

The Impact of Health Care Waste Procedures in Effectiveness of the Health Care Waste Management and Implementation of Software Prototype for Data Management: Special Reference to Kalmunai Medical Officer of Health (MOH) Division

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Abstract: Health care waste is one of the ascended and emerged issues all over the world today. It not only affected people also the environment, animals, and crops. Protection from Health care waste is still a threat for Sri Lanka due to the amount of total generation of clinical waste and the availability of the treatment/disposal hence needed drastic technological improvements. This study aims to identify the impact of the current disposal management process in Health Care Waste Management (HCWM) of selected hospitals in Kalmunai Medical Officer of Health Division, Sri Lanka, along with the development of a software prototype for effective data management and decision making, using agile methodology, accommodating most functionalities. The output of the prototype witnesses proper data management. OLS method used to examine the relationship between Health Care Wastes (HCW) Procedure impacts on HCWM; the regression results show that except for other variables, the Segregation of HCW and Waste treatment & disposal have a negative relationship with the HCWM. These negative relationships highly recommended a need for a software system for making important decisions regarding the Health care waste procedure to have a standardized Health care waste management system sheltering Whole Island with sustainable solutions.

Keywords: Health care waste, Ordinary Least Squares, Health Care Waste Management, Prototype, Software Engineering Methodology

I. INTRODUCTION

Throughout the years, there has been incredible headway in the health care system. Health care waste management (HCWM) [1]–[3] one of many complex and demanding fields in the rapidly growing analysis of Health Economics [4]–[6] due to the rapid increments of population and their needs. Moreover, Health Care waste Issues are the most identifiable externalities in the

health sector. United Nations reported that every year there is a 1.10% increase happening in the world population, and that will reach 8.6 billion in 2030 and 9.8 billion by 2050 [7]. Since the need for Medical wastes management increases considerably. The amount of health-care waste has increased significantly over the past three decades; in 2010, the USA generated approximately 3.6 million tons of wastes, and South Africa produced 42000 tons of health care waste [8]. Hospitals and medical health-care centers contain infectious and non-infection wastes. It is essential to make sure the health of the public and the environment from the infection wastes. According to the Biomedical Rule 1998 [9], [10], medical wastes are the waste produced during treatment, research, and testing of any human being, animal, and other living things.

Disposal of clinical waste is one of the arisen and emerged problems in most areas worldwide these days. It not only affected people but for the environment, animals, and crops. In worldwide, 8-16 million hepatitis B, 2.3 - 4.7 million hepatitis C, and 0.08 – 1.6 million HIV infections are reported and estimated to occur yearly due to the reuse of needles and syringes [11]. Most countries are differently affected by improper waste management. Most countries try to dump their wastes in the seas and lakes, which negatively affects the people in different ways [12]. Hence, proper disposal management is necessary to reduce and block all unnecessary illnesses spread through the health-care waste for fortifying the human being from illness and other living species from pointless issues.

On the other hand, the Decision support system is one of the key phrases which is used by senior-level management for any decision-making process by checking the progress and opportunity of an organization with the help of efficient data. After the rapid advancement of Information Technology, data became very much essential objects for sort out almost all tasks more straightforward manner. Hence its essential obligations to manage and secure the data using excellent tactics. In that respect, even clinical waste management sink under the proper data process and management for having the exact decision in case of emergency.

Early days, why? Even nowadays, most clinical waste management systems are using spreadsheets for storing and processing clinical waste data. Early day's population is manageable, and spreadsheets are okay to manage the data process. However, the rapid growth of clinical waste management could not manage by using the spreadsheet. We need to switch from existing traditional methods to the well-organized method. Thus, Database management System (DBMS) provides a variety of opportunities and perfect ways to manage the data and provide exact data in the decision-making process.

This study was conducted on selected hospitals in the Kalmunai Medical Officer of Health (MOH) Division, which is situated in the Ampara district in Sri Lanka. The area under investigation was selected conveniently due to resource availability. According to the Medical Officers and the hospital staff in the Kalmunai Medical Officer of Health (MOH) Division, They are facing many issues in recoding the data [13]. It leads to a lack of efficiency in the progress of the HCWM. Also, they highly agree that the HCWM process is computerized; the burden of the issues could be reduced at some level. Therefore, they are looking for the perfect ways to manage the data and provide exact data in the decision-making process. The objectives of this study are to identify the impact of the current disposal management process in HCWM of selected hospitals in Kalmunai Medical Officer of Health (MOH) Division, Sri Lanka. Also,

develop a software prototype for an effective data process and try to improve the method of waste management.

II. LITERATURE REVIEW

Reddiar Janagi *et al.* reported from their review study that, in each year, more than 16 thousand injections are used by the medical relevant staff, and all waste of needles and syringes do not dispose of properly. Also, they have found that Famous country hospital, like UK hospital they are wasting 2.5 kilograms per bed per day, In the US, 4.5 kg/bed/day, In France, 2.5 kg/bed/day, In Spain, 3.0 kg/bed/day and India 1.5 kg/bed/day medical wastes are distributing every day. The type of wastes they have categorized are Sharp waste, Infection wastes, Pathological waste, and pharmaceutical waste, chemical, radioactive and non-hazard waste. Moreover, improper disposal management of this wastes tends to cause an environmental hazard; hence its needful to develop a proper waste management system to prevent a variety of risks and safety life of every single life of the environment [14].

As mentioned by Syed Shahzaib Ali *et al.*, a patient is creating and distributing approximately 2 kilograms of wastes per day in a Pakistan hospital, which includes infectious waste and non-infectious waste. It is crucial to have a proper waste management system to avoid infectious waste to evade unnecessary problems to the patients [15], [16]. Furthermore, indicated by Yasmeen T *et al.* that incinerations are a way of destroying medical wastage in a hospital by using the ignition method. This method abolished all kinds of waste-producing by hospitals, mostly solid wastes [17].

