



## Evaluation of Waste Management Practices at Burjeel Hospital Abu Dhabi, UAE

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### Abstract

**Purpose:** The purpose of this research was to find out the waste management practices being carried out in Burjeel Hospital Abu Dhabi, UAE. Appropriate waste management practices are very important for the safety and well-being of all hospital staff, patients and also for a safe and healthy environment.

**Study Design:** Deductive approach was adopted whereby hypotheses were formulated followed by preparation of a research instrument i.e. a well-structured questionnaire for data collection. The study is explanatory in nature.

**Place and Duration of Study:** This study was undertaken at Burjeel Hospital located in Abu Dhabi, UAE. Waste handlers belonging to different departments were approached for obtaining their views. This is a cross-sectional study which was undertaken within two months in January to March 2018.

**Sample and Methodology:** Adopting convenience sampling technique, primary quantitative data were collected through a questionnaire, from a sample of 107 healthcare waste handlers belonging to different departments of Burjeel Hospital Abu Dhabi. The data were treated through statistical tools Pearson's Correlation, Regression analysis and T-test with the help of SPSS, version 23.

**Results:** In case of 'Waste Collection and Segregation' beta value is 0.401 and p value is 0.000 (less than 0.01), which indicates that it is a useful estimator and creates a positive impact on Effective Waste Management. The p value of the second independent variable is 0.000 (<0.01) and beta value is 0.361; it shows that this variable is also a useful estimator and its impact is significant. For the third independent variable, beta value is 0.053 whereas p value is 0.492 (>0.01); it means that this variable creates a positive impact on Effective Waste Management which is not significant. Hence, 'Waste Collection and Segregation' and 'Waste Handling and Storage' are useful estimators of Effective Waste Management but 'Waste Treatment and Disposal' is not a useful estimator.

**Conclusion:** Data analysis has revealed that waste management practices are being carried out satisfactorily in different departments of Burjeel Hospital Abu Dhabi. Out of three variables mentioned above, only 'Waste treatment and disposal' is not significantly contributing towards Effective Waste Management; hence one hypothesis is rejected. The waste management system requires proper disposal planning, implementation of the plans for hazardous healthcare waste management and supervision of the practices being carried out. Other hospitals may also benefit from this study and may conduct their own waste management audit for ascertaining effectiveness of existing waste management practices. The study is equally useful for other hospitals of the healthcare industry.

**Keywords:** Waste Generation/Collection and Segregation; Waste Handling and Storage; Waste Treatment and Disposal; Healthcare Waste Management

### Introduction

Waste generation and environmental pollution have turned into an incredible concern during recent few decades. The reasons identified with these concerns are related with the individuals, their ways of life and patterns of utilization/consumption which have resulted in generation of large volumes of waste of different types [1]. Each health care center must have a waste administration policy and a waste management plan. Through the policies and plans, standard working systems could be set out which could characterize the working methodology, operating procedures, training,

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roles and responsibilities of service representatives (employees) taking up various waste management assignments. The healthcare waste created because of the enhanced and extended medical services is a combination of risky and non-risky materials. Apparently, the hazardous (risky) waste which is around 10% to 25% of the total waste produced in Abu Dhabi Hospitals, ends up damaging the environment with its toxins. According to the specifications and conditions specified by Center of Waste Management and Health Authority, Abu Dhabi (HAAD). Dealing with this type of waste is an extremely difficult task for the government authorities, Abu Dhabi faces a serious danger with regards to hospital waste management [2,3].

Hospital waste management is considered quite dangerous in developing nations. The poor management of hospital waste is related with expanded risk of spread of severely deadly diseases. The dangerous component of hospital waste *i.e.* infectious waste makes around 33% of aggregate waste produced in health care hospitals. The management of waste is a worldwide concern because of the increase in the population in the urban areas, as compared to rural areas. Concerns arise when the systematic management of waste is not properly done. The systematic waste disposal helps address issues related with wellbeing, environmental factors, resources, and economic concerns. The waste produced is a great concern for the population everywhere including the people, groups, local authorities, non-government authorities and government authorities of Abu Dhabi. The principle purpose behind the inappropriate strategies for hospital waste management is lack of assets and lack of awareness too. In spite of the fact that the models were there for direction, before rather than environmental and financial concerns were of core interest. It has been in recent years that government authorities, stakeholders, groups and non-government organizations, have been a part of this chain of systematic activities engaged with effective waste disposal [4,5].

