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Evaluation of Basic Radiographic Services at Governmental Hospitals-Gaza Governorates, Palestine

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Research Article

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ABSTRACT

Background: The complex situation of the current health services exists to shift the system in significant ways to improve on this situation. The radiographic services need more efforts for building capacity. This study is conducted to evaluate radiographic services at governmental hospitals in Gaza Governorates.

Methods: Triangulated study design was used for data collection. The quantitative part; 170 Radiologic Technologists completed questionnaires with 95.5% response rate. The researcher used arbitrated checklist to evaluate medical imaging facilities. Census study conducted on all Radiologic Technologists and medical imaging departments at six main governmental hospitals in the Gaza Strip. In addition, three key informant interviews with Radiologic Technologists manager were conducted.

Results: Researcher have directly interviewed 170 participants. Findings revealed that there was shortage in number of radiographic equipment and Radiologic Technologists. Statistically significant relations between number of exams and patient waiting time in Conventional Radiography (p=0.000). Generally, radiographic departments that followed standard in structure were 45%. Regarding to fluoroscopic rooms, 79% of structure were followed the standard. The majority of existing Darkrooms full filled the international standard.

Conclusion: An improvement in human resources among medical imaging facilities was clearly observed after 1996. An observable shortage in number of radiographic machines and Radiologic technologists at all governmental hospitals. All departments revealed clear defect in structure, design and essential supplies. Critical readings were observed respecting to insufficient radiation protection tools and holding of Thermo luminescence Dosimeters.

INTRODUCTION

Health care system in Palestine is complex, because health service delivery in Palestine is divided into five major health care providers: Two public providers (The Ministry of Health and the Ministry of Interior – Military health services, multiple private providers, hospitals and clinics) and numerous NGOs providers (The United Nations Relief and Works Agency-UNRWA and other local NGOs). The main provider MOH is operating 25 hospitals and 448 PHC facilities, 394 in West Bank (WB) and 54 in Gaza Strip (GS) [1-3].

MOH is the main provider of secondary care in the GS. It is responsible for 13 hospitals across the five governorates and the number of hospital beds in the GS is about 2037 and percent of hospital bed per 1000 capita is about 1.2 [2]. The average occupancy rate at hospitals in the GS is about 88%. The unstable Palestinian political situation increases the load on the health care services in Gaza and West Bank.

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Substantial effect in diagnosis and treatment of different diseases is attributed to the medical imaging services. The medical imaging services are a critical part of health care provision for patients at all of the three levels of health care (primary, secondary, and tertiary) especially in secondary care. The Ministry of Health (MOH) is the main provider of the medical imaging services in Palestine, where the number of radiological examinations in the GS reached 519,220. The majority of these exams (81%) were conducted at governmental hospitals in the GS. These services are represented as the following: conventional radiography 78.6%, Computed Tomography (CT) 6.2%, Magnetic Resonance Imaging (MRI) 0.7%, fluoroscopy 0.8%, and others 13.7%. A significant increase in medical imaging services in the GS between 2006-2014 [3].

No previous study about evaluation of medical imaging services in the GS was reported. Evaluation of medical imaging services is very important particularly in the GS, which is politically instable, suffering poverty and low health resources. This study conducted to evaluate basic radiographic services (conventional x-ray, fluoroscopy and processing room) at Governmental Hospitals in the GS.

MATERIALS AND METHODS

Study Design

The design of this study was descriptive, analytical cross-sectional one with a triangulated design (quantitative and qualitative).

Study Population and Data Collection

The current study was conducted on six main targets; medical imaging equipment, human resources and department designs. All designs, RTs and equipment of radiographic departments at the six main governmental hospitals were evaluated based on international standards and reports.

The quantitative part was collected from the radiographic departments. With regard to the qualitative part, in-depth interviews were accompanied with three key informant managers from the medical imaging administration of governmental hospital.

The first part presented characteristic data about the participants, which was personal and work related data: age, gender, residency place, qualification, training courses, years of experience, hospital name etc. The second part demonstrated equipment information about basic radiographic services. The data was included: machine numbers, machine types, machine status, maintenance check-up and annual breakdown and image types. The second type of data collection was checklist develop by the researcher based on international standards "Australasian Health Facility Guidelines", "radiological protection Institute of Ireland" and "National Health Services.

