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Analysis of Food Waste That Contains Carbohydrate Starch in Hospital

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Hospital "X" provides class A health service. Its service activities produce positive and negative impacts. One of them is food waste originating from hospitalisation. This research aims to obtain quantitative potential of food waste that contains carbohydrate starch (rice waste) and its utilisation. The method used is Absolute Deviations and then analysed using SEM. The results obtained from the arising of rice waste amounted to 36.25% or 0.29 kg per patient per day, and as a comparison of inpatients dispose of food waste an average of 953 grams per day in Portuguese hospitals (Dias-Ferreira, Santos and Oliveira, 2015) and food served to inpatients in hospitals, amounting to 41.6% wasted not utilised (Schiavone, Pelullo and Attena, 2019).

Key words: *Waste, food, carbohydrates, hospital, absolute deviations.*

Introduction

Hospitals with class A at least provide services that include medical services, pharmaceutical services, nursing and midwifery services, clinical support services, non-clinical support services, and inpatient services (Peraturan Menteri Kesehatan Republik Indonesia Nomor 56, 2014). The implementation of eco-hospitals is the reduction of waste (Peraturan Menteri Kesehatan Republik Indonesia Nomor 7, 2019). Food waste is a challenge for most hospitals, which is not just a matter of cost but also in terms of nutrition (Ofei *et al.*, 2015). Our research shows concern about the results of the percentage of food waste that requires hospital manager assertiveness. This hospital food waste not only has environmental and economic consequences, but has patient health consequences due to malnutrition. (Schiavone, Pelullo and Attena, 2019).

The issue of food waste is increasingly being discussed and considered. Even some articles have written down the value of the quantity of food wasted (Hooge *et al.*, 2017). Food waste is something that can be eaten as human consumption and discarded, lost, degraded, and consumed by pests on the way to consumers. Food waste has an important influence on natural resources and environmental protection (Otles, Semih; Despoudi, Stella; Bucatariu, Camelia; Kartal, 2015). Food waste can be interpreted as all food, food parts that cannot be eaten, removed from the food supply chain and then discarded, so that it can be defined briefly that all food is lost or discarded, although it is still suitable for human consumption (Aschemann-witzel and Hooge, 2018). Food waste is produced from a variety of different behaviours, from planning, purchasing, storage, preparation to serving and when consuming (Roodhuyzen *et al.*, 2017).

Food waste can occur on all supply chain trips, and as much as 35% at the level of final consumption (Chalak *et al.*, 2020). In Europe, approximately 100 kg of food is wasted as per capita waste per year. It is estimated that around 52% is lost at the consumer level, 30% of food in the UK and 9.2% in Sweden is wasted because it has expired (Ceuppens *et al.*, 2016). Globally, approximately one third of food for human consumption is wasted, which is around 1.3 billion tons per year (Schanes, Dobernig and Gözet, 2018). Food waste in the household averages 614-1220 g / week (Herpen *et al.*, 2019). Wasted food waste ranges from 194–389 kg / person / year on a global scale and 158–298 kg / person / year on a European scale (Corrado and Sala, 2018). Inpatients dispose of food waste an average of 953 grams per day in Portuguese hospitals (Dias-Ferreira, Santos and Oliveira, 2015). Research says that food from hospitals contributes to 50% of all waste. Environmental factors, the patient's clinical condition, food and diet are included in the recommendations for the high levels of waste in the hospital (Goonan *et al.*, 2014). Food served to inpatients in hospitals, amounting to 41.6% was wasted not utilised. This figure is higher than the previous research which is around 25-40% (Schiavone, Pelullo and Attena, 2019). Vegetable and fruit waste is discharged flowing into rivers, landfills to produce leachate and methane emissions and biodegradability that can be an environmental threat (Mullen *et al.*, 2015). High food waste can cause adverse environmental impacts, one of which is greenhouse gases (Parizeau, Massow and Martin, 2015). Food causes about one third of the total which causes greenhouse gas emissions (Aschemann-witzel *et al.*, 2015). Only a few researchers have investigated the role of food consumption in producing food waste (Schanes, Dobernig and Gözet, 2018). Reducing food waste is an action needed for more sustainable food security (Aschemann-witzel *et al.*, 2015). A company has begun to become socially responsible, namely through food supply chain actors who have acted to avoid and reduce food waste (Aschemann-Witzel, de Hooge and Normann, 2016).