### **Profile of Burjeel Hospital, Abu Dhabi, UAE**

Burjeel Hospital is Abu Dhabi's largest private Tertiary care hospital, is focused on providing patients with a complete scope of tertiary care hospital services supported by newest advanced technology, qualified and trained clinicians. Highly experienced, specifically trained and committed team of medical professionals. Burjeel Hospital has been recognized by the Joint Commission International, highest International standards of safety and care that can be achieved by a Hospital. It has 209 patient beds, 14 beds ICU, 14 Emergency beds, 2-Endoscopy Suites, 13 Neonatal Intensive Care Unit beds, 5 Newborn beds, 26 Day Care beds, 10 Operation Theatres to provide inpatient facility covering all aspects of medical and surgical specialties.

On Waste Management side, the hospital is heavily focusing on the appropriate collection, segregation, handling, storage, treatment and disposal of medical waste to prevent it from being a health risk to humans, either through contact with sharps puncturing the skin, spreading infection. Medical waste may also include laboratory waste, on which tests have been done which again could be infectious. Tadweer (The Center of Waste Management - Abu Dhabi) includes waste transportation, treatment, recycling, in the Emirate of Abu Dhabi. For waste collection, it provides biodegradable bags, Sharp boxes and yellow colored bags used for disposable syringes and for scissors. Similarly, for shifting of garbage from wards to selected collection place, it provides trolleys, dustbins, plastic bags, *etc.*,

Furthermore, Drivers and waste handlers of the medical waste management service are trained and well-found with personal protective equipment such as uniforms, aprons, medical gloves, masks, safety shoes, *etc.*, Garbage trucks along with a tractor are also available for transportation of non-infectious waste from Burjeel Hospital to municipal land filling area. Approximately 120 tons of hazardous waste per month is produced in Abu Dhabi's hospital that is burnt according to specifications in the incinerator. As the population of the Emirates is further growing, Abu Dhabi plans to increase its capacity in terms of medical waste.

Healthcare waste management by and large and particularly the hazardous waste has turned into a worldwide concern for the healthy living. The hazardous waste is just a one quarter of the total waste generate yet at the same time the management of this segment of waste is a threat. Despite the fact that the guidelines for safe management are not new to all the concerned working staff managing the waste, the issues still exist. Poor waste management has resulted in spread of diseases and may lead to loss of human life. It is therefore very important to have regular reinforcement of the rules by conducting safe management workshops; regular rounds should be taken for supervision of the practices to ensure proper waste management. This study aims at evaluating the existing waste management practices including (collection/generation of hospital waste, transportation, waste treatment, disposal within and outside hospital premises), followed in various wards and departments of Burjeel Hospital, Abu Dhabi. Following objectives were set for this study:

- To examine the existing 'collection and segregation' of waste management practices at Burjeel hospital for its contribution to overall effective waste management.
- To investigate the awareness of waste handlers at Burjeel hospital and their contribution to effective waste management.
- To find out the impact of waste treatment and disposal on healthy green environment.

- To propose measures to the hospital for enhancing waste management practices.

### **Literature Review**

#### **Significance of waste management**

The health of healthcare workers or hospital staff and patients may be directly or indirectly in danger with incorrect practices for hospital waste management [6]. According to WHO, healthcare waste refers to medical waste generated by healthcare services, such as disposable syringes, dirty dressings, any body parts for diagnostic samples, blood, chemicals, pharmaceuticals medicines, medical devices and radioactive constituents. Hospital facilities create a great quantity of waste but just a single quarter of that waste represent a risk to the patients, staff and nature. So as to diminish the dangers, it is essential to think about techniques, to reduce the high rates of waste generation.

