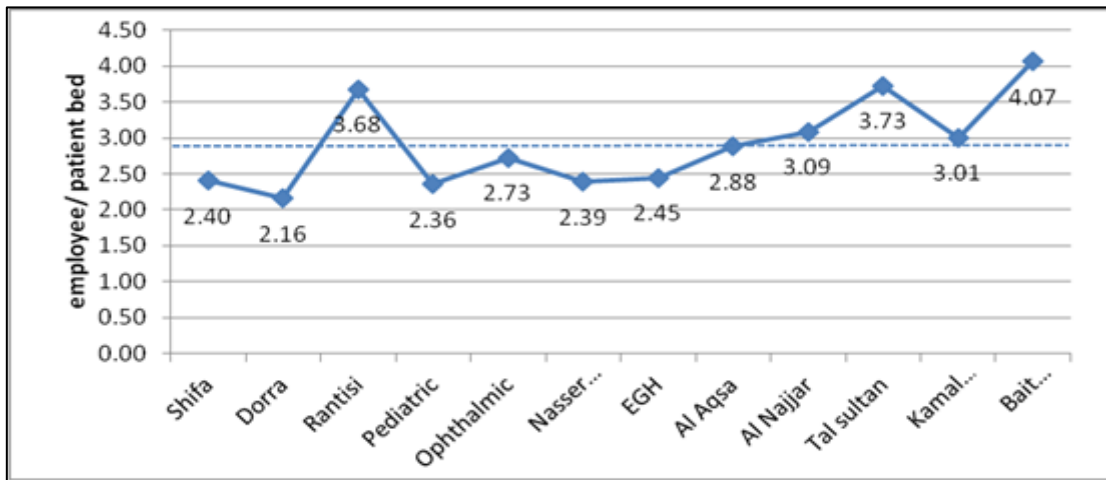


Figure 4: Number of employees vs. number of patient beds

3.5 Maintenance Employees

Table 8 illustrates that the maximum number of technician staff in the maintenance department within the surveyed hospitals, was the electrical technician with an average of (5.8), followed by the HVAC technicians (5.6) and (5.2) mechanic technicians. On the other hand, the biomedical engineers have the majority among the engineering staff with 5 bio medical engineers on average for the center, and a maximum of 16 biomedical engineers in some centers. The mechanical engineers is the second- highest engineering group with an average 2, followed by the electrical engineer with an average 1.8 and finally the civil engineer which have the lowest staff numbers in maintenance center. Unfortunately there are no architect engineers in the maintenance department; this is due to two reasons: firstly the political situation in 2006 in Gaza Strip which led most of employees to leave their work. Secondly the maintenance and engineering department officers considered the scope of the architect works in maintenance field in MoH is limited, though they rely on the architects in the engineering department.

Table 8: Maintenance employee profession

Profession	Average	Min.	Max.
Head of department	1.0	1	1
Administrative	2.2	0	5

Profession	Average	Min.	Max.
Biomedical engineers	5.0	0	16
Biomedical technician	4.4	0	14
Civil engineer	1.4	1	3
Civil engineer assistant	0.6	0	2
Architecture engineer	-	-	-
Electrical engineer	1.8	1	4
Electrical technician	5.8	0	15
Mechanical engineer	2.0	1	3
Mechanical technician	5.2	1	11
Electro mechanic technicians	0.6	0	3
Plumping technician	3.4	1	6
HVAC technician	5.6	2	15
Sterilization technician	2.2	0	11
Metal work	4.4	2	12
Painter	2.4	0	8
Carpenter	4.8	2	12
Communication technician	1.6	0	8
Building technician	1.2	0	3
Electronics technician	1.8	0	3
Medical Gazes technician	0.2	0	1
Aluminum Technician	1.6	0	4
Office devices technician	0.4	0	1
Safety technician	0.2	0	1
Water desalination technician	1.0	0	3
Worker	0.8	0	3
Store officer	0.4	0	2
Maintenance technician	1.2	0	3
Total	63.2		

3.6 Maintenance types

As indicated in the literature review, there are three main types of maintenance: preventive, corrective and immediate maintenance. In the Gaza Strip it was found that all the 13 hospitals implement the corrective maintenance, the preventive maintenance was conducted along with the corrective maintenance, only in three hospitals, those are: Rantisi hospital, European Gaza hospital and Tal El sultan. This is because preventive maintenance needs human recourses and more detailed maintenance plan and check list, which is unavailable in the other hospitals.

