

Quantitative Assessment of Medical Waste Management in Hamad Medical Corporation—Qatar

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Abstract

A proper waste management system is very important in healthcare facilities because the overall benefit outweighs the cost. In the healthcare sector, hazardous health care waste (HHCW) consists of wastes that are potentially contaminated by dangerous agents. Identification and segregation of HHCW is harbinger for its proper management. The quantitative analysis study on HHCW had not been done in Qatar government hospitals. This study quantitatively analyzed the current practice for HHCW management in Hamad Medical Corporation (HMC), Qatar. The objective of this study is to provide a first comprehensive assessment of hazardous healthcare waste managements in Qatar and offers an opportunity to improve existing practice. This is a retrospective survey study carried out on secondary data collected from the department of occupational health and safety (OHS), HMC. OHS department collects and keeps records of hazardous wastes produced by HMC. Data on the HMC hospitals' characteristics from 2017 to 2019 were retrieved from Planning and Statistics Authority's website. World Health Organization (WHO) formula for calculating HHCW generation rate was used to calculate the rate for HMC. Data analysis results show a steady increase in HHCW generation rate in HMC, the generation rate was 2.6 Kg/patient bed/day, 2.8 Kg/patient bed/day and 3.1 Kg/patient bed/day for the years 2017, 2018 and 2019 respectively. There were also significant variations in HHCW generation rates between hospitals. The highest generation rate was 4.64 Kg/patient bed/day recorded for AWH and the lowest was 0.2 Kg/patient bed/day recorded for mental health and both hospitals contributing 23.18% and 0.29% respectively of HHCW in HMC.

Keywords

Hazardous Healthcare Waste, Quantitative Analysis, Generation Rate, World Health Organization, Hamad Medical Corporation Qatar

1. Introduction

Global campaign for proper waste management is critical for the conservation of our environment and public health promotion. The environmental, health and economic benefits of proper management and control of healthcare wastes had been reported by several authors [1] [2] [3]. The concept of waste has different meanings to different individuals and nations. However, generally wastes are categorized into two broad groups: hazardous and non-hazardous wastes [4] [5] [6]. In the healthcare or medical sector, hazardous wastes consist of wastes that are potentially contaminated by biological, chemical, or physical agents that possess health or environmental hazards [7] [8] [9] [10]. Several studies had suggested that a typical general hospital in any country worldwide produces about 80% non-hazardous and 20% hazardous wastes. The hazardous group is composed of about 15% pathological waste, 3% chemical waste, 1% sharp waste, and less than 1% special waste such as cytotoxic, broken thermometers, pressurized containers, radioactive waste and used batteries [9] [11] [12].

These reported proportions are not far from World Health Organization (WHO) estimates for hazardous and non-hazardous healthcare wastes. WHO estimated that each country globally has a generation rate of healthcare waste ranging from 0.5 to 3.0 Kg/bed/day [7] [8] [13]. According to WHO (2014) report, high-income countries on average may generate up to 0.5 kg of hazardous medical waste per hospital bed per day whereas low-income countries generate on average 0.2 kg per hospital bed per day. However, this quantity can vary in the developing or low-income countries due to lack of proper waste identification and segregation practices. The volume and composition of the waste stream produced by healthcare depend on many factors which include the specialties and size of the hospitals, the segregation process applied, and available laws and policies [9] [11] [12] [14].

Approximately 90% of hazardous healthcare waste is infectious by nature. Infectious healthcare wastes are wastes that may be produced during the diagnosis, treatment or immunization of humans or animals, or during the research activities pertaining thereto, or in the production or testing of biologicals [15] [16] [17] [18]. Hazardous medical wastes are unique forms of wastes that require absolute care and management because of its origin and negative public perceptions about its characteristics. This type of waste needs a proper treatment to avoid the risk of presence of pathogens in substantial quantities that may lead to the spread of diseases through air, water, and contact [16] [17] [19]. Globally, different management and treatment methods for infectious healthcare waste

have been developed and applied across different countries [16]. Waste identification, segregation, packing, and decontamination are among common practices worldwide however, significant variations in process, magnitude and scope exist. Among observed decontamination methods for treating infectious medical waste includes thermal incineration, steam sterilization, microwaving, irradiation, and chemical disinfection [9] [11] [12].