Waste generation by and large and particularly hospital waste is a test and challenge, the waste generated in hospital's if not managed properly could be a risk for healthy living [1]. Waste generation has increased everywhere throughout the world with the expanding population day by day and utilization patterns, in such manner health care sector is no exception as they also face an increase in the waste produced in hospitals and other units related to health. The hazardous or infectious waste created in hospital facilities is just around 15% to

25% of the aggregate waste produced, however in the event that not took care of handled properly can cause a potential danger. The critical factor is dealing with this waste appropriately to decrease risks related to it. Healthcare waste contains both infectious and non-infectious waste. Hindrance in appropriate planning in making arrangements for hospital waste management in creating nations is because of many factors that affect the performance of the system; this includes insufficient documentation on waste management practices works on, bringing about mistaken waste management. The Gondar University hospital, Ethiopia faces waste management issues because of absence of accurate waste segregation practices, insufficient protective kit/tools/bags/devices, inadequate information of the waste handlers about proper waste management [7,8]. Exact waste segregation practices reduces the danger of diseases, injury and damage to the waste managers and handlers, in the end waste management is taken a cost controlled as it diminishes the cost of treatment. Change is required as far as arrangement of sufficient assets, resources and work must be improved the basic situation setting up a fundamental human healthcare waste management system. Such investments will eventually improve the health conditions and eventually reduce the money related issues [9].

Transfer of infectious waste together with the general waste has been observed, this is a serious worry as the infectious waste may expose the waste handlers with severe diseases like Hepatitis B, Hepatitis C or HIV. Hospital waste handling without the basic fundamental steps for care can make harm to individuals and nature. Involvement of all concerned with the issues of healthcare waste management, that is the professional organizations, service providers and the service users, likewise all in danger of exposure; when all is said in done the entire group or population is important [1,10].

### **Waste collection/Generation and segregation**

Significant components for waste generation are the type of the hospital, hospital capacity for patients, and the in-patient and out-patient turnover rates. This information on waste generation rate helps plan for waste handling, satellite and central storage, transportation, medical waste dealing and discarding of the hospital waste [11,12]. An examination conducted in Bahrain looking at Salmaniya Medical Center and different hospital's facilities over a few years uncovered that for the most part there was an expansion in the hospital waste generated, however the pattern at Salmaniya Medical Center continued as before [2]. This was a result of the introduction of new ideas and thoughts for hazardous waste reduction like traditional sphygmomanometers (blood pressure measuring apparatus) and X-ray films with computerized technology. This killed introduction to mercury from the blood pressure apparatus and destructive chemicals which were utilized for preparing X-ray films. A case analysis conducted in Nablus, Palestine compares different types of hospitals facilities and the waste produced from them. The model outlined was to predict the treatment cost and waste generation in various different types of hospital's facilities [13].

The results of a study examination in Portugal reveal deficiencies in waste segregation practices which are resulting in exposure to infectious waste. Waste segregation at the site of the source is arranged through emphasis on assembling, training, education and instruction of waste handlers. Hospital waste originates from different sources inside the region of the hospital's facility that is produced during treatment, and diagnosis of the patients [14,15]. Real major sources include different wards with hospitalized

**Table 1:** Color Scheme of Bins.

S. No	Color of the Bin	Type of Waste
1	Black	Non-infectious waste (paper waste, card board, food packing waste, etc.).
2	Red	Infectious waste (clinical Laboratory waste, blood bank waste, syringes) Sharps are kept in separate red colored containers.
3	Yellow	Pathological and Pharmaceutical waste (body parts, blood, body fluids, expired medicines, etc.).

patients, facilities, clinics, blood banks, laboratories, Daycare units, and Nursing stations. Minor sources include the counseling centers, dispensaries, workplaces, offices, pharmacies, cafeterias, and so on. It is vital to know the quantities of waste generated for safe disposal. The generation of health care waste not only depends upon the size and the available office of the hospital. Waste produced in created countries is more because of the request of high consumption of goods and services. There is more use of disposable items like instruments and packaging materials, likewise proper rules are followed for waste segregation [1,8]. There are many variables that impact the rate of waste generation, including:

- Location of hospital (rural or urban);
- Level or type of office facility (e.g. clinic, hospital);
- Type of department (clinics, blood banks, offices, laboratories general ward, and surgical unit/theatre).