Figure 5 depicts that 42% of the maintenance staff is located in Gaza governorate, because 6 hospitals are located in Gaza city, which is considered as the center for the entire maintenance department in all hospitals. Rafah maintenance department represents 25% of the maintenance staff due to the existence of European Gaza hospital which is considered as one of the most important hospital in the southern region.

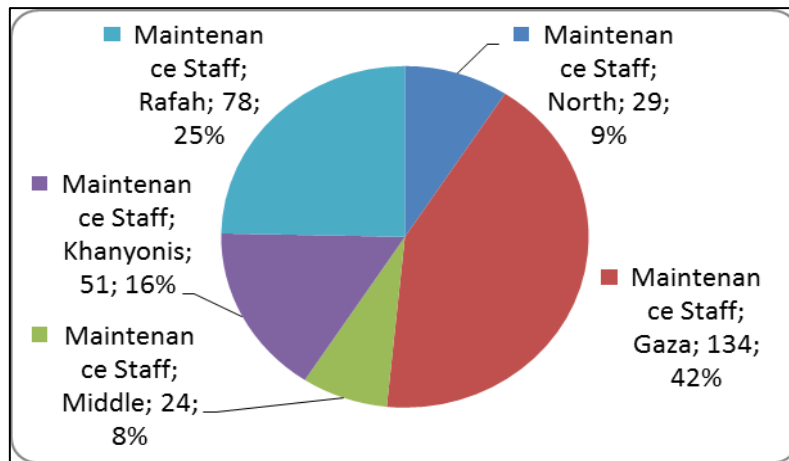


Figure 5: Maintenance employees' allocation in Gaza Strip governorates

3.7 Maintenance Expenditure

Expenditure of maintenance in public hospitals can be categorized into two types:

1. Internal sourcing which is funded by the Ministry of Finance that contains second mints, bills maintenance contracts and spare parts in MoH stores. **Error! Reference source not found.** shows the internal maintenance expenditure in 2011 and 2012. As noticed in Figure 6, there is a huge difference in local internal expenses of maintenance in hospitals. Shifa hospital has increased in 2012 about 22.5% than 2011. Rantisi hospital also increased about 73%, these increases are not systematic but it's due to immediate maintenance items which are needed. On the other side, other hospitals nearly stayed at the same level of expenses like: Naser pediatric, Al Najjar, Tal sultan and Bait Hanoon. The difference of expenditures in 2011 and 2012 can be explained by the starting of stabilization in the political status in the Gaza Strip and the support of Arabian donors for the budget of MoH.
2. Outsourced funded are from NGOs, Islamic bank for development and Islamic relief which are presented in Table 10 and Table 11. The donors for the maintenance projects have many conditions like choosing the target hospital to maintain, amount of donation and type of work done. Awarding the projects requires close cooperation between the donors and MoH managers and engineers.

Table 9: Internal maintenance expenditure in 2011 and 2012

Financial Year Hospital	Maintenance expenditures 2011 NIS	Maintenance expenditures 2011 \$	Maintenance expenditures 2012 NIS	Maintenance expenditures 2012 \$
Shifa	316361.91	\$ 85,503.22	661622.69	\$ 178,816.94
Dorra	13,327.71	\$ 3,602.08	82,355.50	\$ 22,258.24
Rantisi	441845.75	\$ 119,417.77	60865.34	\$ 16,450.09
Naser Pediatric	27045.4	\$ 7,309.57	75918.78	\$ 20,518.59
Ophthalmic	10626	\$ 2,871.89	26977.5	\$ 7,291.22
Nasser complex	332957.09	\$ 89,988.40	166286.75	\$ 44,942.36
EGH	319799.24	\$ 86,432.23	455402.75	\$ 123,081.82
Al Aqsa	66473.69	\$ 17,965.86	173525.7	\$ 46,898.84
Al Najjar	45525.14	\$ 12,304.09	77247.25	\$ 20,877.64
Tal sultan	23913.5	\$ 6,463.11	15049.5	\$ 4,067.43