Based on these thoughts, this research focuses on “Analysis of Food Waste That Contains Carbohydrate Starch in Hospital”.

Method

Research Methods

The first step in this research begins with the idea through the literature, a study of food waste flow systems that contains carbohydrate starch (rice waste) in hospitals. Inpatient services produce rice waste which is the arising and observed data for eight consecutive days. These evaluations and calculations are carried out starting from sorting, keeping and collecting. Nurse assistants monitored by the head of the room do sorting, keeping and collecting in each room, involving cleaning service (CS). CS has the responsibility in the process of collection, transportation and weighing which is then transported to a temporary shelter. This weighing process will be the data arising (kg).

The method of collecting field data is carried out according to the schedule of transporting garbage to the Temporary Shelter (TPS) by CS every morning and afternoon. Data of arising of rice waste is taken every transportation period. The frequency of sampling was carried out for eight consecutive days.

Statistical Analysis

Statistical analysis using Originpro software, which is homogeneity of morning and afternoon of arising of rice waste data for eight consecutive days, was tested using Levene's Test (Absolute Deviations), with the results of population variations are or are not significantly different. Originppro is also used to test regression between latent variables. Analysis to test the relationship between latent variables and indicators uses SEM WarpPLS approach.

Results and Discussion

Rice Waste Analysis

Data recapitulation of arising of rice waste for eight consecutive days in the morning (table 3.1), comes from rice served at 200 g per patient in the morning and 300 g per patient in the evening. Arising of rice waste in the afternoon (table 3.2), comes from rice served at 300 g per patient:

Table 3.1: Data recapitulation of arising of rice waste (morning)

Inpatients Room	**Days to**							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1	0.5	2	1.5	1.5	2	3	0.6	3
2	5	4	3.5	3.5	3	2	5	3
3	3	3.5	4.5	2	1	0	0.4	2
4	2.5	7	3	2.5	3	4	3	5
5	3	2.5	3	3	3.5	3.5	2	3
6	7.5	7	5	4.5	4.5	3.5	8	5
7	0.6	0.5	0	0	0	0	0.3	0
8	0.5	0.5	0	0	0	0	0.6	0
9	2	2	3.5	1	1	1.5	0	3
10	1.5	1	2.5	3	3.5	4	2	2
11	0.5	1.5	1.5	1.5	1.5	1.5	1	2
12	1	1	0.1	0.1	0.1	0.1	0	1
13	2.5	1	3	3.5	4	4.5	3	3
14	2.5	2.5	5	3.5	3	3.5	3	3
15	0.4	3	3	2	2	2	2	2
16	0.5	1	1	1	2	2.5	1	2.5
17	1.5	1	2	2	2	2	1.5	2
18	3.5	4	2	2.5	3	3	4	5
19	1.5	1	1.5	1.5	2	1	2	1.5
20	1	0	0.5	0.5	1	2	1.5	2
Average	2.05	2.30	2.31	1.96	2.11	2.18	2.05	2.50
STDev	1.78	1.98	1.57	1.30	1.33	1.45	1.94	1.40
Total (kg)	41	46	46.1	39.1	42.1	43.6	40.9	50
BOR (%)	41.99	42.07	38.65	37.41	40.25	42.55	43.97	50.53

Source: Survey Data

Inpatients rooms 4, 6 and 18 have the highest of arising of rice waste. This is due to the higher quantity of patients, as explained in table 3.3

Table 3.2: Data recapitulation of arising of rice waste (afternoon)