Segregation of waste should be started from the point of generation of waste (bedside of patient, operating theatre, research centers, laboratories, etc.). It is very vital to know the types, and amount of waste generated in a healthcare service centers as it is the initial phase towards harmless disposal. It is very important to ensure that the clinical waste is not mixed with the other municipal (civil) or household waste. This not only increases risks for the waste handlers but in the long run, it adds to the cost to the hospital [16]. The information gathered initially on the waste delivered is useful in evaluating the required capacities with respect to bags, satellite and central storage areas, transportation, and disposal. Waste collection data can be utilized to give data on generation of waste in various areas of the hospital. A review was conducted in Iran for waste minimization [17], the outcomes exposed that waste segregation practices were significantly higher in government hospitals. This evaluation of the waste administration process regarding waste practices makes reason for development openings as of now currently followed, explain health workers regarding waste and determine ways for waste minimization. This will include characterizing objectives, purposes, defining goals, making arrangements for various different areas, attaining of equipment (like personal protective equipment, weighing scales, containers and bags required), information collection, analysis of information and recommendations for improvement. Organization of waste practices is common in developing nations and if health care waste isn't segregated then the presence of sharps or other different infectious material could endanger the health of the population moving around these waste local sites [1].

### **Methods of waste segregation**

The segregation of non-hazardous waste and potentially hazardous waste into different color bins is divided in to "three-bin system" as indicated in Table 1.

A study was conducted on waste management and the results showed that 46% of the waste handlers had practiced waste segregation correctly and effectively; non-availability of proper color

coded containers affected the practice of segregation of healthcare waste [14]. The sharps are disposed in sharps containers that are marked properly to avoid any risks and dangers of contact (normally red in color). If there is uncertainty of the type of waste then as per precaution the waste should be placed in the bags and container holder for hazardous healthcare waste. The hazardous waste is separated into two sections utilized sharps and possibly infectious waste items (like bandages, swabs, tissues tubing, and disposable medical items). The exposure to contaminated infectious clinical waste may cause serious effects and in the long run the treatment is important and as well as costly too [7].

Hospitals in Bahrain use black plastic bags for segregation of general waste or the domestic local waste, yellow or red bags are used for infectious waste, and for hazardous objects yellow containers are used [2]. This was seen as a typical common practice however a few health care centers did not follow the correct color shading coding pattern for collection of hazardous waste, rather than yellow bags, black bags were used. Lack of supervision in the region was the reason behind this carelessness. Separation of waste from the location of generation of waste is generally effective but when similar waste of different departments is handled in bulk then the required level of satisfaction may not be met [18]. Accurate segregation of waste can avoid unwanted use of resources and help in cost savings. Generally waste is segregated in all aspects each area of the hospital on a daily basis. Particular color coded containers are utilized to separate the types of waste. Bags from the container are weighed and then measured, which are compared to the number of patients handled. Such information and data collected over a period of a month is more accurate and precise information and data collected for a week or certain number of days. If collection of this information and data is repeated at various different times in a year it gives more exact information and data of the amounts of waste generated in departments of the hospital.

### **Interim waste collection and storage**

A study was conducted in UK hospitals which revealed the evidence of necessities for improvement in Healthcare waste segregation, storage and security of the waste storage areas. The staff in-charge is responsible to get a visual sign of the risk exposed by the bags or containers. The procedure of waste collection actually begins with weighing and measuring the containers and bags with the waste produced in a specific unit of the hospital department. The accumulation of waste is done on a daily basis. Information and data collected on a daily, weekly or monthly basis gives limited information and may not be accurate due to seasonal variations or other. An accurate picture could be achieved by collected information and data for a period of month or more and repetitive at various times in the year [19,20].

Waste wagons or trolleys with lock lids covers are used for collecting the waste, segregation, transportation and storage of the clinical waste. At times it was watched that these wagons or trolleys were blood stained. These wagons or trolleys after bulk accumulation and transportation of waste is kept in a satellite storage area and afterward moved to a central storage area which has unauthorized access restricted in its region. The region is used for storage until the bulk collection is completed. The issues of waste management are not only a treating situation in the creating countries but in certain created countries similar issues exist. A study conducted in UK hospitals a year after an initial audit exposed a lot of areas which

required change in a better way. The waste interim storage sites were easily opened and not secured [16,19].

### **Transportation of waste from interim site to disposal & treatment area**

The unbalanced handling and disposal of waste inside hospital is currently widely known as a source of preventable risky environment. The healthcare waste that requires careful management because of being infectious or hazardous is just 10% to 25% of the waste generate; rest of 75% to 90% is non-hazardous waste or general waste. All faculty members working within a hospital and working in closeness with healthcare waste specially the hazardous risky waste are possibly in danger of exposure to risks. Waste handling instructions should be given to all those handling hospital waste; it should include instructions on safety and security of the workers, such as using Personal Protective Equipment (PPE) and avoid physical connection with hazardous waste items [16].