Financial Year Hospital	Maintenance expenditures 2011 NIS	Maintenance expenditures 2011 \$	Maintenance expenditures 2012 NIS	Maintenance expenditures 2012 \$
kamal odwan	67105.03	\$ 18,136.49	194723.99	\$ 52,628.11
Bait Hanoon	15161.2	\$ 4,097.62	81794.43	\$ 22,106.60
Total	1,680,141.66	\$454,092.33	2,071,770.18	\$559,937.88

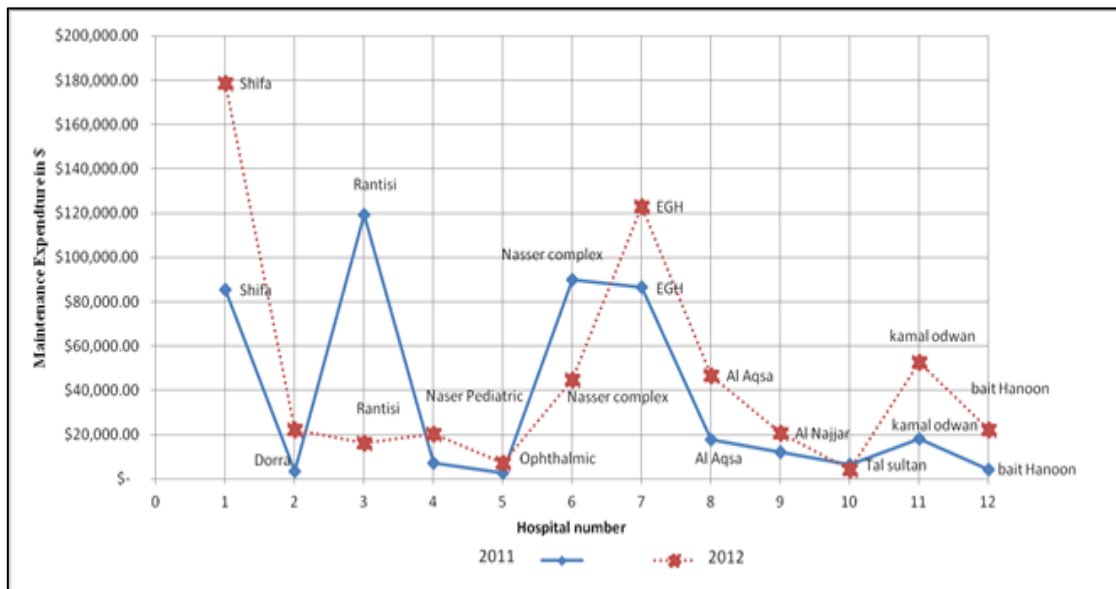


Figure 6: Internal sourcing of maintenance expenditure in 2011 and 2012 in public hospitals

Table 10: Outsourced funding maintenance projects in 2012

#	Project location	Funding organization	Value of donation in (US \$)
1	Ophthalmic rehabilitation and renovation	Islamic bank	\$ 200,000.00
2	Shifa , Naser Pediatric and kamal Odwan Hospitals maintenance	Islamic Bank for development	\$2,876,000.00
3	Dorra hospital maintenance	Muslim Hands (NGO)	\$ 80,000.00

Table 11: Implemented outsourced maintenance projects in 2012

#	Project location	Funding organization	Value of donation in (US \$)
1	Daily care department rehabilitation in Bait Hanoon hospital	International Arab Authority	\$ 50,000.00
2	Nasser complex	Islamic bank operated by Qatar Crescent	\$910,348.00
3	Nasser building maintenance in Nasser complex	Islamic Relief	\$100,000.00
4	Intensive care maintenance in Naser Pediatrics	Islamic bank operated by Qatar Crescent	\$200,000.00
5	Operation room maintenance in Kamak Odwan hospital	Islamic Relief	\$ 20,000.00

3.8 Functional management maintenance service

3.8.1 Responsiveness and timeliness

The results indicated that 50% of the maintenance departments took few hours to respond to maintenance requests, while the rest took one day to respond for the normal requests. There is a good coordination of receiving the requests from the hospitals users. However, the responsiveness in implementing the request is dependent on the availability of spare parts and the skills of technicians.