The key informant interviews were used as a third data collection method. Semi structured, open-ended statements were performed. Three experts were selected to conduct in-depth interviews to dig beneath of the elicited quantitative data, make deep understanding and generate new ideas, and give more evidence towards their perception.

RESULTS

General Information about Existing Radiographic Department

Table 1 shows readings for Gaza-governorates number, hospitals establishment, hospital area, employees, RTs and beds number in the six main governmental hospitals (Al-Shifa, European Gaza, Indonesia, Shohda Al-Aqsa, Nasser, and Abu Yousef Al Najjar Hospital).

Table 1. Distribution of main six governmental hospitals in the GS.

Item / Hospital name	Governorate	Establishment	Area (m^2)	Employees number	Radiologists number	RTs number	Beds number
Indonesia	North	2015	16,000	350	4	20	110
Al-Shifa	Gaza	1946	45,000	1535	20	55	583
Shohda Al-Aqsa	Mid Zone	2001	4,000	474	3	21	261
European Gaza	Khan Younis	2000	56,000	691	11	29	261
Nasser	Khan Younis	1960	25,000	880	6	28	330
Abu Yousef Al Najjar	Rafah	2000	4,000	297	3	17	49

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Table 2. Distribution of RTs by characteristics variables (N=170).

Variables		Frequency	%
Gender	Male	139	81.8
	Female	31	18.2
Age groups	<30 years	34	20
	30-40	94	55.2
	40-50	21	12.4
	>50 years	21	12.4
Experience	<10 years	62	36.5
	Oct-17	74	43.5
	17-24	16	9.4
	>24 years	18	10.6

Table 2 clarifies that 20 % of RTs aged less than 30 years, 55.2% between 30-40 years, around 12.4% between 40-50 years and the same percent for those older than 50 years. In addition, around 36.5% of RTs have less than 10 years' experience and 43.5% of them have 10-17 years' experience, while 9.4% of RTs have 17-24 years' experience and 10.6% more than 24 years' experience.

The total number of distributed questionnaires was 176 and the number of respondents was 170 with a response rate of 95.5%. The first section is planned to analyze the demographic characteristics of the study sample (Radiologic technologists) N=170 including (Name of hospital, Age, Gender, Certificate, Employment, Years of experience, Training).

Regarding to participants gender, the majority of RTs were males (81.8%), while 18.2% were females as shown in **(Figure 1)**.

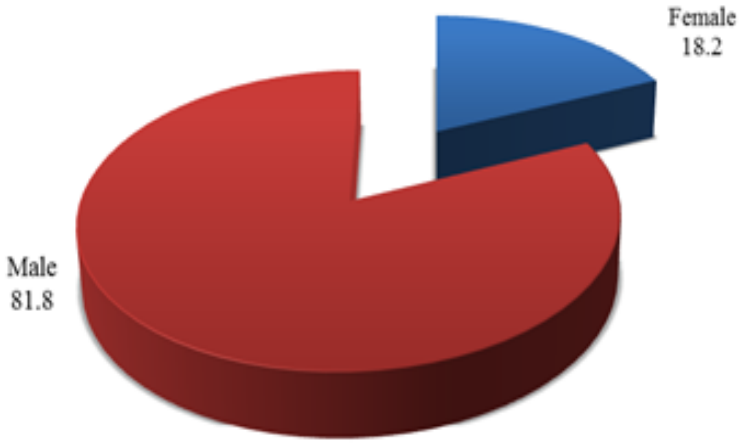

Figure 1. Distribution of RTs based on Gender.

EVALUATION DESIGNS OF EXISTING RADIOGRAPHIC DEPARTMENT

Conventional Radiography Design Checklist

Table 3 clarifies that all of conventional radiography rooms in medical imaging department have a control console, but only 56.3% of these rooms have proper size (≥ 1.5 × 2 m^2) and provided with drainage sewage [4]. Generally, the operator console area allows observing and communicates the patient during imaging process. This area should be sufficiently large to reduce radiation intensity at the operator's screen and boundaries [5]. Around 18.8% of rooms have windows, and toilet inside imaging room.