Following are the hospital staff in danger of contact or exposure to hazards:

- Doctors, nurses, nursing assistants, and hospital maintenance personnel.
- Patients who are admitted or out patients.
- Relatives of the patients or other visitors to the hospital or healthcare facility.
- Support staff of the hospital (cleaners, drivers, laundry handlers, food handlers of the patients in the ward).
- Waste handler staff, transporting waste to the disposal site.
- Staff members working in waste management areas like landfills or disposal plants.

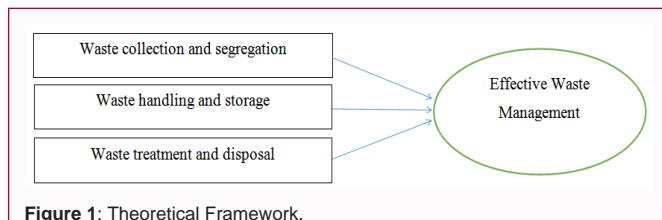
### **Waste treatment and disposal**

Safe Disposal of the hazardous waste ensures safety of all waste handlers. Suitable measures utilized for treatment of healthcare waste help reduce the potential hazards to the patients, healthcare workers, hospital staff population in general and protect the environment. An organized approach from generation of waste to treatment and disposal, certifying that the clinical waste is not mixed with the non-clinical waste, keeps the population and the environment safe and healthy [21]. A study on disposal practices of healthcare center waste in Nigeria exposed that the waste is not being disposed properly. Unclaimed dead bodies, waste from the labor rooms were seen in depths and other waste material was openly disposed off. An examination conducted in Iran to observe the changes implemented as in the past the practice was mixing up of municipal civil waste with clinical waste [22,23].

### **Waste treatment and disposal technologies**

Following are the waste treatment and disposal technologies:

- **Thermal processes:** Waste is treated with heat or thermal energy to kill the pathogens. This kind of treatment used in hospitals globally [24].
- **Biological treatment or process:** Pathological waste is buried for decomposition.
- **Mechanical treatment:** This process includes destroying (needles and syringes), grinding and mixing to limit the bulk (size); however the microorganisms are not destroyed. This procedure is

**Figure 1:** Theoretical Framework.**Table 2:** Gender.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	68	63.6	63.6	63.6
	Female	39	36.4	36.4	100
	Total	107	100	100	

**Table 3:** Age group.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	22-30	36	33.6	33.6	33.6
	31-40	64	59.8	59.8	93.5
	More than 40	7	6.5	6.5	100
	Total	107	100	100	

mostly followed by different treatments for complete destruction of pathogens.

- **Treatment of waste with radiation:** Microorganisms are destroyed with radiation, sufficient enough to penetrate through closed containers and bags. The staff managing in such areas requires appropriate protection, or shielding for avoiding occupational hazards.

The WHO has stated that for developing countries, incineration may be an adequate method if used appropriately, until they have more safe choices for healthcare waste management to ensure a healthy and safe environment. Segregation of the waste from the point of generation makes it advantageous, convenient and easy for choice of treatment alternatives. Non-hazardous waste, such as, food waste items collected from various different departments in the hospital are collected in the kitchen, these things could be treated by soil or if rules allow could be used for animal feed. Certain healthcare workers remove the needle from the syringe and dispose the needle in the sharps container; the others basically utilized the container holder which has a needle cutter. It is critical to ensure protection of waste handlers damage and exposure to body fluids [25].

## Theoretical framework

The theoretical framework was developed on the basis of research variables (Figure 1).

## Research hypotheses

H1: Waste Collection and Segregation contribute towards effective waste management.

H2: Waste Handling and Storage contribute towards effective waste management.

H3: Appropriate Treatment and Disposal of waste contribute towards effective waste management.

## Research Methodology

This research is explanatory in nature and is based on quantitative

**Table 4:** Professional Status.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Doctor	18	16.8	16.8	16.8
	Head Nurse	34	31.8	31.8	48.6
	Assistant Nurses	19	17.8	17.8	66.4
	Lab Technician	11	10.3	10.3	76.6
	House Keeping staff	18	16.8	16.8	93.5
	Others	7	6.5	6.5	100
	Total	107	100	100	

**Table 5:** Job Experience.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 2 years	7	6.5	6.5	6.5
	2-5 years	40	37.4	37.4	43.9
	6-10 years	47	43.9	43.9	87.9
	More than 10 years	13	12.1	12.1	100
	Total	107	100	100	

data; the data was analyzed to find the cause and effect analysis between the dependent variable (Effective waste management) and independent variables (Waste collection and segregation, Waste handling and storage and Waste treatment and disposal).

