

## Improving Nutrition Services to Reduce Plate Waste in Patients Hospitalized Based on Theory of Constraint

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### ABSTRACT

**Background:** Highly plate waste in hospitalized patients has become a problem in Hospitals' nutrition service unit, this causes adding treatment time for patient's recovery and making the hospital service inefficient.

**Objectives:** To improve the quality of nutrition unit services by reducing plate wastes in hospitals.

**Methods:** This research uses a cross-sectional approach. The constraint causing analysis is done by observing dominant waste in each menu's component and conducting FGD (Focus Group Discussion) with the management team, nutrition unit, and other related units. The research sample is plates in total population that are 1,230 plates.

**Results:** In this study, it was found that 26.59% observed plates had food waste. Based on the causes of Constraint emergence, the results showed that *steamed rice* (41.9%) was mostly wasted menu components on main dish because the taste didn't meet the respondents' expectations. Furthermore, fish (46,0%) was the menu components on animal-based side dish that mostly wasted because of the fishy aroma and the thorn of fish. Whereas, Tofu (40,0%) was mostly wasted on plant-based side dish because the bland taste. While, soupless vegetable (49,35) was mostly wasted on vegetable dish because of the taste didn't meet respondents' expectations. This is because the existence of SOP (Standard Operational Procedure) has never been evaluated for its implementation and the SOP on food processing is incomplete.

**Conclusions:** Wasted food reduces the quality of inpatient nutritional services. Recommendation for overcoming constraints are providing training for the nutrition unit on cooking processing skills (removing fishy aroma, adding food flavors, giving menu variations) and conducting food tests regularly to ensure menu quality through taste audits periodically.

**Keywords:** Nutrition service, plate waste, theory of constraint

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### INTRODUCTION

Hospital nutrition service is a service that tailors its service to a specific patient based on clinical state, nutrition state, and body metabolism state. The nutritional state of a patient highly influences the recovery process, otherwise, the disease can also affect the nutritional state of a patient. It is a common case that a patient's condition worsens because their nutrition is inadequate for recovery. The affected organ function will worsen because of the disease and nutrition inadequateness<sup>1</sup>.

The Hospital Nutrition Services is a set of activities covering acquisition, process, analysis, conclusion, suggestion, implementation and evaluation, food, and dietetics to achieve optimal health status<sup>2</sup>. The nutrition service for inpatient treatment is a service that starts from nutrition assessment, nutrition diagnosis, nutrition intervention including planning, food provision, education and extension, nutrition counseling, and nutrition monitoring and evaluation<sup>3</sup>. The purpose of the service is to provide nutrition for the patient so that they receive food according to their health status in order to

boost the recovery process, also to sustain and improve their nutrition status.

A good quality hospital nutrition service have to achieve three quality indicators: quality control and observation to ensure that the product is safe, ensuring consumer satisfaction, and high-quality assessment. In Minimal Hospital Service Standard or Standard Operational Procedure (SOP)<sup>4</sup>, it is set that the indicators include: Food provision punctuality (100%), Patient's leftover food ( $\leq 20\%$ ) and no mistakes on diet administration (100%). The success of nutrition service in an inpatient treatment unit is evaluated with food leftover observation. The food waste is an effect of the nutrition service system in a hospital.

A lot of patient's food leftover means that administered nutrition is less than it should be, causing malnutrition. The nutrition requirement is one of the important factors to consider in developing a patient's menu<sup>5</sup>. The uneaten food cause unnecessary cost, affecting the whole hospital budget as well. Therefore, the hospital management team needs to develop an efficient and effective food management system. Effective in providing the correct nutrition according to



accurate nutritional analysis, and efficient in terms of using the available resource economically <sup>6</sup>.