M. Adama *et al.* do a study on Heavy metal Solid wastes called “Heavy Metal Contamination of Soils around a Hospital Waste Incinerator Bottom Ash Dumps Site.” This study reported that, though incineration is a better way of disposing of wastes produced in hospital, the output of consequence of bottom ash of incineration still have heavy metals like Zinc and Mercury. Also, the bottom of the ash has organic waste. Both metal and organic wastes tend to produce difficulties to the public in respiratory harm, cancer, and other anomalies; hence there must be a proper invoke to overcome these issues. This study has followed Ghana’s Medical Waste Management Guidelines to tackle these problems out. Eventually, from the conclusion, we can be identified that heavy metals in ash and soil will directly affect waste workers and other plants, animals surrounded by that particular perimeter. This study recommended that waste workers must be trained well. It must provide them with proper metal ash disposal tactics for safe disposal to them and the environment. Eventually, we can conclude from this study that incineration is a better way to dispose of the wastes in hospitals. It also needs to improve some strategies for better performance [18].

Also specified by Julija Gusca *et al.* most of the area all over the world, 6 kilograms of clinical waste per bed has been producing per day. From the total waste of all available beds, only 20% of waste is problematic waste, and a proper waste management system is needed for avoiding unwanted problems from that wastes [19].

As indicated by Ayanthi Saranga Jayawardena that, generally in hospitals, 10% to 25% of wastes are mostly risky wastes and which categories as Sharpe waste, infectious wastes, Pathological wastes, Pharmaceutical Waste, Chemical, and Radioactive wastes. This kind of wastage needs to dispose of in a proper manner for mitigating the infections. Usually, this kind of wastes are not disposed of properly due to a lack of knowledge of staffs; thus there must be a training phenomenon is necessary to discontinue this kind of complications and also from

Karunasena G *et al.* we got to know that clinical waste proposal methods are very much essential to protect the environment and hazards. Moreover, from the result and conclusion of Ayanthi Saranga Jayawardena, we can be recognized that Waste management practices are inadequate due to the lack of knowledge and carelessness of the staff. So it is essential to provide a good training program for health care officers, and the proper person must monitor them for avoiding carelessness and protect them from the dangerous zone[20], [21].

As stated by Shiferaw *et al.*, it identifies that high practical diseases like HIV, hepatitis viruses B and C, cholera, and diphtheria are easy to transfer viruses to the human body in different ways. It could be reached the human rapidly by improper disposal of hospital medical waste[22].

Jalil Jaafari *et al.* made a study to identify solid waste in Iran hospital called “Investigation of hospital solid waste management in Iran.” Gained result from this study that, In Iran’s public hospital medical waste 56% per day and sharp waste 2% per day and also from specialized hospitals medical waste and sharp waste, they have identified 63% and 1%, respectively. They also have identified problems in each hospital are improper waste management. There are no proper labels for infection wastes, Insufficient bin for both infection and non-infection wastes, and workers do not have proper knowledge in the waste management field[23].

Waste to Energy (WtE) is a technology used to create energy using the waste property, the most crucial WtE for medical waste is incineration, which is mostly used and disposed of solid wastes in the hospital by using heat, fuel, and electricity [24]–[26].

Past three decades, medical wastes are considered under critical classification. The effect of medical waste not only affect human but also it affects the environment, plants, community, and ecosystem. The suitable dumping method and knowledge are fundamental to overcome every issue [27]–[29].

As indicate by Komilis *et al.*, Nwachukwu *et al.*, and WHO that, blood, body parts, chemical, needles and syringes, analytic samples, medical equipment, and harmful resources are classified under medical waste [30]–[32].

As detailed by Patan S and Mathur P, the color-coding biomedical waste rule that yellow includes Plastic bag, the category 1,2,3,6 and treatment of yellow is Incineration/deep burial; Red includes Disinfected Container/ Plastic bag, the category 3,6,7 and the treatment Autoclaving/Microwaving/ Chemical Treatment, Blue/ White translucent includes Plastic bag/puncture-proof container, the category 4 and 7, treatments Autoclaving/Microwaving/ chemical treatment and destruction/shredding. Furthermore, Black includes Plastic bags, category 5,9,10, and the treatment of Black is disposal in a secured landfill[11].

III. CONCEPTUAL FRAMEWORK

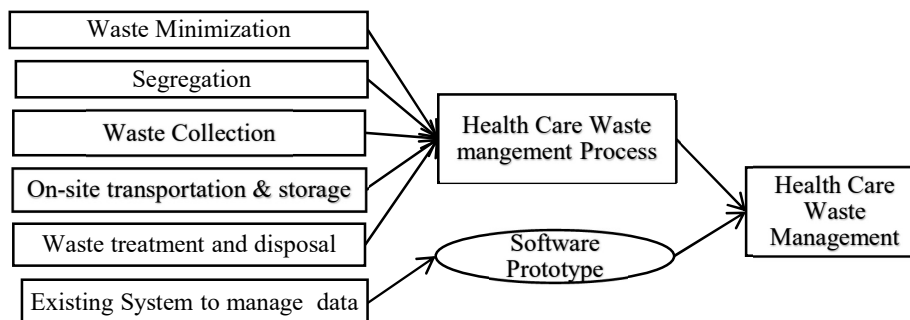


Figure 1: Conceptual Framework of the research

IV. METHODOLOGY

This study is mainly divided into two parts. One is Multiple Regression Analysis, and the other one is Software Prototype

A. Multiple Regression Analysis

The purpose of this analysis is to determine the impact of the Health care waste process in the effectiveness of the Health Care Waste Management in Kalmunai Medical Officer of Health (MOH) Division Hospitals. In this study, the target population is the staff who are engaged with the process of Health care waste management. According to the focal point for HCWM, 20 sample elements were identified for this research under the assumptions of the non-probability convenience sampling technique. This study mainly included primary data through structured questionnaires and interviews. All the questionnaire questions are structured with five alternatives, and the responses are scaled using the five Likert scale.

Operationalization of the variables

The following table 1 explains the operationalization of the variable. The survey format questions were adopted from previous research and the national policy of Clinical waste management- Sri Lanka. The questionnaire was designed to consist of six major sections.