Identification and segregation of medical waste is a harbinger for its proper management. These two processes are directly linked to infectious waste magnitude within a hospital setting [13]. Poor medical waste identification and segregation often result in an increase in hazardous waste generation per patient bed per day. This in turn results in a significant increase in the demand for waste management resources [16] [17]. World Health Organization (WHO) had suggested a quantitative analysis of healthcare waste among healthcare establishments. This analysis provides an ideal method to determine waste generation rate and waste assessment process that offer an opportunity to improve the existing practices. Medical waste has not received appropriate consideration in developing countries and some Middle East countries [1] [3] [7] [13].

In Qatar, the quantity of healthcare waste is rapidly increasing as a result of the rapid establishment of numerous medical care facilities in the country in the last few years. In recent years growing interest and implementation of healthcare waste management systems have been contributing to the protection of public health in Qatar. The healthcare waste management system emphasizes the need to train healthcare workers on proper handling, segregation, storage, and disposal of healthcare waste in order to prevent the health risk to the individual, general population and the environment [1] [10].

Hamad Medical Corporation (HMC) is the largest healthcare provider in Qatar. The organization composed of 14 Joint Commission International (JCI) accredited tertiary hospitals including the country's ambulance service. Many more health facilities under HMC are waiting commissioning. HMC healthcare waste management system includes a hazardous materials and waste management program. The objective of the program is to achieve excellent waste management through proper waste identification, segregation, packaging, waste tracking system and proper treatment and safe final disposal. The hazardous materials and waste management program was developed in response to the Guideline of Health Care Waste Management issued by Council of Ministers Qatar.

Several researches on healthcare waste management are available in different countries worldwide. However, no such study on healthcare waste had been carried out in any of the tertiary hospitals in Qatar. The need for empirical analysis of healthcare waste generation among HMC hospitals is inevitable. The objective of this study is to quantitatively analyze the current practices in healthcare waste management among HMC hospitals in Qatar. The study focuses mainly on hazardous (infectious) waste magnitude and generation rate. The waste generation rate will be portrayed through active bed capacity within each hospital and as

collectively. Secondly, results from this study will be compared to WHO health-care waste estimate reports and estimate reports from other countries especially countries belonging to Gulf Cooperation Council (GCC).

2. Methods

This study was carried out in ten (10) governmental tertiary hospitals under Hamad Medical Corporation (HMC) in Qatar. The hospitals are Al Khor Hospital (AKH), Al Wakra Hospital (AWH), Communicable Disease Center (CDC), Hamad General Hospital (HGH), Hearth Hospital (HH), Mental Health Services (MHS), National Center for Cancer Care & Research (NCCCR), Rumailah Hospital (RH), The Cuban Hospital (TCH), and Women's Wellness & Research Center (WWRC). The characteristics and description of the hospitals are shown in **Table 1(a)** and **Table 1(b)** respectively. This includes the number of active beds, number of Units/Departments, and number of employees in each hospital for 2017 to 2019.

The Healthcare Wastes (HCW) generated from these hospitals are centrally managed by two corporate departments—Hospitality Department and Occupational Health and Safety (OHS) Department. The Hospitality Department is responsible for the collection, packaging, labelling, and transportation of all HCW generated from every of the hospitals. The non-hazardous HCW is transported to government landfill for possible recycling and final disposal by the Ministry of Municipality and Environment, Qatar.

The Hazardous Healthcare Waste (HHCW) is transported to Waste Treatment Plant (WTP) controlled by Environmental Safety Section of OHS Department (ESS-OHS). At the WTP, the wastes are measured and the weight of different categories of waste is recorded. ESS-OHS operates four (4) medical WTP in Qatar. The WTP's treatment technology uses autoclave with integrated shredding which decontaminate and shred the infectious HHCW. Other HHCW are treated off-site by incineration provided by licensed private company.

3. Data Collection

Environmental Safety Section of Occupational Health and Safety Department (ESS-OHS) collects and maintained records of hazardous healthcare wastes (HHCW) generated from individual hospitals of HMC. 2017, 2018, and 2019 wastes records for individual hospitals were extracted from the master record of HHCW maintained by ESS-OHS. The wastes data collected for individual hospital includes infectious wastes, sharp wastes, pathological wastes, and cytotoxic wastes (**Table 2**).