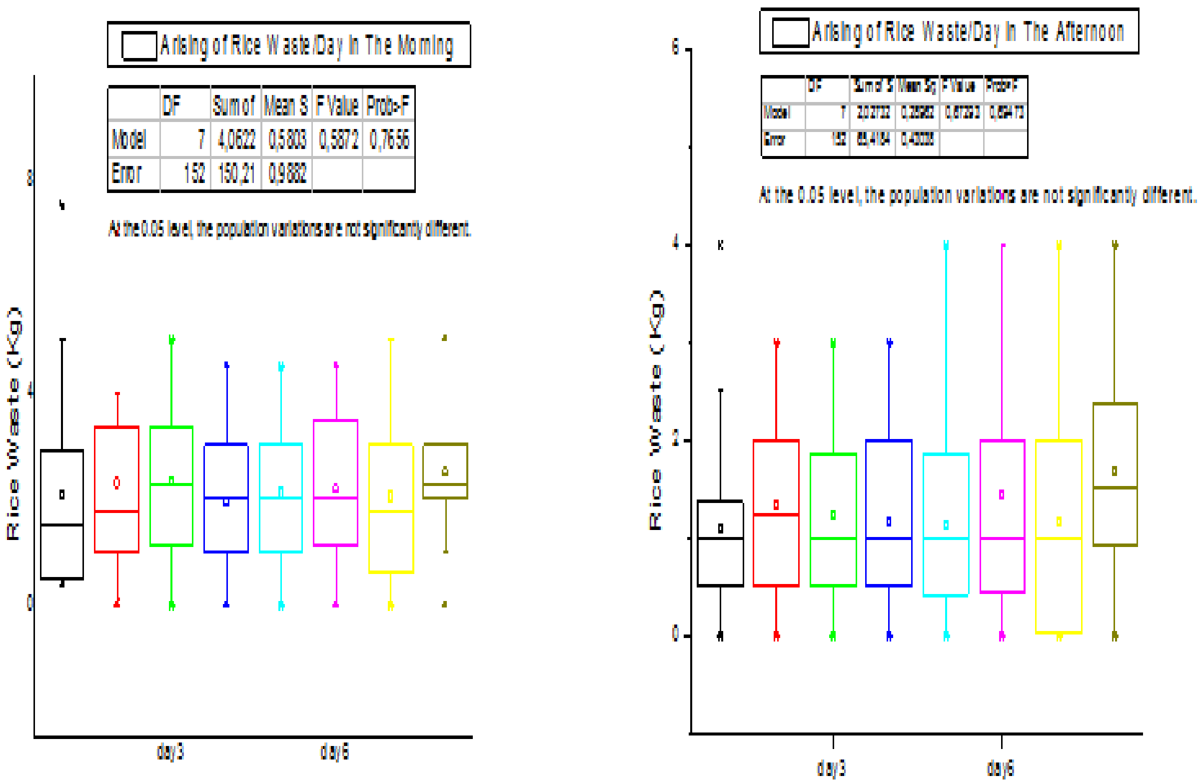
Inpatients Room	**Days to**							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1	0.5	1	0.5	1	0.5	1	0.6	0.9
2	2.5	2	1.5	2	2	1.5	2	1
3	1	2	2	1	0.4	0	0.1	0.8
4	0	3	3	3	4	4.5	4	4
5	1	2	2.5	2	2	3	2	2
6	3	2	3	3	3	4	4	4
7	0	0	0.5	0	0	0	0	0
8	0	0	0	0	0	0	0	0
9	1	0.5	1.5	0.5	0.6	0.7	0	1
10	1	2	1.5	2	1.5	2	2	3
11	4	1	1.5	1	1	2	1	1.5
12	0.6	0.5	0.5	0	0	0	0	0.4
13	1	0.5	0.5	0.5	1	2	1	1.5
14	1	1.5	1	1.5	1	1	0	1.5
15	1.5	3	0.5	1	0.5	0.4	0.5	2.5
16	0.5	1.5	1	1.5	1	1	1	1.5
17	1	0.5	1	0.5	0.6	0.6	0.6	2
18	1.5	3	2.5	2	2.5	3	2	4
19	0.6	1	0.5	1	1	1	1.5	1
20	0.5	0	0	0	0	1	1	1
Average	1.11	1.35	1.25	1.18	1.13	1.44	1.17	1.68
STDev	1.02	1.00	0.94	0.94	1.08	1.32	1.22	1.24
Total (kg)	22.2	27	25	23.5	22.6	28.7	23.3	33.6
BOR (%)	42.07	42.07	38.65	37.41	40.25	42.55	43.97	50.53

Source: Survey Data

Higher and lower value of arising of rice waste is caused by the number of patients as described in Figures 3.2 and 3.3, namely latent variable patients affect latent variable Rice.