Table 1: Operationalization of the variables

Variable	Indicator	Questions	Variable	Indicator	Questions
Health Care Waste Management	Effectiveness	Q1-Q4	Waste Collection	Hazardous waste	Q10 - Q13
	Issue identification			Sharps	
	Data System			General waste	
	Protection measures				
Waste Minimization	Internal rules and regulation	Q5-Q6	On-site transportation & storage	Regular Schedule	Q14 - Q17
	Separated Collection			Trolley	
				Central Storage facility	
				Inaccessibility	
Segregation	Waste generation	Q7 - Q9	Waste treatment and disposal	hazardous HW	Q18 - Q23
	Color code			chemical waste	
	Types of containers			liquid communicable waste	
				blood	
				Infectious solid HW & Sharps	
				radioactive waste	

Source: Author Constructed, 2020

B. . Software Prototype

Flowchart of prototype

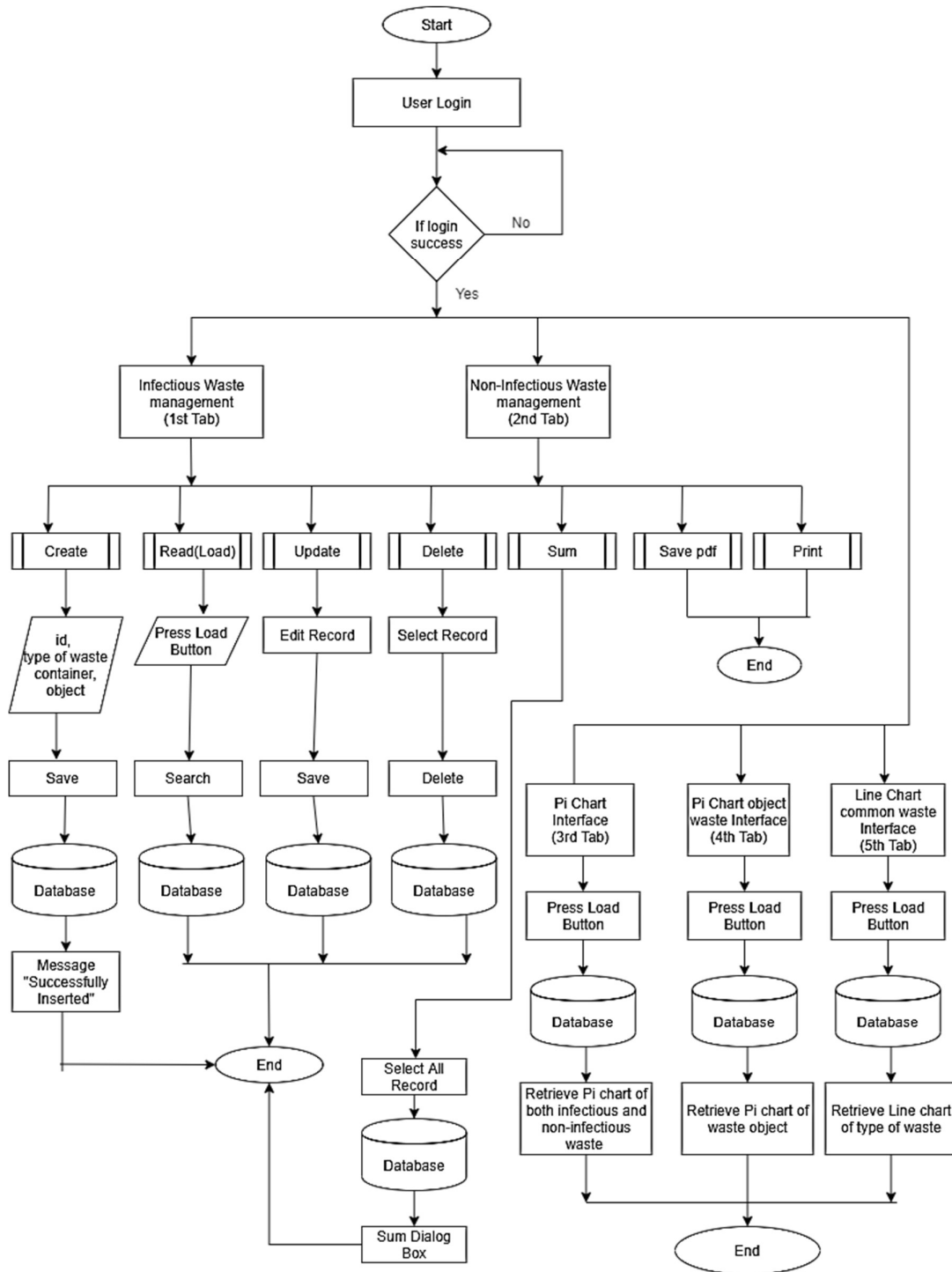


Figure 2: Flowchart to the Clinical waste management prototype

The primary goal of this software system is to provide maximum support to clinical waste management in case of the decision-making process. Also, managing (Create, Read, Update

and Delete (CRUD)) the data-efficient and effective manner, ensure clinical data is available at any instant, offers user-friendly and ease of access to its user.

System Design and Architecture

Whenever the user interacts with this system, he/she must log in first for authentication. When the username and password match with the database, the user can move to the software's Graphical User Interface (GUI). In the GUI, the system has five tabs, and each tab has its functionalities. The first tab is Infectious waste management. Using this tab, the user can do all CRUD activities to the exact data. Furthermore, users can get a print of the data if necessary, and users can save/store this accessed data in the form of a pdf in their preferred place. Eventually, they can check the total sum of the waste with a single click. All processed and accessed data interacts with the Database when CRUD happens. The second tab is for non-infectious waste management, which has the same functionalities as infectious waste management. The third, Fourth, and Fifth tabs are graphical representation data of both the 1st and second tab in the form of pie and line charts. Using the third, fourth, and fifth tab, users can be made the decision process regarding the current situation. The First and Second tabs help to manage and secure an effective and efficient way.

Tools and technologies

To build the clinical waste management system software prototype, we had used the following tools and technologies.