The collected wastes data were organized using Microsoft Office Excel and the total annual wastes generated were calculated for 2017, 2018, and 2019. The HHCW generation rate (kilogram of wastes per patient bed per day) was calculated using the modified World Health Organization formula: HHCW generation rate is equals to total weight of HHCW in kilograms per year divided by the product of number of days in a year and number of active beds.

Table 1. (a) Characteristics of HMC hospitals; (b) Brief description of studied HMC hospitals.

(a)				
Hospital	Year	Characteristics of Hospital		
		Number of Active Beds	Number of Units/Departments	Number of Employees
Al Khor Hospital (AKH)	2017	113		980
	2018	113	35	980
	2019	172		1470
Al Wakra Hospital (AWH)	2017	326		3337
	2018	326	70	2351
	2019	295		2518
Communicable Disease Center (CDC)	2017	65		228
	2018	65	18	281
	2019	65		303
Hamad General Hospital (HGH)	2017	678		5298
	2018	663	73	6030
	2019	678		6120
Heart Hospital (HH)	2017	116		1111
	2018	114	37	1098
	2019	116		1282
Mental Health Services (MHS)	2017	77		399
	2018	77	12	470
	2019	116		560
National Center for Cancer Care & Research (NCCCR)	2017	65		659
	2018	61	30	707
	2019	60		739
Rumailah Hospital (RH)	2017	294		1795
	2018	377	40	1723
	2019	344		1644
The Cuban Hospital (TCH)	2017	72		472
	2018	72	32	497
	2019	72		665
Women's Hospital (2017) Women's Wellness and Research Center (2018-2019) (WWRC)	2017	354		1600
	2018	339	39	1800
	2019	340		1938
(b)				
Hospital	Description			
Al Khor Hospital (AKH)	Al Khor Hospital is a general hospital and one of HMC's community hospitals in the northern region of Qatar. The hospital hosts an Antenatal and Postnatal Exercise Center, as well as a Breastfeeding Resource Center. It also has Emergency Department, Intensive Care Unit, Pediatrics, Obstetrics and Gynecology, Radiology, Dermatology, Psychiatry and Surgery Departments.			

Al Wakra Hospital (AWH)	Al Wakra Hospital is a general hospital in the south of Qatar serving the towns of Al Wakra and Mesaieed. The hospital offers range of general hospital diagnostic and treatment services for outpatients, inpatients, and day care patients. It has capacity for general, acute patients, critical care, high dependency, observation/day beds, and burn patients of all ages. It has the largest hospital building in Qatar with its own Central Sterile Services Department, Mortuary, Laboratories, Laundry, Supply Chain Warehouse, Engineering Services, and Waste Treatment Plant.
Communicable Disease Center (CDC)	The Communicable Disease Center is a specialist tertiary center which has 65 single-isolation rooms with outpatient services that support and treat patients with a spectrum of communicable diseases. The hospital specialized in tuberculosis (TB) and other infectious disease management. It offers diagnosis, treatment, and prevention of infectious disease as well as education and research.
Hamad General Hospital (HGH)	Hamad General Hospital is a general hospital located in Doha which offers wide range of medical care and clinical services including emergency medicine, pediatrics, critical care, specialized and sub-specialized surgeries, specialized medicine, laboratory medicine, diagnostic and adult rehabilitation services. It also has Mortuary, Central Sterile Services Department, Laboratories, Supply Chain Warehouse, Engineering Services, Laundry, and Waste Treatment Plant.
Heart Hospital (HH)	Heart Hospital is a specialist hospital for cardiology and cardiothoracic surgery patients. It offers specialized care and cardiology services for patients including cardiac and thoracic surgery, open heart surgery and emergency cardiac services. The hospital has its own clinical imaging department delivering cardiac computed tomography (CT), cardiac isotope studies and a full range of diagnostic procedures. It also has dedicated nephrologists and a dialysis service.
Mental Health Services (MHS)	Mental Health Service provides specialized mental health care and treatment to a range of acute and community-based services which includes consultation/liaison, inpatients, and emergency services. It has outpatient clinics for adults, adolescents, and children. They also provide therapies such as psychology and psychotherapy.
National Center for Cancer Care & Research (NCCCR)	The National Center for Cancer Care and Research is the primary cancer hospital in Qatar. It takes care of patients who require constant treatment such as chemotherapy and radiotherapy, treats blood conditions, it also provides Bone Marrow transplant. The facility also offers services such as urgent care, hematology, oncology, and palliative care. The hospital houses Positron Emission Tomography-Computed Tomography (PET CT) scanner to detect and monitor cancers to improve patient outcomes.
Rumailah Hospital (RH)	Rumailah Hospital is a multi-specialty hospital that offers specialized care and services including dermatology, surgical services for ear, nose, throat (ENT), ophthalmology and plastic surgery, physiotherapy, geriatric, and long term care.
The Cuban Hospital (TCH)	The Cuban Hospital, located in Dukhan, Qatar. The hospital offers specialized care and services including dentistry, gynecology, diabetes, dermatology, ENT, and audiology, emergency services for children and adults and general medicine.
Women's Wellness and Research Center (WWRC)	Women's Wellness and Research Center is the country's largest tertiary hospital dedicated to women's health. It offers expertise in areas including antenatal, gynecological, and neonatal care, with a wide range of clinical services for inpatients, outpatients, expectant parents, and new parents.