The results of Levene's Test and ANOVA data of arising of rice waste each room in the morning and afternoon, *Graph 3.1:*

Graph 3.1. Arising of Rice Waste in The Morning and Afternoon



Data of arising of rice waste in the morning and afternoon was tested using the Levene's Test (Absolute Deviations) Originpro software, having population variations are not significantly different. Data recapitulation of arising of rice waste during the day for eight consecutive days is listed in table 3.1, table 3.2 and graph 3.1 above.

Variable Analysis

Variable analysis is used to test the relationship between latent variables. The recapitulation data of latent variable of Rice (arising of rice waste) is presented as in Tables 3.1 and 3.2, recapitulation data of latent variable of patients and BOR in Tables 3.3 and 3.4:

Table 3.3: Data Recapitulation of Patient (morning and afternoon)

Inpatients Room	**Days to**							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1	4	6	6	8	10	11	10	10
2	10	9	7	8	8	9	10	8
3	12	8	9	5	3	1	2	6
4	33	32	32	31	31	33	39	41
5	11	10	12	11	11	12	13	14
6	26	25	25	26	25	26	31	31
7	5	5	2	2	2	2	2	2
8	1	1	1	1	1	1	3	4
9	6	8	7	2	6	6	1	9
10	19	18	18	18	19	19	23	26
11	14	15	12	13	14	15	14	15
12	3	2	1	1	1	1	1	4
13	12	12	11	11	12	14	15	14
14	13	14	10	9	9	9	9	13
15	9	12	5	4	4	5	6	12
16	10	12	11	11	12	11	12	15
17	3	2	4	4	4	6	8	12
18	28	26	25	25	34	36	28	27
19	10	11	12	12	12	13	11	11
20	8	8	8	9	9	10	10	11
Average	11.85	11.80	10.90	10.55	11.35	12.00	12.40	14.25
STDev	8.63	8.21	8.34	8.56	9.42	9.96	10.45	9.85

Source: Survey Data

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Volume 11, Issue 6, 2020

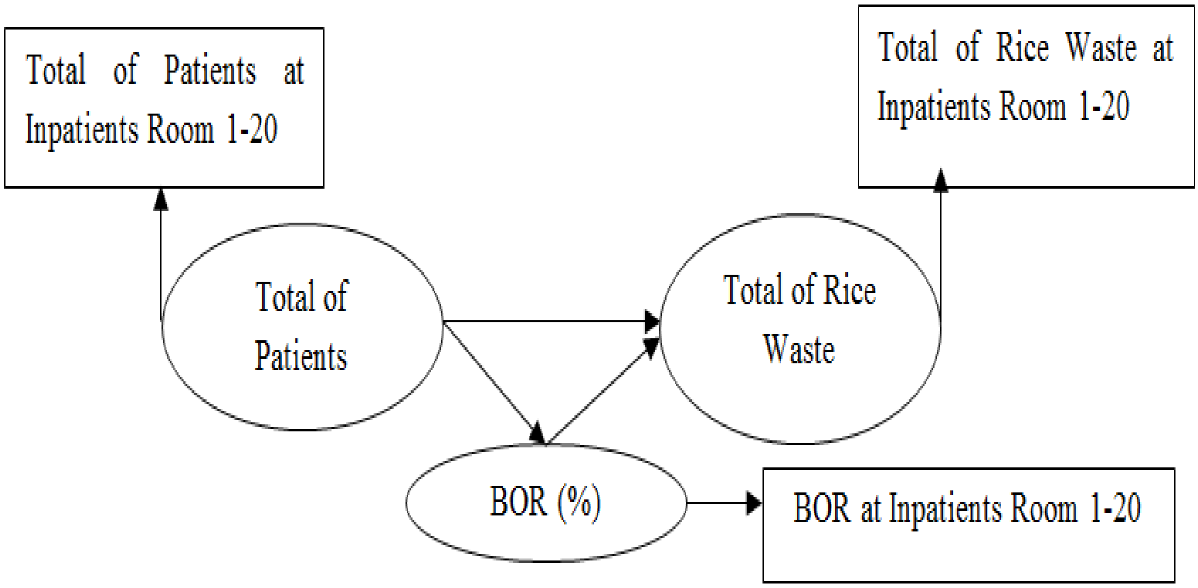
Table 3.4: Data Recapitulation of BOR morning and afternoon (%)