Food leftover (plate waste) is considered high if it reaches more than 20%. Plate waste can happen because of the patient's both internal and external factors. The patient's internal factors include the clinical and pathological condition of the patient i.e. appetite fluctuation, alteration of taste buds, dysphagia, stress, and duration of stay. While the external factors include food quality such as flavor, aroma, plate size, menu variation, texture, staff attitude, food misdelivery, unpunctuality of food administration, and treatment room ambiance <sup>3</sup>. The effect of high plate waste for the patient are malnutrition risk, increasing treatment time, and diminished immune system.

Rumah Sakit Islam (RSI) Surabaya Hospital in East Java, which has passed plenary accreditation, continues to strive to improve the quality of its services and the welfare of its employees. On the other hand, the quality services at the nutrition unit experienced decrease continually until December 2016 with an increase of 39% of the food waste that was not eaten by patients. In 2016 to 2017, the average plate waste was 24.4% compared to the standard  $\leq 20\%$  at RSI Hospital. The success of a nutritional service in the inpatient room is evaluated by observing the plate waste that is not consumed after the food is served. Plate waste is an impact of the decreasing quality of the nutritional service in the hospital. Related to nutrition service in hospital inpatient treatment, waste identification is done with 5 steps in the theory of constraint <sup>7</sup>. To improve performance, the first step is to identify the weakest link in the nutrition service system. The steps in the theory of constraint are used to identify, analyze, set and formulate solutions of the constraint, and develop a recommendation for building a system to reduce waste <sup>8</sup>. This research aims is to improve nutrition service in the hospital inpatient treatment unit by reducing plate waste.

## METHOD

This research used a cross-sectional method. The population of the research is served plate for all patient in the ward class II and class III during 10 days observation (1,230 plates). The sample of the research is all plates in total population (1,230 plates). This research involved 7 enumerators consisting of trained and experienced nutrition officers. They have an educational background of Bachelor Diploma III or Diploma IV in Nutrition and Culinary Science. Before going to the field, enumerators were trained to equalize perceptions among enumerators about the portion of the meal and how to

visually measure leftovers using the 7 scales visual Comstock method. From identified samples, an information source is then set to assess organoleptic variables from each served menu. Patients in the adult ward who ate per-oral or through nasogastric tube (feeding tube) which receive a blenderized diet, sieved porridge, liquified diet or patient in a child ward are excluded from the research.

The primary data is acquired by means of questionnaires, direct observation, and interviews. The questionnaire consisted of menu components and food service which includes a main dish, animal-based side dish, plant-based side dish, and vegetables in breakfast, lunch, and dinner during 10 days cycle. The questionnaire also includes taste, aroma, texture, portion, temperature, appearance and level of satisfaction to food. Direct observation is used for measuring plate waste, using this formula:

$$x(\%) = \frac{(\sum p1.w1) + (\sum p2.w2) + \sum pn.wn}{n}$$

Note: X (%) = waste average (%),  $\sum p$  = plate count, w = waste (%), n = sample size,  $\sum pn$  = plate count to n dan wn = % n-th waste.

Visual Comstock assessment covers score (1) if leftover reach 100%, (2) if leftover reach 90%, (3) if leftover reach 75%, (4) if leftover reach 50%, (5) if leftover reach 25%, (6) if leftover reach 20% , and (7) if there's no leftover. The interviews are done to study the cause of constraint and the patient's perception.

The research is done through some processes i.e. identifying plate waste, setting constraint priority through Focus Group Discussion (FGD), analyzing the constraint cause, formulating solution of constraint, and developing constraint control recommendation. The analysis used the Likert 1-4 scales.

## ETHICS STATEMENT

Ethics approval (ref number: 237-KEPK) was obtained from the Health Research Ethics Committee, Faculty of Public Health, Universitas Airlangga.

## RESULTS AND DISCUSSION

### A. Sample Characteristics

Observed menu characteristics are standard menu without extra, and distinguishable based on the main dish, animal-based side dish, plant-based side dish, and vegetable. Following is total observed menu and identified waste component in 10 days menu cycle.