Table 2. HMC Hospitals Hazardous Healthcare Wastes (HHCW) generation from 2017-2019.

HOSPITALS	TYPE OF WASTES	YEAR/WEIGHT (Kg)		
		2017	2018	2019
Al Khor Hospital (AKH)	Infectious Wastes	83,346	99,858	107,969
	Sharp Wastes	31,188	18,326	13,146
	Cytotoxic Waste	2	13	0
	Pathological Wastes	859	771	837
	TOTAL	115,395	118,968	121,951
Al Wakra Hospital (AWH)	Infectious Wastes	414,593	529,608	604,050
	Sharp Wastes	15,912	15,505	15,860
	Pathological Waste	3332	2512	2235
	Cytotoxic Waste	226	47	81
	TOTAL	434,064	547,672	622,226
Communicable Disease Center (CDC)	Infectious Wastes	53,379	60,232	65,180
	Sharp Wastes	31	2815	3532
	Cytotoxic Waste	0	8	0
	TOTAL	53,410	63,055	68,712
Hamad General Hospital (HGH)	Infectious Wastes	602,782	664,946	739,570
	Sharp Wastes	129,792	65,930	70,033
	Pathological Waste	1626	8979	13,586
	Cytotoxic Waste	736	811	285
	TOTAL	734,937	686,770	823,474
Heart Hospital (HH)	Infectious Waste	54,305	68,259	79,332
	Sharp Wastes	11,155	9705	11,876
	Cytotoxic Waste	0	3	0
	TOTAL	65,460	77,966	91,208
Mental Health Services (MHS)	Infectious Wastes	5281	5775	5908
	Sharp Wastes	1184	1039	751
	TOTAL	6,465	6,814	6,658
National Center for Cancer Care and Research (NCCCR)	Infectious Wastes	55,190	51,302	65,112
	Sharp Wastes	11,332	8219	9500
	Cytotoxic Waste	6311	6772	7777
	TOTAL	72,833	66,293	82,389
Rumailah Hospital (RH)	Infectious Wastes	280,627	345,971	308,021
	Sharp Wastes	14,573	15,705	17,899
	TOTAL	295,200	361,676	325,920

The Cuban Hospital (TCH)	Infectious Waste	73,273	79,587	80,355
	Sharp Wastes	3194	1664	4308
	Pathological Waste	720	867	709
	TOTAL	77,186	82,118	85,371
Women's Hospital (2017) Women's Wellness and Research Center (2018-2019) (WWRC)	Infectious Wastes	184,740	252,069	320,774
	Sharp Wastes	10,979	12,923	12,528
	Pathological Waste	10,748	10,624	11,336
	Cytotoxic Waste	65	114	117
TOTAL	206,532	275,731	344,755	

$$\text{HHCW generation rate} = \frac{\text{Total HHCW weight kg/year}}{(365.24 \text{ days})(\text{number of active beds})}$$

Finally, the combined data from each of the ten facilities was used to estimate the average HHCW generation rate for HMC in 2017 to 2019.