- **JavaFx:** Library, use to build smooth and creamy GUI applications.
- **Database:** Repository, use to do CRUD operations.
- **IntelliJ IDEA:** IDE, use for build smart GUI and web applications
- **MySQL Workbench:** Software used to manage all databases and tables.

V. RESULT AND DISCUSSION

This study was conducted on selected hospitals in the Kalmunai Medical Officer of Health (MOH) Division, which is situated in the Ampara district in Sri Lanka. Figure 3 explains the amount of health-care waste generated per day (Kilograms) in the selected hospitals.

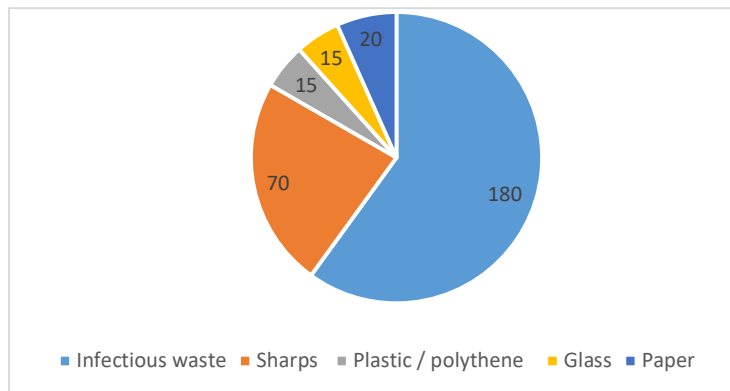


Figure 3: The Amount of Health care Waste generated per day

A. Multiple Regression Analysis

i. Reliability and Validity Test

The reliability test is used to estimate internal consistency reliability estimation to explain how the results are consistent for the different items for the same construct within the measure. The validity test accuracy of the operationalization of the variables and indicators. It reflects the ability of the measurement of the variable.

In this study, 22 pretest questions were used in the questionnaire in different categories to reflect the entire practice of the health Care Waste Procedures. The SPSS 21 was used to calculate the reliability and validity of each indicator.

Table 2: Reliability and Validity Test

Reliability Statistics			Validity of Statistics				
Criteria	Cronbach's Alpha	N of Items	Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	Bartlett's Test of Sphericity	Sig.	Extraction	Variance %
Health Care Waste Management (HCWM)	0.969	4	.862	119.973	.000	HCWM_Q1= .917 HCWM_Q2= .953 HCWM_Q3= .895 HCWM_Q4= .899	91.600
Waste Minimization (WM)	0.966	2	.500	46.443	.000	WM_Q1= .967 WM_Q2= .967	96.719
Segregation of Health Care Waste (SHWC)	0.947	3	.709	87.165	.000	SHCW_Q1= .953 SHCW_Q2= .942 SHCW_Q3= .827	90.732
Waste Collection (WC)	0.862	3	.602	54.763	.000	WC_Q1 = .932 WC_Q2 = .856 WC_Q3 = .655	81.445
On-site transportation & storage (OSTS)	0.865	4	.692	62.084	.000	OSTS_Q1= .548 OSTS_Q2= .864 OSTS_Q3= .835 OSTS_Q4= .693	73.507
Waste treatment and disposal (WTD)	0.827	6	.683	84.701	.000	WTD_Q1= .568 WTD_Q2= .869 WTD_Q3= .828 WTD_Q4= .851 WTD_Q5= .825 WTD_Q6= .820	79.345

Source: Estimated, IBM SPSS Statistics 21, 2020

According to table 2, Health Care Waste Management consists of four questions. The overall variance explained by this component was 91.6%, and the reliability statistics show the internal consistency in a Cronbach alpha of 0.969, which indicated the excellent internal consistency. Two Questions consisted of Waste Minimization. It shows 96.7% overall variance explained by the variable, and the Cronbach Alpha of 0.966 represents the excellent internal consistency. Segregation of Health Care Waste included three questions. The overall variance explained by this category was 90.7%. The Cronbach Alphas shows a value of 0.947, which denoted excellent internal consistency of the component. The Waste Collection component is made of three questions. The overall variance explained by this component is 81.4%.

The Cronbach Alpha of 0.862 which indicate the excellent internal consistency of the component. On-site transportation & storage component prepared by using four questions. The

overall variance explained by this component is 73.5%. The reliability statistics show the internal consistency in a Cronbach alpha of 0.865, which indicated the right internal consistency. The final component of the research, Waste treatment, and disposal consists of six questions that are closely related. The overall variance explained by this component is 79.345. The reliability statistics show 0.827 of Cronbach Alpha value. It indicates the right internal consistency between the indicators of the component. It emphasizes that all the components show the right internal consistency, and the questions have a high ability to represent the variables. So the mean values of the indicators in the component are considered as a variable—for example, the mean of Health care Waste management.

$$HWW_M = \frac{\sum_{k=1}^{i=n} HCWM_i}{n}$$

ii. Regression Analysis

Examine the relationship between health care waste Procedure impacts on effective health care waste management, and the specified indicators had been analyzed by using ordinary Least Squares (OLS). In this multiple regression model, the effectiveness of Health care waste management is the dependent variable. And the procedures of the health care waste management are the independent variable

$$HCWM_{ij} = \beta_0 + \beta_1 WM_{ij} + \beta_2 SHCW_{ij} + \beta_3 WC_{ij} + \beta_4 OST S_{ij} + \beta_5 WTD_{ij} + u_i$$

HCWM - Health Care Waste Management

WM - Waste Minimization

SHCW - Segregation of Health Care Waste

WC - Waste Collection

OSTS - On-site transportation & storage

WTD - Waste treatment and disposal

U - Error Term

Model Summary

Table 3: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.993 ^a	.987	.982	.11084	2.529
a. Predictors: (Constant), WTD_M, SHCW_M, OST S_M, WM_M, WC_M					
b. Dependent Variable: HCWM_M					

Source: Estimated, IBM SPSS Statistics 21, 2020

In the model, R-value is 0.993, which indicates the excellent relationship between Health care waste management procedures and effective health care waste management. Moreover, the Adjusted R statistics show 0.982. The HCW Procedures influence HCW Management by 98%. The unexplained variation is 0.11084 is lower than the explained variation, which indicates that the status model is good fitted to analyze.