**Table 1.** Sample characteristics based on treatment class in RSI Surabaya Hospital ward patient year 2018

No.	Treatment Class	Σ The Observed Plates		Σ Plates Without Waste		Σ Plates Contain Waste	
		n	%	N	%	n	%
1.	Class II	742	100.00	549	73.99	193	26.01
2.	Class III	488	100.00	354	72.54	134	27.46
	Total	1,230	100.00	903	73.41	327	26.59



According to Table 1, there are 1,230 total observed plates which consisted of 742 plates at ward in class II and 488 plates at ward in class III. At ward in class II, 549 plates (73.99%) without waste and 193 plates (26.01%) contain waste. On the other hand, at ward in

class III there are 354 plates (72.54%) without waste and 134 plates (27.46%) contain waste. The highest plates percentage that contains waste was at ward in class II (73.99%) than in class III (72.54%).

**Table 2.** Sample Characteristics based on diet administration in class II and class III ward of RSI Surabaya Hospital year 2018

No	Menu	Σ The Observed Menu		Σ Plates Without Waste		Σ Plates Contain Waste	
		N	%	n	%	n	%
1	Standard Menu	364	100.00	272	74.73	92	25.27
2	Diet Menu	866	100.00	631	72.86	235	27.14
	Total	1,230	100.00	903	73.41	327	26.59

According to Table 2, there are 1,230 observed plates which consisted of 364 plates of standard menu and 866 plates of diet menu. From the standard menu, 272 plates (74.73%) without waste and 92 plates (25.27%) contain waste. While from the diet menu, 631 plates (72.86%)

without waste and 235 (27.14%) contain waste. The highest plates percentage that contains waste was at standard menu (74.73%) than in diet menu (72.86%).

**Table 3.** Sample Characteristics based on food serving time during 10 days in class II and class III ward of RSI Surabaya Hospital year 2018

No	Serving Time	Σ The Observed Menu		Σ Plates Without Waste		Σ Plates Contain Waste	
		n	%	n	%	n	%
1	Breakfast	419	100.00	295	70.41	124	29.59
2	Lunch	397	100.00	296	74.60	101	25.40
3	Dinner	414	100.00	312	75.36	102	24.64
	Total	1,230	100.00	903	73.41	327	26.59

Based on the Table 3, there are 1,230 observed plates which consisted of 419 plates of breakfast, 397 plates of lunch and 414 plates of dinner. Furthermore, on the breakfast serving time there are 295 plates (70.41%) without waste and 124 plates (29.59%) contain waste.

While from the lunch serving time, 296 plates (74.60%) without waste and 101 (25.40%) contain waste. The highest plates percentage that contains waste was at dinner serving time (75.36%) than in breakfast (70.41%) and lunch (74.60%) serving time.

**Table 4.** Menu component, observed plate counts, and plate waste counts during 10 days of food administration in RSI Surabaya Hospital class II and class III ward year 2018

No	The Observed Menu Components	Σ The Observed Plates		Σ Plates Without Waste		Σ Plates Contain Waste	
		n	%	n	%	n	%
1	Main dish	1.230	100.00	903	73.41	327	26.59
2	Animal-based side dish	1.230	100.00	903	73.41	327	26.59
3	Plant-based side dish	1.230	100.00	903	73.41	327	26.59
4	Vegetable	1.230	100.00	903	73.41	327	26.59

According to Table 4, the observed plates components are main dish, animal-based side dish, plant-based side dish, and vegetable. In addition, each of observed menu components consists of 1230 observed

plates with 903 plates (73.41%) without waste and 327 plates (26.59%) contain waste among them.