4. Results and Discussion

The data findings from the HMC demonstrates that from the ten samples of the different healthcare facilities, HGH had the largest number of active beds between 2017 to 2019 with 678, 663 and 678 respectively (**Table 1(a)**). This means that HGH served the majority of patients within the HMC. Chances were very high that most of the patients came from other branches to HGH for treatment. However, the facility that had the lowest number of active beds was the NCCCR, which had approximately, 65, 61, and 60 between 2017 to 2019 sequentially, which means that it served the lowest number of inpatients (**Table 1(a)**). The difference between the two facilities within the same period was 613, 601, and 613 correspondingly. The variation was quite large as it was almost ten times despite the fact that the number of units differed with around half, where HGH had 73 units while the NCCCR had 30 units, which means that they differed with 43 divisions (**Table 1(a)**). Furthermore, HGH had 5298, 6030 and 6120 employees between 2017 to 2019 respectively while NCCCR had 659, 707 and 739 (**Table 1(a)**).

The HHCW that have been collected from HMC waste treatment plant represented that HGH had the highest amount of wastes collection within the three years period of 2017 to 2019 respective. The quantities were 734,936.65 kgs, 686,770.10 kgs and 821,251.20 respectively, which signified that a reduction in the number of active bed contributed to the decline of the waste quantity and that an increase in the number of active beds led to the increase of the number of hazardous waste (**Table 2**). Farther, the infectious wastes productions were the most maximum, while the cytotoxic wastes were the most insignificant. This aspect was clear that the facility had a high number of infections wastes; thus, individual in such places were highly vulnerable to such problems. On the other hand, MHS had the lowest number of the medical waste generations, which was

6464.60, 6813.90 and 6658.20 between 2017 to 2019, respectively (Table 2). The infectious wastes were 5281.00, 5774.50 and 5907.60 between the three years period (Table 2).

The HMC yearly average HHCW production rate showed that creation of hazardous wastes within the 10 facilities was high in 2019 with approximately 3.1 while in 2018, it was 2.8 and the lowest in 2017 that had 2.6. From the data shown in Figure 1, it was apparent that 2017 had the lowest numbers of patients who visited the different health care facilities while the number increased in 2018 with approximately 20%. Additionally, in 2019 the rate improved by 30% which illustrated a further increase in the number of people who attended the hospital. This aspect means that between 2017 and 2019, the rate HHCW contrasted by 50%. From the analysis, the health status in the society continued to decline within the same period causing more hospital admission rates forcing doctors to apply more treatment supplies. This indicates that the society suffered higher infection rates in 2019 compared to 2017 and 2018.

Figure 2 demonstrates the HHCW generation in the number of patient attendances per month to the several HMC facilities from the year 2017 to 2019. The number active beds in HMC facilities in 2017 rose steadily to the highest level of 2260 compared to 2018 whereby it posed a significant reduction of 15%. This indicated that the prevalence of diseases in the year 2017. HGH recorded

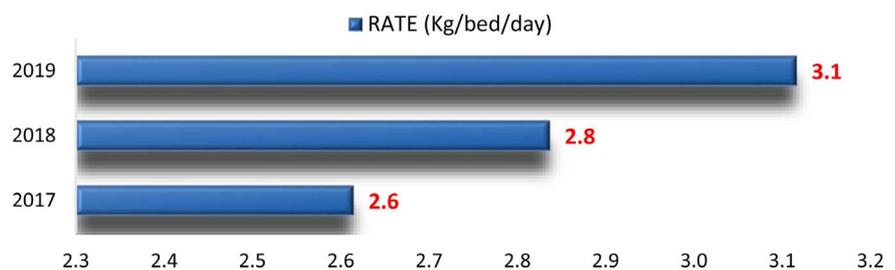


Figure 1. HMC yearly average hazardous healthcare waste generation rate.