Inpatients Room	**Days to**							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1	21.05	31.58	33.33	44.44	55.56	61.11	55.56	55.56
2	50	45	35	40	40	45	50	40
3	34.29	22.86	25.71	14.29	8.57	2.86	5.71	17.14
4	56.9	55.17	55.17	53.45	53.45	56.9	67.24	70.69
5	30.56	27.78	33.33	30.56	30.56	33.33	36.11	38.89
6	42.62	40.98	40.98	42.62	40.98	42.62	50.82	50.82
7	62.5	62.5	25	25	25	25	25	25
8	11.11	11.11	11.11	11.11	11.11	11.11	33.33	44.44
9	20	26.67	23.33	6.67	20	20	3.33	30
10	44.19	41.86	41.86	41.86	44.19	44.19	53.49	60.47
11	34.15	36.59	29.27	31.71	34.15	36.59	34.15	36.59
12	50	33.33	16.67	16.67	16.67	16.67	16.67	66.67
13	70.59	70.59	64.71	64.71	70.59	82.35	88.24	82.35
14	59.09	63.64	45.45	40.91	40.91	40.91	40.91	59.09
15	37.5	50	20.83	16.67	16.67	20.83	25	50
16	40	48	44	44	48	44	48	60
17	13.64	9.09	16	16	16	24	32	48
18	58.33	54.17	51.02	51.02	69.39	73.47	57.14	55.1
19	41.67	45.83	50	50	50	54.17	45.83	45.83
20	61.54	61.54	61.54	69.23	69.23	76.92	76.92	84.62
Average	41.99	41.91	36.22	35.55	38.05	40.60	42.27	51.06
STDev	17.00	17.15	15.47	18.02	19.76	22.16	21.81	17.53

Source: Survey Data

Model of the relationship between latent variables and their indicators in Figure 3.1:

Figure 3.1. Model Latent Variable and Their Indicators



Furthermore, the model processed using WarpPLS software produces the following models in Figure 3.2 and Figure 3.3:

Figure 3.2. Latent Variable Model of Arising of Rice Waste in The Morning (Software WarpPLS)

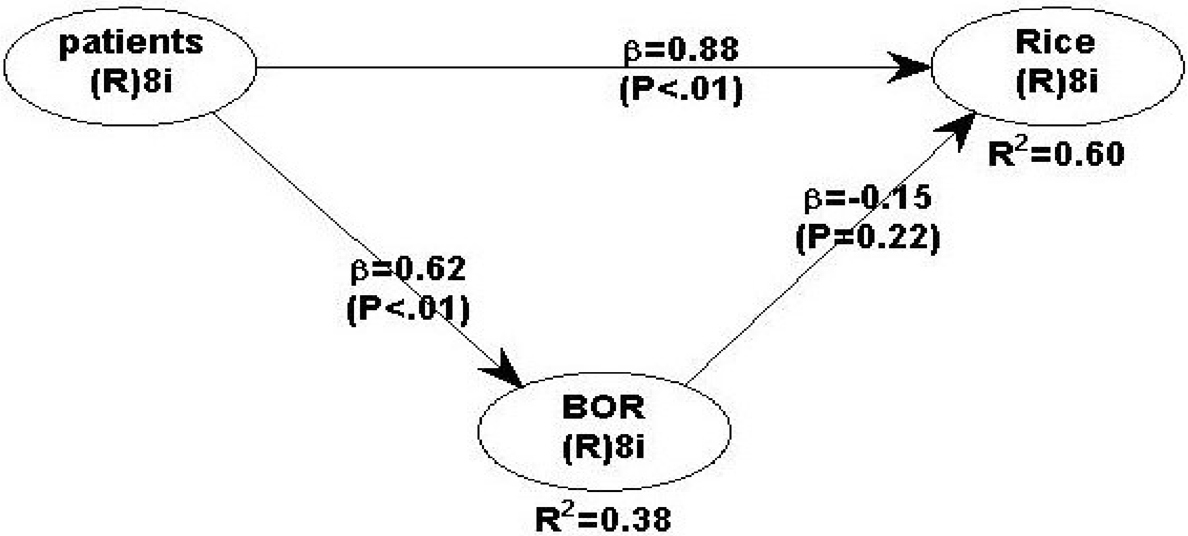
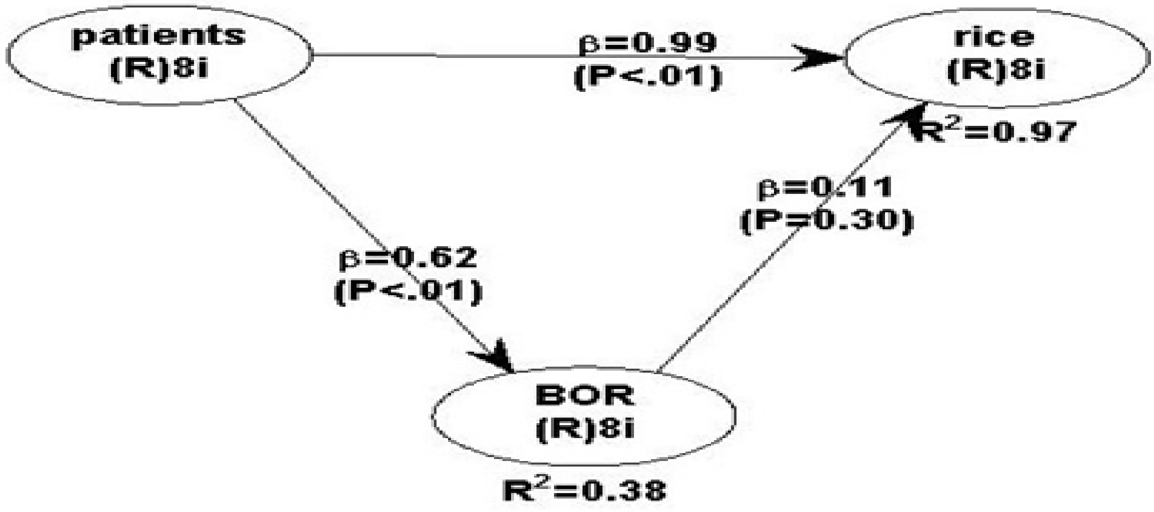