**B. Constraint Establishment in 10-Day Menu Cycle in Food Administration of Ward Patient**



**Table 5.** Constraint establishment in 10-day menu cycle in Food administration activity of class II and class III ward of RSI Surabaya Hospital year 2018

No	Variable	Constraint		Standard
		Categories	Score	
1	Aroma	Respondents still appreciate the aroma of mediocre food.	2.27	> 2.30 – 3.00
2	Vegetable taste	Vegetable taste is not flavor yet for respondents	2.60	>3.00
3	Main dish taste	Main dish taste is not flavor yet for respondents	2.69	>3.00
3	Plant-based side dish taste	Plant-based side dish taste is not flavor yet for respondents	2.72	>3.00
4	Animal-based side dish taste	Animal-based taste is not flavor yet for respondents	2.76	>3.00
5	Food plating	Respondents assessed the ordinary food plating not arouse their appetite	2.86	>3.00 – 4.00
7	Appropriateness and appetite for the menu	Respondents assessed enough between appropriateness and demand from served menu.	2.88	>3.00

According to table 5, food factor is the primary cause of constraint. From these food factors, the first constraint is Aroma with 2.27 point score, below the standard of > 2.30-3.00. Secondly, the flavor of vegetables, main dish, plant-based side dish, and animal-based side dish with average score of 2.70 which is also below the standard of > 3.00. Moreover, the food

presentation scored 2.86, again below the standard of > 3.00-4.00. Finally, respondent's suitability and desire about the served menu scored 2.88 point, below the standard of > 3.00.

**C. Constraint Cause in 10-Day Menu Cycle of Food Administration Activity in Ward patient.**

**Table 6.** Constraint cause in each component of the observed menu of RSI Surabaya Hospital year 2018

No.	Waste	Waste Average (%)	Notes
1.	Main Dish Waste	39.60	Based on its shape, the essential waste menu in main dish is steamed rice (41.90%) because of the taste which did not need the respondent's expectation.
2.	Animal-Based Side Dish Waste	30.80	Based on the type of animal-based side dish, fish is the greatest waste contribute (46.00%) because of its fishy aroma a little bit disturbing and fish thorn that hasn't been lost.
3.	Plant-Based Side Dish Waste	36.00	Based on the type of plant-based side dish, tofu is the greatest waste contribute (40.00%) because of its bland taste and didn't meet respondent's expectation yet.
4.	Vegetable	42.60	Based on the type of processing, souplless vegetable is the greatest waste contribute than soupy vegetable (49.30%) because of its taste which didn't meet respondent's expectation.

According to Table 6, for main dish, the greatest waste is steamed rice (41.90%). Tim is a form of rice dish that is softer because it consist more water than usual rice, but still has the texture of rice, the taste of steamed rice that did not meet the respondent's expectation also identified to be the cause of constraint. For the animal-

based side dish component, fish is the most wasted item (46.00%), the flavor of fish that is too fishy and the presence of small fishbones made the patient choose to not eat the served fish. While in plant-based side dish component, Tofu is the most wasted item (40.00%). The bland taste of tofu is identified to be the cause of waste.



For vegetable dish, patient mostly choose to waste souplless vegetable dish, or stir-fried vegetable dish (49.30%), most of the respondent preferred soupy vegetable dish.

Based on the FGD process, it was found that the cause of the constraints emergence because of SOP had not been routinely evaluated for its implementation, especially SOP related to quality control. This causes the taste of the food to not match the respondents' expectations, the fishy aroma which is extant, and the lack of taste and variety of the food menu. In addition, there are several incomplete SOP and need to be made in regulating patient nutrition services.

Solution formula for constraint cause in a 10-day menu of food administration activity becomes a parameter in cracking the problem in order to reach the quality standard of nutrition unit service. The solution formula covers food administration policy review which is related to menu planning, processing, and food serving, all written in SOP (Standard Operating Procedure)<sup>9</sup>. The nutrition unit SOP which is established in December 2015 needs to be reevaluated to determine whether or not it is still relevant to the current condition, also some missing points need to be added.

Then, the SOP needs to be revised and made another SOP for the activity that still does not have an SOP<sup>10</sup>. Also, the policy related to the food ingredient quality standard and tools usage standard in food serving activity needs to be established. Moreover, training and benchmarking to other hospitals need to be done in order to enhance the employee's competencies. Employee's skill enhancement is important to avoid constraints that are caused by bad food aroma, vegetable taste, main dish, plant-based side dish, animal-based side dish, food presentation, and suitability of patient towards the menu.