According to the independent variables, the $k = 5$ so the $d_L = 0.538$ $d_U = 1.736$. Durbin Watson statistics of the model is 2.539, which fall between $4 - d_U$ and $4 - d_L$. This determines we cannot reach any decision about autocorrelation in the model.

ANOVA Analysis

Table 4: ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	12.812	5	2.562	208.586	.000b
	Residual	.172	14	.012		
	Total	12.984	19			
a. Dependent Variable: HCWM_M						
b. Predictors: (Constant), WTD_M, SHCW_M, OSTS_M, WM_M, WC_M						

Source: Estimated, IBM SPSS Statistics 21, 2020

According to table 4, it can be identified that 12.812 variances were explained by regression and only 0.172 variances explained by the residuals. The F value is 208.586 shows most of the variance explained by the model. P-value is 0.00 show the model is significant at 1% of the confidence interval.

Regression results

Table 5: Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	5.965	.491		12.144	.000*
	WM_M	-.066	.100	-.070	-.655	.523 ^{ns}
	SHCW_M	-1.691	.253	-1.815	-6.687	.000*
	WC_M	1.523	.305	1.685	4.996	.000*
	OSTS_M	.426	.104	.552	4.114	.001*
	WTD_M	-.607	.146	-.219	-4.144	.001*
Significant value: 1% - *, 5% - **, 10% - ***						
Not significant - ns						

Source: Estimated, IBM SPSS Statistics 21, 2020

Evidence to table 5, the equation for the regression line is,

$$HCWM_{ij} = 5.965 - 1.691 SHCW_{ij} + 1.523 WC_{ij} + 0.426 OSTS_{ij} - 0.607 WTD_{ij} + u_i$$

In table 5, Segregation of Health Care Waste, Waste Collection, On-site transportation & storage, and waste treatment and disposal are significantly influenced by the Health Care Waste Management in this area. In that Segregation of Health Care, Waste and Waste treatment & disposal have a negative relationship with the Health Care Waste Management. The other variables have a positive impact on the effective Health care waste management. Waste minimization does not significantly influence effective health care waste management, and also it has a negative relationship.

Waste Collection, On-site transportation & storage have a significant value of 0.000, 0.001, and the coefficient value is 1.523 and 0.426, respectively. Hence this model indicates these variables positively more substantial influence on HCWM. The coefficient value of the Segregation of Health Care Waste

is -1.691, and the Probability value is 0.00. So it is significant at a 1% confidence interval. It has a significant influence on HCWM.

Nevertheless, the model shows the negative relationship, which indicates that the segregation procedure should enhance by the hospital to make effective health care waste management. Moreover, the coefficient value of Waste treatment and disposal is -.607 and the probability value is 0.001, which indicates significant at a 1% confidence interval. However, there is a negative relationship between Waste treatment and disposal and the HCWM.

B. Prototype result and discussion



Figure 4: Login Interface of CWM



Figure 5: Wrong Password Interface of CWM



Figure 6: Correct Password Interface

Result Grid

userId	username	password
1	admin	admin123
NULL	NULL	NULL

Figure 7: Database stored username password

Figure 4, Figure 5, Figure 6, and Figure 7 show the Login interface of CWM, the Wrong password interface of CWM, the Correct password interface of CWM, and the user's database information. If the user wants to login, he/she must use the correct username password as in the database; otherwise, the user stuck as in Figure 5. This authentication process provides

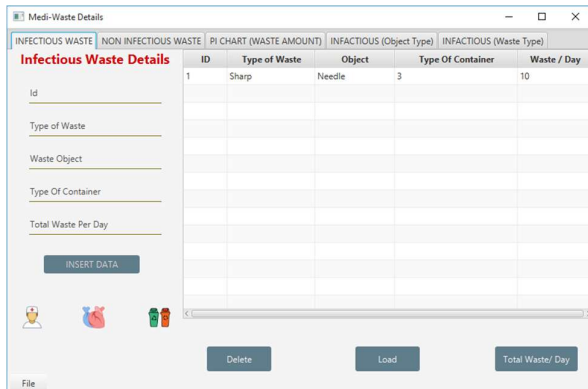


Figure 8: Infectious Waste Tab Interface of CWM

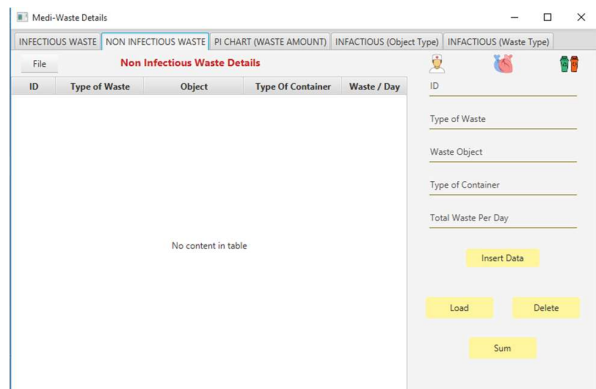


Figure 9: Non-Infectious Waste Tab Interface of CWM

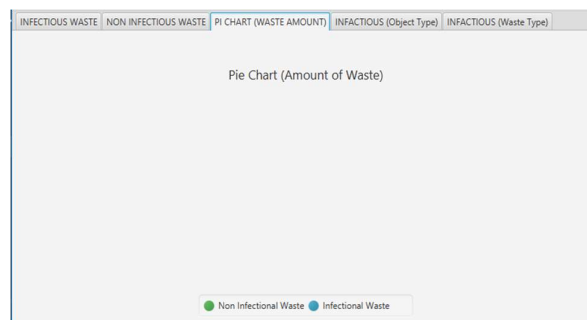


Figure 10: Pie Chart interface of All Waste (3rd Tab)

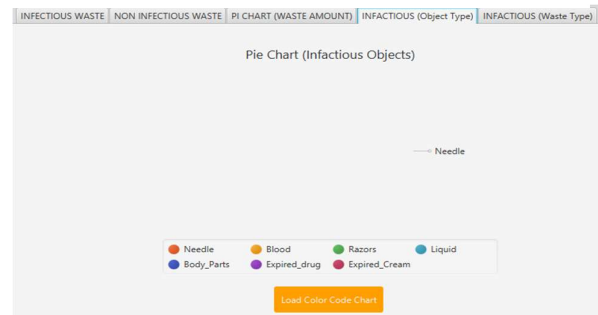


Figure 11: Pie Chart interface of Infectious object's waste (4th Tab)

security to the data and only the authorized person can access to do their task.