The survey population includes all employees who are involved in waste monitoring, handling and reporting practices in Burjeel Hospital, Abu Dhabi. The total capacity of hospital staffs is around 510. The sample size of this study is approximately 120 employees (both male and female), from various departments of Hospital. The sample size was selected based on the discussion with hospital management and availability of regular staffs in different departments. Around 120 questionnaires were distributed for data collection out of which 107 were received in complete form. Response rate was 90%.

Non-probability, convenience sampling method was utilized for this survey. The intention was to approach respondents whenever it might suit them with the goal that their day by day routine activities is not affected. The gathered data were analyzed and treated with statistical tools, including Pearson's Correlation, and Regression analysis and T-test with the help of SPSS 23 software.

## Data Integration and Analysis

### Profile of respondents

A total of 107 questionnaires were received from different departments of Burjeel Hospital Abu Dhabi, as per non-probability, convenience sampling technique. Demographic description of the respondents is shown in the Table 2-5. The characteristics include Gender, Age group, Profession and Experience.

The information in Table 2 shows that maximum respondents were male and female respondents were less. Male respondents were 68 (63.6%) whereas female respondents were 39 (36.4%).

Table 3 shows the Age groups of respondents. Respondents of age group 22-30 years were 33.6% whereas 59.8% are falling between 31-40 years of age and 6.5% are more than 40 years old.

Table 4 indicates that out of 107 respondents, 16.8% were Doctors, 31.8% were Head Nurses and Nurses, 17.8% were Assistant Nurses, 10.3% were Laboratory Technicians and 16.8% were housekeeping

**Table 6:** Reliability Statistics.

Variable	Cronbach's Alpha	No. of Items
Waste Collection and Segregation	0.859	8
Waste Handling and Storage	0.928	8
Waste Treatment and Disposal	0.958	5
Effective Waste Management	0.778	4

**Table 7:** Correlations.

		WCS	WHS	WTD	EWM
WCS	Pearson Correlation	1			
	Sig. (2-tailed)				
	N	107			
WHS	Pearson Correlation	.677**	1		
	Sig. (2-tailed)	0			
	N	107	107		
WTD	Pearson Correlation	.445**	.293**	1	
	Sig. (2-tailed)	0	0.002		
	N	107	107	107	
EWM	Pearson Correlation	.669**	.648**	.337**	1
	Sig. (2-tailed)	0	0	0	
	N	107	107	107	107

\*\*Correlation is significant at the 0.01 level (2-tailed).

**Table 8:** Model Summary<sup>a,b</sup>.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.721 <sup>a</sup>	0.52	0.506	0.33638	2.101

<sup>a</sup>. Predictors: (Constant), Waste Collection and Segregation, Waste Handling and Storage, Waste Treatment and Disposal.

<sup>b</sup>. Dependent Variable: Effective Waste Management.

staff and 6.5 % were other staff members.

The respondents' data displayed in the Table 5 indicates 6.5% were with less than two years of experience, 37.4% with 2-5 years of experience, 43.9% with 6-10 years of experienced and 12.1% with more than 10 years of job experience.

### Test of reliability

The data reliability is a primary concern in quantitative research. Cronbach's alpha Test of Reliability is a measure of inner consistency. Cronbach's alpha is the most generally used tool which indicates how narrowly related a set of variables (independent and dependent) are as a group. However the required value must be more than 0.7 for the scale to be strong. Results of reliability test for individual constructs are displayed in Table 6.

There were eight questions related to the 'waste collection and segregation' independent variable. For Waste Collection and Segregation construct, value of the Cronbach's alpha is 0.859 which shows that the data has positive internal consistency and reliability. There were 8 questions associated to 'Waste Handling and Storage' variable. The value of Cronbach's alpha is 0.928 which represents high level of positive internal reliability and consistency of Waste Handling and Storage. There were 5 questions related to 'Waste Treatment and Disposal'. The value of Cronbach's alpha is 0.958 which represents a positive internal consistency of Waste Treatment and Disposal. For all four constructs, value of Cronbach's alpha is the 0.778 which shows high level of internal consistency.