One of the success indicators of nutrition service in a hospital is having a plate waste that is less than 20%. If the plate waste still reaches more than 20%, it means that there is still a constraint to reach that quality service indicator. Waste identification by 7-scale visual comstock sets the standard that the food component qualifies as waste if it exceeds 20%. The average waste of main dish is 39.60%. The main dish became the most wasted food component because it occupies the dominant portion of the plate<sup>11</sup>.

The most wasted item from the main dish is steamed rice with 41.90% waste. Steamed rice became the most wasted item because of its extra soft texture and its unexpected flavor. Based on the served diet, the average waste on the standard menu is 74.73%, which is more than the diet menu i.e. 72.86%. In animal-based side dishes, the average waste is 30.80%, dominated by fish (46.00%) and followed by chicken (32.80%). Meanwhile, egg waste average is 29.50%, and meat is 20.90%. There is no significant difference in waste in those items if it is compared to the served diet type.

For the plant-based side dish, the average waste is 36.00%. Based on the items of the side dish, tofu placed first on the most wasted item (40.00%) compared to other items such as tempe (34.70%). In the vegetable dish, the average waste is 42.60%, becoming the most wasted menu component compared to others. From those

numbers, the stir-fried vegetable dish is the most wasted item (49.30%) compared to the soupy dish (40.10%). Based on the served diet, the standard menu has more waste (47.70%) than the diet menu (41.10%).

According to the results, it is concluded that the percentage waste for all observed four food components is 26.59%. It means that from 1,230 observed samples, there is 26.59% waste in each food components. Those numbers are still far from the recommended standard, which is  $\leq 20\%$ . The food variable that causes high waste is the unappetizing aroma of the served food. Besides that, the flavor of the food is also deemed not delicious, followed by the unattractive food presentation, all of those factors contribute to the reduced appetite of the patients<sup>12</sup>.

Compared to other hospital in Indonesia, according to the studies in Rumah Sakit RSK Dr. Tadjuddin Chalid South Sulawesi and RSUD Makassar South Sulawesi, the average waste of breakfast for rice dish is 20.70%, animal-based side dish 17.10%, vegetable dish 55.10%; lunch for rice dish 13.80%, animal-based dish 15.90%, plant-based side dish 14.70%, vegetable dish 10.20%, fruits 9.40%, snacks 20.50%; dinner for rice dish 12.00%, animal-based side dish 13.40%, plant-based side dish 12.80%, vegetable dish 16.20%, fruits 7.00%, snack 9.70%<sup>13</sup>. Another study in RSJ Madani Palu Central Sulawesi showed that, rice waste 60.73%, vegetable 42.17%, animal-based side dish 15.86%, and plant-based side dish 13.05%<sup>14</sup>. Those data show that there is still a lot of waste that reaches 20%, meaning that patient nutrition is inadequate. Based on these comparisons, RSI Surabaya is still the hospital with the highest waste. It is necessary to improve the overcome the plate waste problems.

Likewise, if compared to the research from Nutrition Research and Development Unit Nutrition Installation RSUD Tugurejo Central Java in 2011 stated that the plate waste from patients is still high, with rice dish 39.24%, animal-based side dish 27.89%, plant-based side dish 37.43%, vegetable 42.2%, snack 12.59%, and fruits 2.78%. Those percentage increased in early 2012 with the main dish eached 52.00%, plant-based side dish 49.00%, vegetable 57.00%. The high count of plate waste that is still below the set standard of minimum service show that nutrition services is still not optimal<sup>15</sup>. Although the amount of waste in Nutrition Research and Development Unit Nutrition Installation RSUD Tugurejo Central Java was higher than in Nutrition Unit RSI Surabaya, but both of them have similar problems that show that nutrition services is still not optimal.