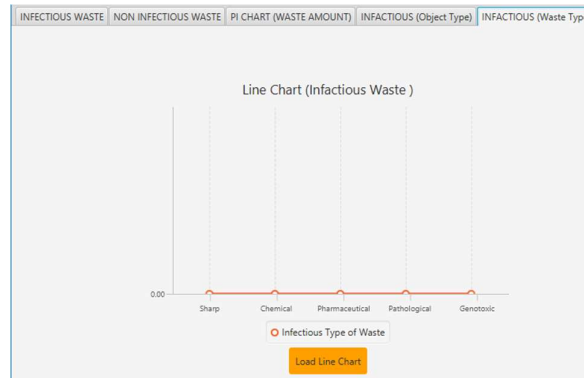


Figure 12: Line Chart Interface of Infectious waste type (5th Tab)

Figure 8 – Figure 12 shows all five tabs mentioned in Methodology parts. Before inserting any data each interface just showing as merely interface and there is no data interaction happened in between the database and CWM interface

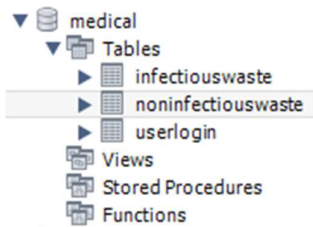


Figure 13: Database and Tables of prototype

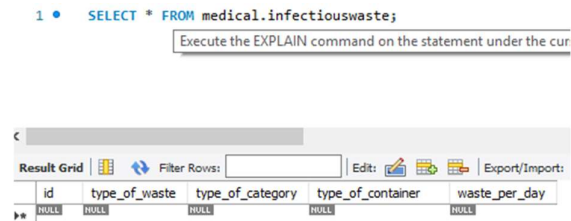


Figure 14: Infectious waste table and columns

Figure 13 and 14 shows the Database tables and columns of Infectious waste respectively. There is no data due to no insertion of database.

If the user wants to insert data, they must go to the left side edit texts as in Figure 15 to fill the edit texts and need to click the “INSERT DATA” button. Once the user has done clicking, a success message appears in the bottom, as in Figure 16. If the user wants to show the data in the table view, he/she must click the “Load” button; once after that button pressed, data will be appeared in the table view as in Figure 17. When the user inserts data, it also will be stored in the back end database, as in Figure 18. Users can check that using MySQL workbench.

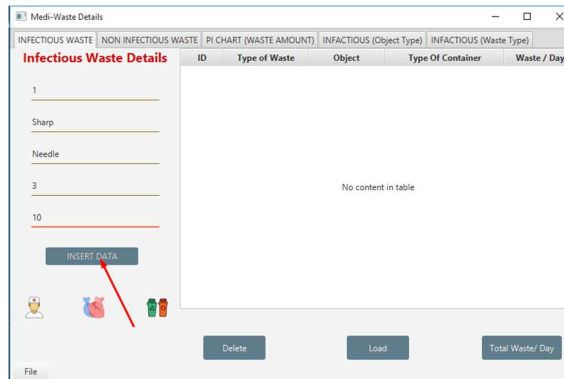


Figure 15: Inserting data in Infectious waste Edit text

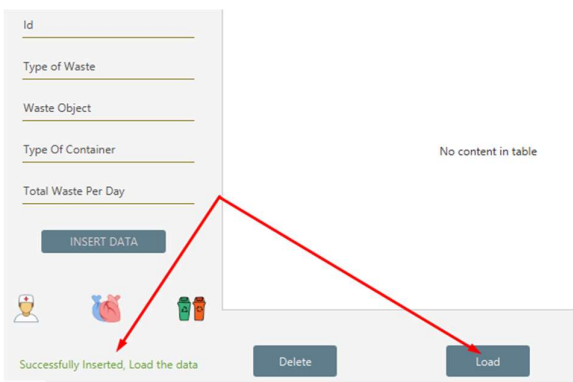


Figure 16: Insert Success Message

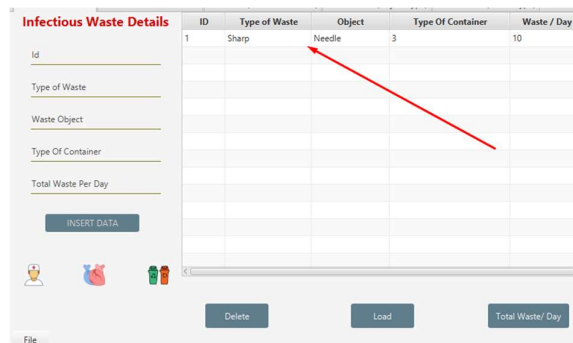


Figure 17: Inserted and Loaded Data in Table View

Result Grid | Filter Rows: | Edit: | Export/Import:

id	type_of_waste	type_of_category	type_of_container	waste_per_day
1	Sharp	Needle	3	10
NULL	NULL	NULL	NULL	NULL