Figure 3.3. Latent Variable Model of Arising of Rice Waste in The Afternoon (Software WarpPLS)



Based on the test results the direct effect in Figures 3.2 and 3.3 is known as follows:

1. Path coefficient from latent variable of patients (Total of Patients) to latent variable of BOR is positive. This shows that latent variable of patient has a positive effect on latent variable of BOR with a value of 0.62. p-values value <0.001, which means it is smaller than 0.05 significance, then latent variable of patient significantly influences latent variable of BOR (in the morning and in the afternoon)
2. Path coefficient from latent variable of patients (Total of Patient) to latents variable Rice (Total of Rice Waste), is positive. This shows that latent variable of patients has a positive effect on the latent variable of rice with a value of 0.88 (in the morning) and 0.99 (in the afternoon). P-values of value <0.001 (morning and afternoon), means it is smaller than 0.05 significance, then the latent variable of patient significantly influences latent variable of rice.
3. Path coefficient from latent variable of BOR to latent variable of Rice, is negative (morning and afternoon). This shows that latent variable of BOR has no influence (negative) on the latent variable of Rice. P-Values value = 0.22 (morning) and 0.30 (afternoon), which means that it is greater than 0.05 significance, then latent variable of BOR does not significantly influence latent variable of Rice.

Based on the discussion of direct influence test numbers 1 through 3, it concludes that BOR is not a mediator variable.

Regression of Variables

The results of statistical regression analysis used Originpro between latent variables Patients (Total of Patients) with latent variable rice (Total of Rice Waste) at morning and afternoon:

Figure 3.4. Regression Total of Patients with Total of Rice Waste (morning)

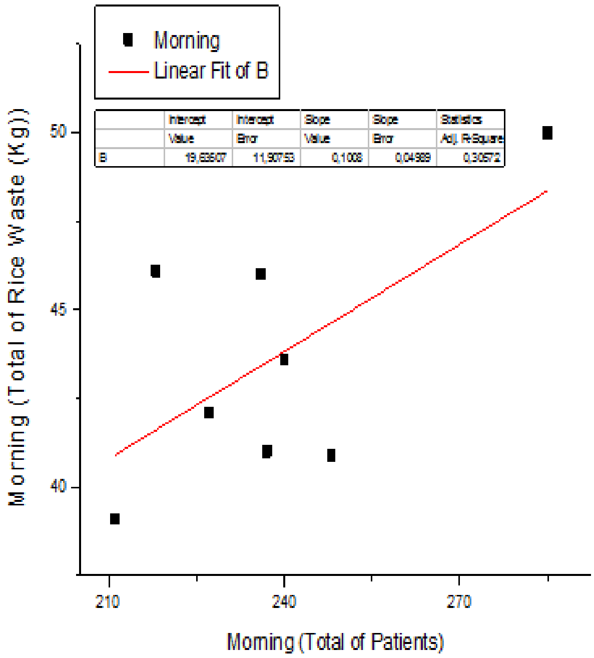


Figure 3.5. Regression Total of Patients with Total of Rice Waste (afternoon)