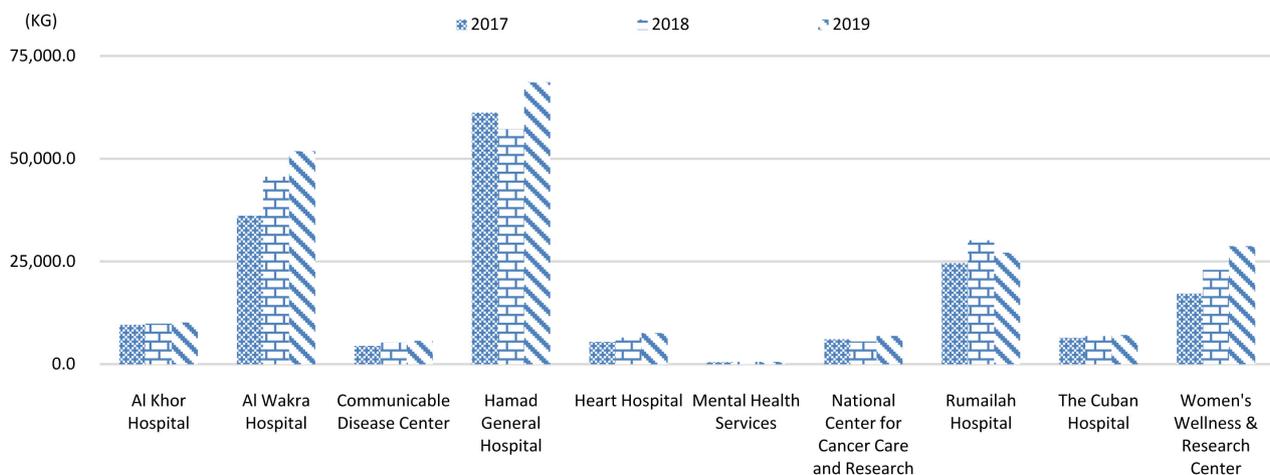


Figure 2. HMC monthly average hazardous healthcare waste generation from 2017 to 2019.

the highest number of patients and active beds throughout the month while Mental Services facility recorded the least cases of patient and active beds. The HGH amounted to almost 60% of the prevalence cases as indicated on the graph while other facilities recorded a minimum of 40% of the cases. However, the analysis provided an overview of the HHCW generation on patient attendance per month. From this observation, the prevalence of diseases mostly occurs on the spring. This is due to cold weather experienced during the season. In addition, the number of employees' recruitment in HMC facilities declined by 5% in 2019 due to less infections and patient attendance to most of its facilities.

Figure 3 demonstrates HHCW percentage contribution per HMC facility from 2017 to 2019. HGH had the highest percentage of 32.4%, and MHS had the lowest value of 0.3%. The difference between the two facilities was 32.1%, which was quite huge. From these data, it is clear that the ratio between the volumes of the HHCW at HGH related to the number of the active beds that was quite high in comparison with other healthcare facilities thus making it to have the highest percentage. Another factor that might have caused this scenario is the generation of high amounts of HHCW that was inversely proportional to the number of active beds in different units of the HGH. On the other hand, the MHS facility had few HHCW compared to other hospitals and thus providing the least amount of HHCW percentage.

In **Table 3**, the information on the ranking based on number of beds, the percentage of HHCW generation, rate of every patient occupying each bed illustrated unique findings. For example, the quantity of the active beds was high at the HGH, which had a value of 2019 active beds, while the lowest was NCCCR that had 186 active beds. This aspect was clear that HGH served the highest number of patients while NCCCR attended the lowest number between 2017 to 2019. Additionally, using the percentage of the HHCW contribution, HGH was still heading with 32.43%, which showed that the HGH had the highest number of patients and hence generated the highest quantities of HHCW. In contrast, MHS had the lowest rank of 10. These results indicate that the facility used a few

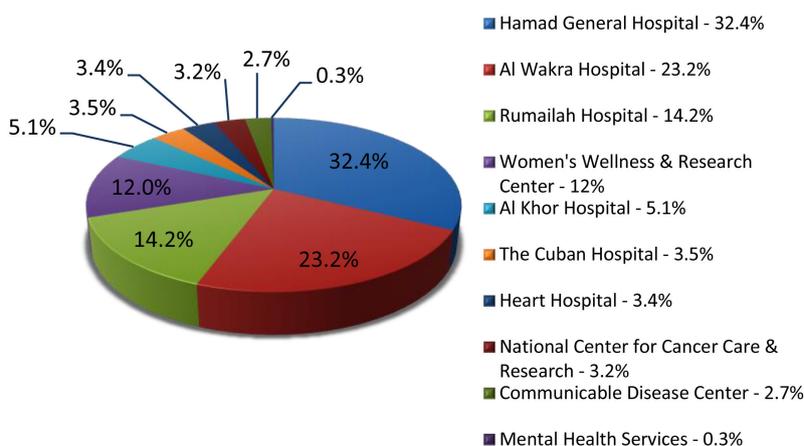


Figure 3. HHCW percentage contribution per HMC hospital from 2017 to 2019.