Figure 18: Inserted Data in infectious waste database table

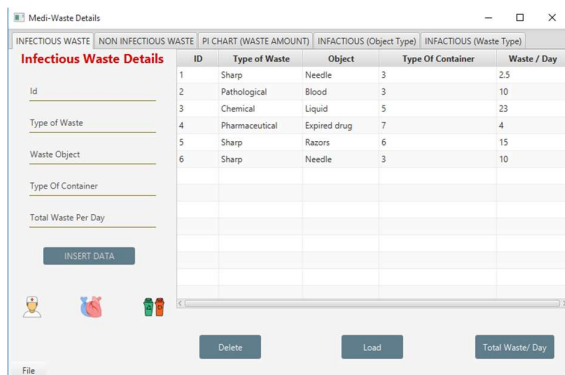


Figure 19: Inserted Infectious waste Data

Limit to 1000 rows

```
1 • SELECT * FROM medical.infectiouswaste;
```

Result Grid | Filter Rows: | Edit: | Export/Import: | Wrap Cell

id	type_of_waste	type_of_category	type_of_container	waste_per_day
1	Sharp	Needle	3	2.5
2	Pathological	Blood	3	10
3	Chemical	Liquid	5	23
4	Pharmaceutical	Expired drug	7	4
5	Sharp	Razors	6	15
NULL	NULL	NULL	NULL	NULL

Figure 20: Infectious waste Database

Figures 19 and 20 show some inserted data in the table view and database view, respectively. When users click the “Total Waste/Day” button, users will interact with the output as in Figure 21. The system calculates and generates the sum using a dialog box. Figures 22, 23, and 24 are the Graphical representation of the data given in Figure 19 and Figure 25. Figure 22 shows the total sum percentage of infectious waste and non-infectious waste. Based on the Pie chart in Figure 22, a worker from the clinical waste management can make some decisions, like “which waste is produced high amount,” “why this amount of waste is high today.” Using such questions, they can explore more information relevant to patients and other needed things.

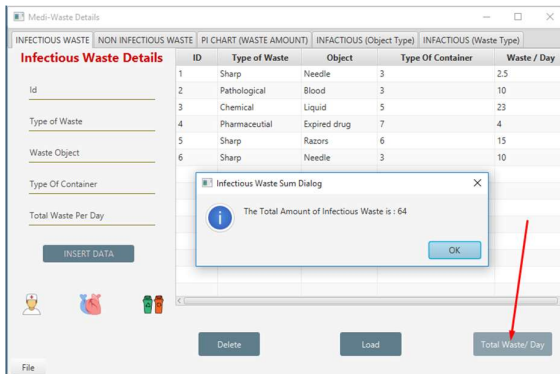


Figure 21: Total Sum of Infectious Waste

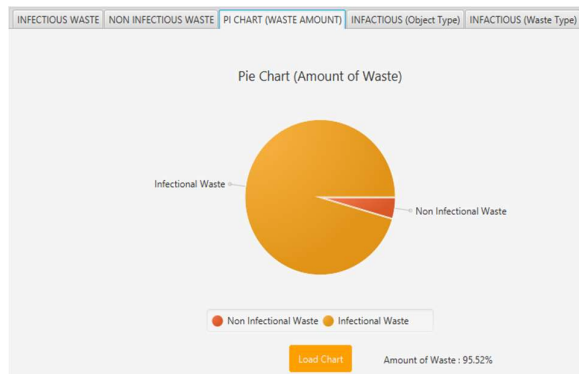


Figure 22: Pi Chart of Percentage Comparison of both infectious and non-infectious Waste

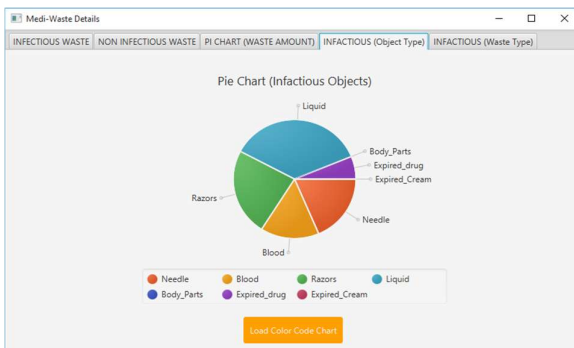


Figure 23: Pi Chart of Infectious Objects



Figure 24: Line Chart for infectious waste

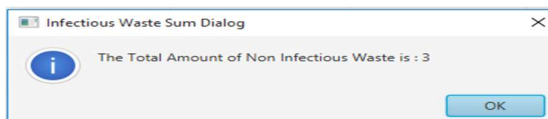


Figure 25: Sum dialog box of non-infectious waste

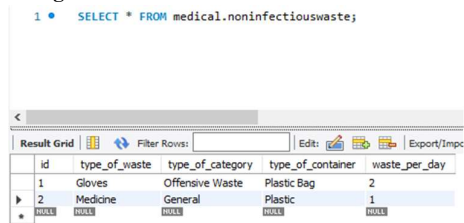


Figure 26: Database table information of non-infectious waste before delete

Also, Figure 23 shows the Pie Chart of the infectious object in percentage. With this chart's help, users can be identified which infectious object is used highly (Reference to chart Liquid is highly used waste) and which is used low (Expired drug), based on monthly details from this list will help to the high decision-making process. Furthermore, from Figure 24, users can identify which type of waste is produced highly per day in a hospital and can make more predictions according to that.

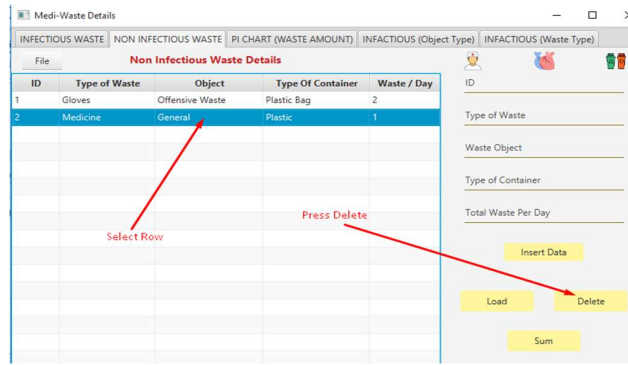


Figure 27: Selection and deletion of non-infectious waste

Figure 26 and 28 show the non-infectious waste table before and after deleted correspondingly. If a user wants to delete tuples (rows) from the database, they must select that row first, and they want to click the delete button, as in Figure 27. Once they have done, they will interact with Figure 29. Also, data from the database will be discarded, as in Figure 28.