3.8.2 Delivering characteristics

The findings of this study revealed that 92.3% of the respondents stated that the maintenance of building conditions in the hospital is improved from year to year. 83.3 % of the respondents mentioned that the final situation of the maintained building is getting better, while 16% of them stated that there is no improvement. These results showed that there is a rapid movement of maintenance projects in hospitals buildings which has led to an improvement in building maintenance in Palestinian hospitals.

3.8.3 Relevance

The finding of this study illustrated that 69.2 % of the maintenance departments received maintenance requests that are related to the existing complaint, while 30.8 % of the respondents indicated that there is no relation between the maintenance request and the actual need for maintenance. This can be traced to the lack of training the users of hospital facility on how to put request for maintenance.

3.9 Maintenance department's activities

3.9.1 Inspection interval of civil works activities

The results revealed that 61.5 % of maintenance departments have no routine inspection of plumbing and water system. The inspection is conducted only when there is a problem in the water and sewage networks and electrical problems. Of the note, the fact that 84.6% of maintenance departments' activities such as replacement of worn washers and defective plugs are considered part of the corrective maintenance procedures. It was found that the electrical renewing is the most frequented activity with an average of 35 times monthly, while roof maintenance is conducted 8 times monthly. Water and sewage networks have 8 times monthly routine inspection.

3.9.2 Medical equipment's maintenance procedure

According to Table 13, the results indicated that 69.2% of hospitals have no maintenance plan for the medical equipment, which included scheduled inspections and routine checkup. 92% of the hospitals have master maintenance record which identifies each equipment location, number and the users of the equipment. Due to the high priority for the medical equipment in the Gaza Strip hospitals, it was found that 53.8% of hospitals have action record for the medical equipment. The hospitals recorded the actions through computerized system which contains the location of the device, the in-charge person and when it was maintained. It was found that 76.9% of hospitals conduct routine inspection for the mechanical systems such as ventilators and gases station. Public hospitals have no quality control system for the repair and preventive maintenance. Technical manuals are not fully utilized when repairs are made, maintenance on the medical equipment are not done on the stipulated time frame. Deferment of maintenance may be required due to non-availability of manpower or other extenuating circumstance for instance lack of spare parts.

Table 12: Medical equipment maintenance

Activities	Yes		No	
	N	%	N	%
Hospital have maintenance plan for equipment	4	30.8	9	69.2
The maintenance manuals for hospital equipment are in one location	9	69.2	4	30.8
Master record of maintenance for each piece of equipment in the hospital	12	92.3	1	7.7
Action record that details the scheduled maintenance to be performed for each piece of equipment on a regular basis or schedule	7	53.8	6	46.2
Routine inspections, oiling and replacement of defective parts for mechanical systems.	10	76.9	3	23.1

4 Conclusion

The aim of this paper was to assess the maintenance management state of public hospitals buildings in the Gaza Strip. The study revealed that the maintenance operational state of public hospitals in the Gaza Strip has been improved recently due to urgent outsource funding. This study showed that all public hospitals implement corrective maintenance, only three hospitals employed preventive maintenance along with corrective maintenance. Most maintenance departments have no routine inspection on plumbing and water system. They react only when there is a problem in water and sewerage networks. Public hospitals in the Gaza strip have no maintenance plan for medical equipment and they do not have quality control system for repair and preventive maintenance.

The results revealed that maintenance staff does not have access to formal training program on maintenance techniques, planning and policy. This is due to the paucity of budget and lack of adequate attention from the hospitals' top management. Public hospital buildings are health services and places; therefore, high priority and attention should be given from the government and the MoH towards maintenance improvement in all hospital building. Maintenance staff should adopt proactive approach to reduce the occurrences of defects which will eventually improve the physical and functional public hospital services. Adequate funding should be provided for the running of maintenance operations.

It is recommended to change the work style (rearrange the human resources, set new standards to receive the maintenance requests). It is also recommended to conduct comprehensive standard training for the maintenance team, medical staff, administrative staff and the management to be aware of the facility management principles. Time scheduled plan is required to make a data collection survey for all the assets of the hospitals and their extensions, and convert it to maps with a full database.

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