**Table 9:** ANOVA<sup>a</sup>.

Model	Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	12.622	3	4.207	37.182 0.000 <sup>b</sup>
	Residual	11.655	103	0.113	
	Total	24.277	107		

<sup>a</sup>. Dependent Variable: Effective Waste Management.

<sup>b</sup>. Predictors: (Constant), Waste Treatment and Disposal, Waste Handling and Storage, Waste Collection and Segregation.

**Table 10:** Coefficients<sup>a</sup>.

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
1	(Constant)	1.589	0.246		6.447 0
	WCS	0.306	0.076	0.401	4.046 0
	WHS	0.291	0.075	0.361	3.894 0
	WTD	0.032	0.046	0.053	0.69 0.492

<sup>a</sup>. Dependent variable: EWM.

### Pearson's correlation

Correlation results provide relationship between research variables. Pearson's Correlation results are shown in Table 7. Research variables are abbreviated as Waste Collection and Segregation (WCS), Waste Handling and Storage (WHS), Treatment and Disposal Waste (WTD), Effective Waste Management (EWM).

Table 7 indicates the correlation between three independent variables and Effective Waste Management (DV). A strong positive relationship of two IVs (Waste Collection & Segregation and Waste Handling & Storage) has been found with DV (Effective Waste Management). Effective waste Management is strongly related with Waste Collection and Segregation, as the value of r is 0.669 and the value of P is 0.000 (<0.01); their connection is statistically significant at 1% significance level. Similarly there is a strong correlation of Waste Handling and Storage with Effective Waste management where r is equal to 0.648 and P is 0.000; this relationship is statistically significant. There is a weak positive correlation of Waste Treatment and Disposal, with Effective Waste Management, since value of r is 0.337 and value of p is 0.000 (<0.01).

### Regression analysis statistics

Table 8 presents the values of R, R square, adjusted R square and the strength of the model. Regression determines the strength of the connection between one dependent variable and three independent variables. R (0.721) represents the correlation between observed and predicted value, so a high positive correlation in this case is marked. Value of R square i.e. 0.520 represents 52% variation in the dependent variable, which can be described by independent variables. The adjusted R square value is 0.506 which means that there is 50.6% impact of effective waste management over collection, segregation, handling, storage, treatment and disposal and a value of Durbin Watson shows that is there any multi collinearity exit in the informative data. In this research, value of Durbin Watson is 2.101 which mean that multi-collinearity does not exist.

The ANOVA table represents how well the regression model fits the data; it defines the significance level of the informative data to analyze the impact of dependent and independent variables (Table 9). The Sig-value, being less than 0.05, concludes that the data is significant and all three independent variables are appropriate to analyze their impact on dependent variable. It is evident that there

**Table 11:** One Sample Test.

	N	Mean	Std. Deviation	Std. Error Mean
WCS	107	3.9357	0.62673	0.06059
WHS	107	3.9918	0.5951	0.05753
WTD	107	3.8262	0.79293	0.07666
EWM	107	4.0748	0.47857	0.04626

is a significant impact of (waste collection and segregation, waste handling and storage and waste treatment and disposal) on effective waste management.

The Coefficient table indicates whether independent variables are significant to the model or not (Table 10). The coefficient table shows the 'Sig' values in the last column, which calculates the significance of the independent variables and represents whether the variables are useful estimators or not. In case of first independent variable "Waste Collection and Segregation" beta value is 0.306 and p value is 0.000 which is less than 0.05; it means independent variable is a useful estimator and creates a significant impact on Effective Waste Management. The beta value for second independent variable is 0.291 whereas p value is 0.000 (<0.05); it shows that this variable is also a helpful estimator of Effective Waste Management. The beta value for third independent variable is 0.032 whereas p value is 0.492 (>0.05); it means the variable creates a weak positive impact on Effective Waste Management which is not significant. Hence "Waste Collection and Segregation" and "Waste Handling and Storage" are useful estimators of Effective Waste Management but "Waste Treatment and Disposal" is not a useful estimator. On the other hand, values of Beta (B) describe that there is a positive impact of independent variables on dependent variable.

The T-test evaluates whether the means of two groups are statistically changed from each other. The T-test analysis is suitable whenever means of two groups are related. If the value of mean is more than 3, as indicated in Table 11, then the particular task is being done acceptably well. Table 12 indicates that all variables have significant influence on effective waste management, since value of Sig is <0.01 and the value of mean is more than 3.