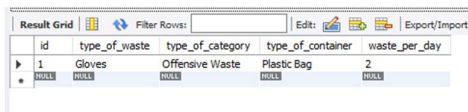


Figure 28: Database table after delete



Figure 29: Non-infectious interface after deletion

Figures 30 and 31 show the print button and print information interface when users make page setup from this window and can be printed the document as their desire.



Figure 30: Print Button of Infectious Waste

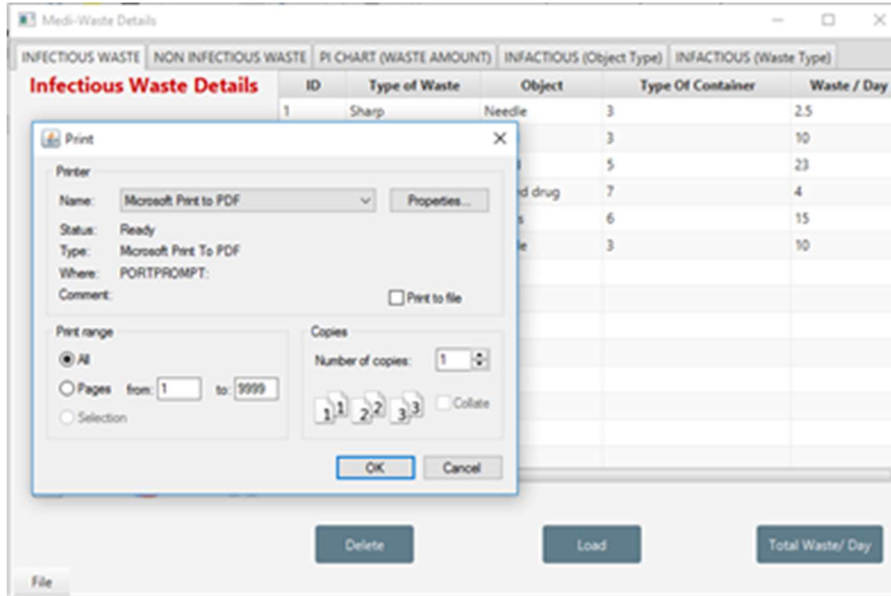


Figure 31: Print Interface of Infectious Waste

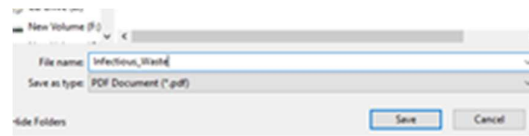


Figure 32: Save the data into pdf document



Figure 33: Saved Pdf

Figure 34 shows the infectious data opened in pdf format. Users can either be get printed documents, or they can be saved the documents in their preferred place on their pc.



ID	Type of Waste	Object	Type Of Container	Was
1	Sharp	Needle	3	2.5
2	Pathological	Blood	3	10
3	Chemical	Liquid	5	23
4	Pharmaceutical	Expired drug	7	4
5	Sharp	Razors	6	15
6	Sharp	Needle	3	10

Figure 34: Stored Data in Pdf

Figure 4 – Figure 34 shows all the functionality done using the clinical waste management software prototype. It is evident from all figures that we can store and do data relevant activities quickly and efficiently. Using a graphical representation, users can be made the best decision in the clinical waste management process. Hence this prototype works as a Decision support system as well as a Security system when compared with the existing spreadsheet system. There is no way to alter speech; the full system with this evolutionary prototype helps the clinical waste management system considerably.

VI. CONCLUSION AND RECOMMENDATION

So, according to the regression results, the effectiveness of Health care waste is negatively influenced by the Segregation of Health Care Waste and Waste treatment & disposal. According to the interview, a medical officer from the selected hospital declares that there are issues in the segregation process. Segregation consists of separating different types of waste based on the type of treatment and disposal practices. The following practices proceeded by the selected hospitals Kalmunai MOH Division

- It takes place at the point of generation of waste.
- A different color-coded used.
- Different containers are used.

The hospital does not follow any system to compute the overall waste amount; the hospital Quality Control Unit should know the amount of waste generated to make decisions about the segregation procedure equipment and tools. However, the hospitals used the traditional data entry method, which could not make any decisions that support conclusions.

Also, in Waste treatment & disposal, the selected hospitals show efficient progress in Infectious solid HW and Sharps. Those preferably are incinerated in a double chamber incinerator. In one hospital, there are using an innovative process in incineration. They are using the Petrol incinerator developed by themselves using a nebulizer which needs a meager amount of petrol

and carbonless. Also, in the procedure, they are using the final disposed water from the ARO plant for gardening, car wash, and ward cleaning process. Even though some hospitals facing issues in the disposal and waste treatments. They emphasize that the current practices they are following are not 100 percent efficient. Another issue is that there is a lack of efficient technology to dispose of radioactive and chemical waste. The reason for this is that waste is generated very rarely. Another issue is seasonal waste generation. Sometimes in the hospital, some waste is generated highly in a particular period. So we should follow the mechanism to handles that. A great example in the current situation is COVID 19. Typically the infectious waste is generated highly. So the administration should be ready to do the procedures to handle that. For this kind of issue, the hospital should have a proper computerized data management system to make proper decision-making to dispose of this waste promptly. Without true wisdom from data management, it is an impossible task.

Also, According to the regression analysis, it is highly recommended that a software system is required to manage the health care waste management for appropriate decision making and exact forecast relevant to health care waste. Therefore this study developed a software prototype based on a Database management system, which is highly effective in the data process. It tries to improve the method of waste management for making important decisions regarding the Health care waste procedure to have a standardized Health care waste management system sheltering Whole Island with sustainable solutions. Suppose if the use or amount of data increases gradually, to store and compute the data, these prototypes can be switched to a “NoSQL” database management system, which allows them to store and process a massive amount of data without failure. “NoSQL” database management is used by social networking sites these days. Very famous examples are “Facebook,” “Twitter,” “YouTube,” and so forth. Hence this prototype is highly flexible, and it has the ability to adapt to the latest technology; therefore, this required software system of data management certainly delivers a sustainable solution in the health care waste management Industry.

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