The current check showed that 50 % of imaging rooms have proper size (≥ 30 m^2) [4-6]. Other international standard exhibited that X-ray room size should be 33 m^2 to contain patient table and the vertical chest Bucky stand. The boundaries to all occupied areas (walls, doors, doorframes, floor, ceiling, window and the protective viewing screen) must shield appropriately [7]. Finally, 31.3% of the current rooms have a change cubicle and patients door entrance dimension fit with the international standard (≥ 180 × 150 cm). The door should be wide enough and must be shield against scatter radiation [4,8].

The location, design and equipment layout of X-ray rooms must carefully consider respecting to radiation protection perspective. This is easier when X-ray facilities dose not designed as stand-alone rooms and planned as part of an integrated radiology/imaging department with its supporting areas and services. Planning the room layouts should start as early as possible in the design process. The design of ancillary facilities such as changing cubicles, toilets should be considered [5].

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Table 3. Checklist about structure of conventional radiography in governmental hospitals.

Item \ Hospital name	Al-Shifa		European Gaza		Nasser		Shohda Al-Aqsa		Indonesia		Abu Yousef Al Najjar		Total	
	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y%	N%
Is control console area suitable? (≥ 1.5 × 2 m)	5	1	2		1	2	1	1		1		2	56.3	43.8
Are there windows for room?	3	3		2		3		2		1		2	18.8	81.2
Is there a toilet inside the room?	3	3		2		3		2		1		2	18.8	81.2
Is a room size at least 30 m^2?	3	3	2		2	1	1	1		1		2	50	50
Is there drainage sewage?	6			2	1	2	1	1	1			2	56.3	43.8
Is there a change cubicle?	3	3	2			3		2		1		2	31.3	68.8
The customers/patients door entrance at least 180 × 150 cm^2?	3	3		2		3	2			1		2	31.3	68.8

Fluoroscopy Design Checklist

Table 4. Checklist about structure of fluoroscopy at governmental hospitals.

Item \ Hospital name	Al-Shifa		Gaza European		Nasser		Al-Aqsa Shohda		Indonesia		Abu Yousef Al Najjar		Total	
	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y%	N%
Is there a control console?	2		1		1		1		1		1		100	0
Is there a toilet inside the room?	2		1		1		1		1		1		100	0
Is a room size at least 36 m^2?	2		1		1			1	1			1	71.4	28.6
Is there a change cubicle?	2		1		1			1	1			1	71.4	28.6
Is there a drainage sewage	2			1	1		1		1			1	71.4	28.6
Are the patient's door entrances at least 180 × 150 cm? (STD)	2			1		1	1		1			1	57.1	42.9

Table 4 clarifies that all of fluoroscopic rooms followed the international standard in terms of control consoles and toilets [4]. In addition, 71.4% of these rooms obey the standards in terms of room size (≥ 36 m^2), have change cubicle and proper drainage of sewage. Fluoroscopy systems may have large machines operated by remote control, control console and much equipment [7,9]. Finally, 57.1% of these rooms have proper patient's door entrance (≥ 180 × 150 cm) [4].

DARKROOM DESIGN CHECKLIST

All darkrooms in medical imaging departments at governmental hospitals were provided with automatic processing machines except Indonesia Hospital have computerized system (Digitalize images). In the current study, 12 processing machines were available in government hospitals. These machines were distributed as 4, 2, 2, 2 and 2 in Al-Shifa, Shohda Al-Aqsa, European Gaza, Nasser and Abu Yousef Al Najjar Hospital, respectively. In terms of product type, four machines were "AGFA product" at Al-Shifa Hospital and eight were "compact product". Finally, four computed radiography machines were available at Al-Shifa, European Gaza, Nasser, and Indonesia Hospital.

Table 5 clarifies that all dark rooms in medical imaging departments at governmental hospitals adjacent to imaging rooms. In terms of a room size, half of dark rooms followed the international standard (≥ 6 m^2) [4]. Around 91.7% of these rooms have drainage sewage and 83.3% have enough space for developing tanks.

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Table 5. Checklist about structure of darkrooms at governmental hospitals.