## Discussion

### Waste collection and segregation

With reference to the waste collection and segregation (first variable), the results in Table 7, indicate a positive relationship between the Waste Collection and Segregation variable and Effective Healthcare Waste Management variable. Besides, coefficients table 10 also indicated that impact of first IV is both positive and significant. This result is compatible with the literature review [12]. The impact of the values demonstrates that Waste Collection and Segregation practices are being appropriately carried out at various departments of Burjeel Hospital Abu Dhabi. Most of the waste collection and segregation is handled by Doctors, Nurses, and Laboratory technicians or nursing assistants, they are very much aware of the careful steps and attempt their best to avoid any kind of carelessness when handling the infectious healthcare waste. The value of T-test in Table 11 and 12 also support the impact of variables.

### Waste handling and storage

With reference to the second variable, the result in Table 7 indicates a positive correlation between 'Waste Handling and Storage' and Effective Waste Management. Moreover, beta value (0.291) and

**Table 12:** One Sample Test.

	Test Value = 0					
	T	Df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
WCS	65	106	0	3.93575	3.8156	4.0559
WHS	69	106	0	3.99182	3.8778	4.1059
WTD	50	106	0	3.82617	3.6742	3.9781
EWM	88	106	0	4.07477	3.983	4.1665

sig value 0.000 (which is less than 0.01). The coefficient Table 10 also indicates that impact of the IV is positive and it is significant as well. Hence the third hypothesis stands accepted. The value of T-test in Table 11 and 12 also support the impact of the variable. This proves that appropriate healthcare waste 'handling and storage' contributes towards Effective Waste Management. During the process of waste handling and storage the workers who are involved in this transportation must be aware of the issues related to unsafe practices. There should be importance on practical application of the steps for careful handling, transportation and storage [8]. Carefree attitude and ignorance about the safety rules and regulations also affect the health of the personnel, thus ending with serious health issues, costing the hospital for treatment and a hazard to the safety of the environment.

### Waste treatment and disposal

The correlation result in Table 7 indicates a weak positive relationship between 'Waste Treatment and Disposal' and Effective Waste Management. However, Table 10 indicates that impact of this IV is not significant as Sig value is 0.492 which is >0.01. Hence, 'Waste Treatment and Disposal' does not significantly contribute towards Effective Waste Management.

## Conclusion

This study has evaluated the waste management practices in various departments of the Burjeel Hospital Abu Dhabi, UAE. In this research, three salient factors of waste management process, including 'Waste Collection and Segregation', 'Waste Handling and Storage' and 'Waste Disposal and Treatment' were examined to see the extent to which the waste management is effective due to these factors. As per results, 'Waste treatment and disposal' is not suitably contributing towards waste management. Remaining factors are found to be positively contributing towards effective waste handling. The main reasons could be lack of education and insufficient knowledge of the waste handlers and other junior hospital staff members. Lack of proper accountability of the waste handling persons may also be cause of this anomaly.

## Recommendations

Based on findings of this study, following are the recommendations for further improving effectiveness of waste management practices in the hospital under study:

- Management of Burjeel hospital should ensure implementation of proper waste disposal practices as per International standards.
- Proper supervision of the disposal practices in various wards should be undertaken by the Waste Supervisors on regular basis.
- Services need to distinct all their waste and monitor

according to the HAAD policy.

- Regular Medical audits should be held to identify anomalies, if any, and take appropriate actions.
- Waste disposal sites should be secluded from public access.
- Sharp objects which could harm individuals; microbiology test samples that contain infections should not be left in an open place.
- Waste containers should be properly sealed before transportation for the disposal with proper labeling of the waste type.
- Liquid infectious waste should not be disposed of in the drains due to chances of mixing up with the drinking water.
- There must be strict accountability of individuals who don't deal with their medical waste accurately.

## Suggestions for Future Research

Due to shortage of resources, this study was limited to only one large private hospital in Abu Dhabi. Future researchers may undertake a similar study on other healthcare sector hospitals in Dubai and beyond. Similarly, a similar study may be undertaken in Pakistani public and private sector hospitals. A comparative study may also be conducted to examine application of waste management practices in Pakistani and Dubai hospitals.

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