Table 3. HMC hospitals rank order based on number of active beds, percentage (%) HHCW contribution and HHCW generation rate from 2017 to 2019.

HOSPITAL	Total No. of Active Beds	Rank	% HHCW Contribution (Kg)	Rank	HHCW Generation Rate (Kg/patient bed/day)	Rank
Hamad General Hospital	2019	1	32.43%	1	3.04	4
Women's Wellness & Research Center	1033	2	11.95%	4	2.19	8
Rumailah Hospital	1015	3	14.20%	3	2.65	5
Al Wakra Hospital	947	4	23.18%	2	4.64	1
Al Khor Hospital	398	5	5.15%	5	2.45	7
Heart Hospital	346	6	3.39%	7	1.86	9
Mental Health Services	270	7	0.29%	10	0.20	10
The Cuban Hospital	216	8	3.54%	6	3.10	3
Communicable Disease Center	195	9	2.68%	9	2.60	6
National Center for Cancer Care & Research	186	10	3.20%	8	3.26	2

quantities of HHCW as they protected the victims of this facility from interfering with the HHCW, which contributes to greater challenges within the hospital. Additionally, the HHCW accumulation rate per individual's bed was highest at AWH, which had 4.64%, while the lowest was MHS, which had 0.20%.

The graph in **Figure 4** illustrates the average HHCW generation per patient bed per hospital from 2017 to 2019. Based on the analysis of the graph, HGH produced the highest volume with approximately 2,245,181 cases while the least was MHS, which it depicted 19,937 cases. HGH contributed to 32.43% of the total number of beds from 2017 to 2019 while MHS provided the minimum percentage of 0.29% to the total number of beds. However, the analysis interpretation brought into account that HGH had the highest medical waste that approximates to almost 58% of the total waste in HMC hospitals. It has an average of 3.04 in kg per bed per day, which is slightly less to AWH that constitutes to 4.64. Although HGH posed a higher medical waste than AWH, the rate of the AWH in HHCW generation per patient per bed is slightly higher because it handles chronic patients who might tend to seek medication longer. This analysis creates a great impact in healthcare service delivery to HMC hospitals in a way that it allows proper decision making and enhancing safety and recovery amongst its clients.

The graph in **Figure 5** demonstrates the HHCW generation in kgs in different seasons from 2017 to 2019. Based on the analysis, the highest volume of HHCW generations was in 2017 appeared in spring with a total of 540,362.50 kgs, and

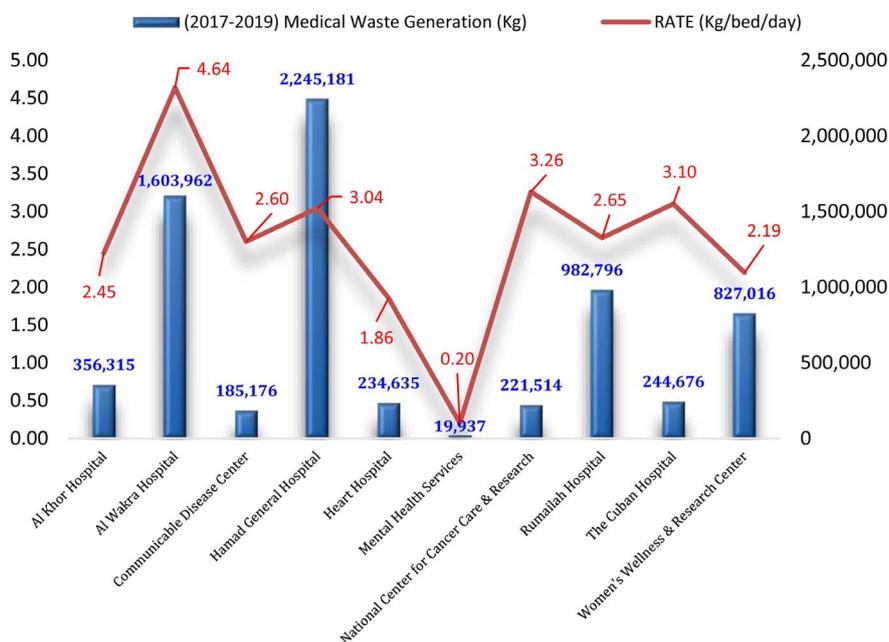


Figure 4. HMC hospitals average HHCW generation rate from 2017 to 2019.