Item \ Hospital name	Al-Shifa		European Gaza		Nasser		Shohda Al-Aqsa		Indonesia		Abu Yousef Al Najjar		Total	
	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y%	N%
Is the dark room adjacent to imaging rooms?	4		1		2		2		1		2		100	0.0
Is the room size ≥ 6 m^2?	1	3	1		1	1	1	1	1		1	1	50	50
Is there drainage sewage?	3	1	1		2		2		1		2		91.7	8.3
Is there a space for developing tanks?	3	1	1		2		2			1	2		83.3	16.7

EVALUATION OF MEDICAL IMAGING EQUIPMENT

Table 6 clarifies the availability of the main four imaging equipment (i.e., Conventional Radiography and Fluoroscopy) at governmental hospitals. Starting with Al-Shifa Hospital, five conventional radiography machines are available (the sixth one is used as spare machine) and two fluoroscopic machines (one is used as spare machine).

In Nasser Hospital, there are three conventional radiography machines (almost two machines work and one is not working) and one fluoroscopic machine. In Shohda Al-Aqsa Hospital, two conventional radiography machines were available and one fluoroscopic machine. Regarding Indonesia Hospital, only one conventional radiography machine and one fluoroscopic machine (not working). Finally, in Abu Yousef Al Najjar Hospital there are two conventional radiography machines, and one fluoroscopic machine.

Table 6. Availability of radiographic machines.

Medical imaging machine		Al-Shifa Hospital	European Gaza Hospital	Nasser Hospital	Shohda Al-Aqsa Hospital	Indonesia Hospital	Abu Yousef Al Najjar Hospital	Total
Conventional Radiography	Functioning	5	2	2	2	1	2	14
	Not Functioning	1	0	1	0	0	0	2
Fluoroscopy	Functioning	1	0	1	0	0	1	3
	Not Functioning	1	1	0	1	1	0	4

Table 7 demonstrates the status of x-ray machines compared with the international standard. Based on equation [6]. The number of x-ray machines is directly proportion with the number of hospital beds.

Required number of x-ray machines=Number of hospital beds/50

Table 7. X-ray machines existing at governmental hospitals compared to the international standard.

Hospital	No. of beds	Required No. of x-ray machines	Existing x-ray machines
Indonesia	110	2.2	1
Al- Shifa	583	11.6	6
Shohda Al-Aqsa	261	5.2	2
European Gaza	261	5.2	2
Nasser	330	6.6	3
Abu Yousef Al Najjar	49	1	2

Based on equation 1, it is clear that all hospitals suffer from shortage of x-ray machines. Accordingly, the required number of X-ray machines should be at least 2, 11, 5, 5, 6 and 1 in Indonesia, Al-Shifa, Shohda Al-Aqsa, European Gaza, Nasser and Abu Yousef Al Najjar Hospital, respectively. Currently, the existing x-ray machines in medical imaging departments were 1, 6, 2, 2, 3 and 2, respectively.

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EVALUATION OF RTS IN GOVERNMENTAL HOSPITALS

Table 8 demonstrates number of RTs in conventional radiographic rooms at governmental hospitals and number of daily exams. At the morning shift, number of RTs worked at morning shift was 5, 7, 8, 7, 7, 12 in European Gaza, Indonesia, Shohda Al-Aqsa, Nasser and Al-Shifa Hospital, respectively. Based on these values, each RT at the morning shift will carry out 24, 21, 18, 23, 18 and 23, respectively. In parallel, number of RTs worked at evening shift was 5, 2, 4, 3, 2, 4 in European Gaza, Indonesia, Shohda Al-Aqsa, Nasser and Al-Shifa Hospital, respectively. Thus, each RT at the evening shift will carry out 16, 50, 18, 30, 45 and 63, respectively.

In Al-Shifa Hospital, RT was conducted 23 and 63 exams at morning and evening shift, consequently. This imaging value considers the largest percentage compared to the other hospitals especially at the evening shift. For example, RT at Al-Shifa Hospital suspected to radiograph four times more than the RT in European Gaza Hospital.

Table 8. Number of daily examinations to the number of RTs in conventional radiography.