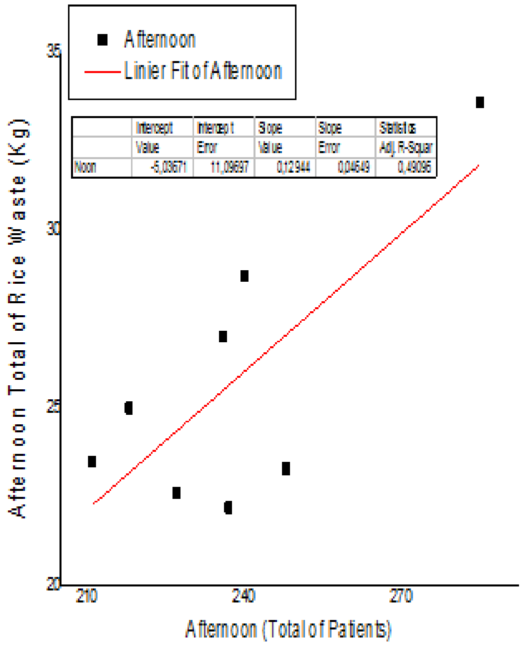


Figure 3.4 shows the equation y = 0.1008x + 19.63507 with Adj. R-Square 0.30572, Figure 3.5 equation y = 0.12944x - 5.03671 with Adj. R-Square 0.49096 where "x" is latent variable of patients and "y" is latent variable of Rice.

Arising of Rice Waste

Rice of 800 g per day is presented, resulting in the arising of rice waste from the calculation in the field for eight consecutive days, namely in the morning (arising of rice waste in the evening and morning) and afternoon is 36.25% or 0.29 kg / patient / day or 69.34 kg / day with a BOR of 42.19% and a total of 238 patients. Based on the calculation of the regression equation with 238 patients, the arising of rice waste is 43.63 kg (morning) and 25.77 (afternoon) so that the total is 69.40 kg / day or 0.29 kg / patient / day. Table 3.5 shows the average arising of rice waste and BOR as follows:

Table 3.5: Recapitulation of average arising of rice waste, total of patients dan BOR

Days to	Rice Waste	Total / Day	Total of Patients	Total / patients (3/4)	BOR (%)
1	**2**	**3**	**4**	**5**	**6**
1-mor	41	63.2	237	0.27	42.07
1-aft	22.2				
2-mor	46	73	236	0.31	42.07
2-aft	27				
3-mor	46,1	71.1	218	0.33	38.65
3-aft	25				
4-mor	39.1	62.6	211	0.30	37.41
4-aft	23.5				
5-mor	42.1	64.7	227	0.29	40.25
5-aft	22.6				
6-mor	43.6	72.3	240	0.30	42.55
6-aft	28.7				
7-mor	40.9	64.2	248	0.26	43.97
7-aft	23.3				
8-mor	50	83.6	285	0.29	50.53
8-aft	33.6				
		69.34	**238**	**0.29**	**42.19**

Source: Calculation Data
Note: mor is morning and aft is afternoon

Conclusion

Variable regression in the morning and afternoon, resulting in the remainder of inpatient service activities in the form of rice waste that can be utilised quantitatively to the next process as conveyed by journals and books as follows: making ethanol from raw materials of food waste, not only able to solve environmental problems, but can also provide renewable energy biofuels (Huang et al., 2015). Bioconversion by insects is a promising thing and provides an alternative to reduce food waste (Problem, 2019); (Nyakeri et al., 2017), and insects require large amounts of food waste on industrial production scale (Giroud et al., 2016). Therefore, researchers believe that there is a need for further research on the bioconversion of food waste in hospitals.

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