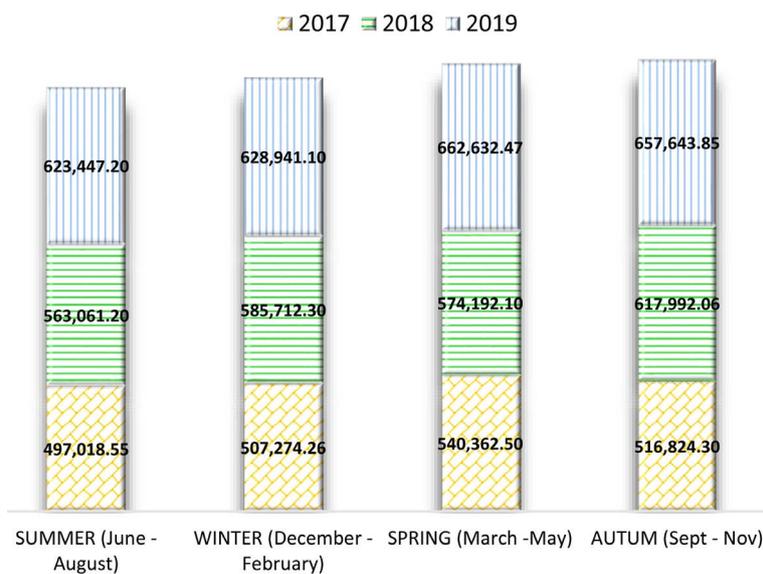


Figure 5. HHCW generation (Kg) per qatar season from 2017-2019.

the lowest in summer with 497,018.55 kgs. In 2018, the most significant quantities occurred in autumn with 617,992.06 kgs, while the lowest was 563,061.20 in summer. Additionally, in 2019 the largest amounts of HHCW were 662,632.47 kgs in spring and the most lower during this period was 623,447.20 kgs occurred in summer. These results indicate that most people became sick in the autumn season as illustrated in 2017 and 2019, which had the highest quantity of HHCW. However, the overall findings from Figure 5 are that the summer season over the three years experienced the lowest quantities of HHCW generation. This aspect occurs because during this time, the weather is conducive and hence

hospitals receive reduced numbers of patients, as they don't fall sick regularly. This aspect results in generation fewer amounts of HHCW. Therefore, seasons play a critical role in the determination of the HHCW.

This observed rate corresponds to WHO estimated HHCW generation rate. WHO estimated that each country globally has a generation rate of HHCW ranging from 0.5 to 3.0 Kg/bed/day [7] [8] [13]. Compared to the results from some other countries in the Middle East, Qatar HHCW generation rate is lower to Iran, Jordan, and Kuwait average HHCW generation rates which were 3.03 Kg/patient bed/day, 3.44 Kg/patient bed/day and 3.81 Kg/patient bed/day respectively [7] [20] [21]. However, the results from studies in Palestine and Saudi Arabia shows a lower generation rate 0.85 Kg/patient bed/day and 0.51 Kg/patient bed/day compared to result from Qatar [7]. Studies from Ethiopia and Uganda, two African countries show generation rates of 3.46 Kg/patient bed/day and 0.25 Kg/patient/day respective [22]. Results from all countries worldwide indicated that HHCW generation rates were affected by multiple factors, which include waste identification, segregation, policies, and study duration. Compared to most studies from other countries where study results were gotten from short term HHCW assessment and analysis, this study comprised of a three-year assessment of HHCW and possesses a higher external validity in relation to many studies in other countries were only few healthcare facilities were enrolled for study.

5. Conclusion

The result of this empirical analysis of HHCW generated from HMC shows an overall average generation rate value of 2.833 Kg/patient bed/day. The result of this study indicates a moderate HHCW generation rate. Seasons play a critical role in the determination of the HHCW.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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