Item	Hospital					
	EGH	Indonesia	S. Al-Aqsa	Nasser	A. Al Najjar	Al-Shifa
Number of RTs at morning shift	5	7	8	7	7	12
Number of exams at morning shift	120	150	145	160	125	270
The number of examination for each RT in morning shift	24	21	18	23	18	23
Number of RTs at evening & night shift	5	2	4	3	2	4
Number of exams at evening & night shift	80	100	70	90	90	250
The number of examination for each RT in evening shift	16	50	18	30	45	63

Table 9 demonstrates the ratio of RTs to the number of daily fluoroscopic exams at governmental hospitals. At the morning shift, each fluoroscopic room, in all hospitals, has only one RT. Based on these readings, each RT at the morning shift will carry out 7, 1, 9 in Nasser, Abu Yousef Al Najjar and Al-Shifa Hospital, respectively. Regarding to evening shift, only Al-Shifa Hospital provides fluoroscopic exams with one suspected case daily.

Table 9. Number of daily examinations to the number of RTs in fluoroscopy.

Item	Hospital		
	Nasser	Abu Yousef AL Najjar	Al-Shifa
Number of RTs at morning shift	1	1	1
Number of exams at morning shift	7	1	9
The number of examination for each RT in morning shift	7	1	9
Number of RTs at evening & night shift	0	0	1
Number of exams at evening & night shift	0	0	1
The number of examination for each RT in evening shift	0	0	1

Table 10 illustrates correlation between patient waiting time and number of exams at morning shift in conventional radiography by using Pearson correlation test. The value of correlation coefficient was 0.779 and p-value was 0.000 (>0.05). This result indicates that there is statistically significant relationship between the tested variables at significance level $\alpha \leq 0.05$. When number of exams increase, patient-waiting time will consequently increase. Actually, the patient-waiting time can reduce by increasing number of radiographic machines.

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Table 10. The relationship between patient waiting time and number of exams at morning shifts in conventional radiography.

Items	Test Statistic	P-value
The relationship between Patient waiting time and number of exams at morning shift	**0.779**	**0.000***

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

DISCUSSION

The current results showed that around 75 % of the RTs aged less than 40 years and around 25% older than 40 years. It is known that medical imaging services need special effort, skill and tolerance (heavy-duty and experience). The current readings presented multiplicity in ages of RTs, which facilitate process of department's management. In addition, around 86.5% of RTs were permanent employees and 10.0% of them were contracts, and six (3.5%) were volunteers.

Regarding RTs gender, the current results are completely differing than the international readings (60-70% female and 30-40% male) [10].

Respecting to rooms that have windows, they are only at Al-Shifa Hospital at different height levels without lead shielding. According to the international standard, no window should be in radiographic room and in case of exist these windows must be lead shielded.

In concerning to change cubicle, it should be close to X-ray room and may design as individual changing rooms, which open directly into the X-ray room. This will allow for changing arrangements consistent with good radiation protection practice, greater privacy, security and perhaps faster patient throughput [5].

No medical imaging department fulfills the international standard. In the GS, several difficulties and obstacles faced in the developing of medical field particularly the medical imaging field. These obstacles related to high cost of equipment and siege imposed on the GS. Finally, the occupation prohibited the import of equipment and related spare boards and parts [11].

Regarding to fluoroscopic rooms, It is well known that radiation dose of fluoroscopic machine is significant and higher than X-ray machine. A serious problem can observe at Al-Shifa Hospital. Thus, RT at this hospital suspected to perform 2 to 8 cases more than Nasser and Abu Yousef Al Najjar Hospital, respectively. Consequently, duplication in radiation dose is highly expected for RTs at Al-Shifa Hospital compared to other hospitals.

CONCLUSION

Radiographic departments in the governmental hospitals were evaluated based on international standards. The evaluation was conducted based on several questions through face-to-face interview with the RTs at governmental hospitals and through personal interview with medical imaging administration. The number of RTs was dramatically increased (~5 times more) during the last twenty years. Four-fifths of RTs were males and aged less than 40 years. Significant overload on RTs was remarked in all medical imaging departments at governmental hospitals, especially at evening and night shift. Statistical significant relations were observed between excess number of exams at morning shift and patient waiting time in Conventional Radiography.

Regarding conventional X-ray machines, 16 machines were available and almost all ready for use; five fluoroscopic machines were obtainable, but about half were not functioned. Comparing with the international standards, there was shortage in number of X-ray machines at all medical imaging departments.

In conclusion, around 45% of all Conventional Radiography structure at governmental hospitals adapted the international standard and 74% of radiographic equipment is functioning. Regarding fluoroscopy rooms and Darkrooms, 79% and 81% followed the standard, respectively.

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