Williams & Walton also reported similar results, they stated that from 32 hospitals in Australia, the plate waste average is 30.00%, far more compared to other foodservice management. This might be correlated to the patient's clinical condition of the patient, food and menu problems (bad food quality, undesired plate size, and limited food options), service problem (food accessibility, complicated ordering system), and environmental factors (unpunctuality, unhappy environment). Waste reducing strategy covers decreasing plate size with food fortification, food mass-delivery system, eating





assistance, eating room provision, and ideal feeding time<sup>16</sup>.

Comparing the mealtime of breakfast, lunch, and dinner, most wastes happened at dinner with 75.36%. Followed by lunch 74.60%, and breakfast 70.41%. According to the SOP about food administration punctuality, breakfast will be served at 07.00-09.00, lunch at 12.00-14.00, and dinner at 17.00-19.00. The high waste at dinner might be because the interval between lunch and dinner is too short, moreover, in that interval, snacks are usually served. The food distribution time is also not proportional between breakfast, lunch, and dinner. The time interval between dinner and the next breakfast is the longest interval, amounted to 12 hours.

Constraint priority is set based on the identified constraint scale. The smaller the scale value, then the bigger the constraint. The constraint in food aroma scored 2,27 from >2,3 standard<sup>17</sup>. Food aroma is caused by an aromatic compound found in food, spices, fruits, perfumes, and essential oils. The second constraint is vegetable flavor with 2,6 score (adequate) below the set standard which is 3 (good). According to (Liber, 2014) the patient who received better food quality has more consumption rates compared to lesser quality food that has no improvement in flavor<sup>18</sup>. It means that food good flavor positively influences food intake in patients, so the probability of waste logically became smaller. The type of vegetable dish that mostly became waste is the stir-fried vegetable dish<sup>19</sup>.

The third constraint is the main dish flavor with 2,69 score (adequate), below the standard of 3 (good). The main dish is an item that is consumed dominantly, carbohydrate source, fulfilling, and produced locally. The most wasted item from the main dish is steamed rice (41.90%).

Then, the fourth constraint is the flavor of the plant-based side dish with 2,72 score (adequate), and the fifth constraint is the flavor of an animal-based side dish with 2,76 score (adequate). Both are still below the set standard of 3 points (good). The most wasted item of plant-based side dish is tofu (40.00%), while from animal-based side dish is fish (46.00%).

The sixth constraint is food presentation with a 2,86 score (adequate), also below the set standard of 3 points (good). Respondents deemed that food presentation is not interesting. Finally, the score for menu suitability with respondent's expectation is 2,88<sup>20</sup>.

Respondent's score of flavor in the main dish, side dishes, and vegetable averaged at 2,69 (adequate). This means that the respondents are still not satisfied with the service. Ideally, the average score is above 3. Food aroma score 2,27, ideally >2,3. While food presentation scored 2,86, ideally >3. Food administration is one of the core activities in a hospital nutrition service. The activity can help the patient recovery process. The healing process can be helped with food that qualifies the standard, both from quality and quantity<sup>21</sup>.

The food administration in RSI Surabaya still needs some improvements, especially in processing. The food processing in the Nutrition unit needs to be reviewed by considering the nutrition service policy and service guidelines of RSI Surabaya, especially related to

quality standard and ingredient specification i.e. the rice standard, side dishes, vegetables, and spices<sup>22</sup>. Moreover, the service guidelines for standard menu and diet menu administration, master menu development, and menu planning need to be reviewed so that the patient's request and wishes based on their cultural background and beliefs can be accommodated<sup>23</sup>.

Furthermore, to draw up recommendations, FGD is needed to dig up information about internal constraints and external constraints at RSI Surabaya and formulate recommendations in an effort to improve the process of improving performance achievements in order to minimize plate waste using Theory of Constraints approach to inpatients at RSI Surabaya. The FGD produced recommendations to evaluate existing SOP and added several SOP that needed for the development of nutrition services.

The reevaluation of RSI Surabaya Nutrition unit's SOP is needed. The SOP needed is providing outside food SOP, labeling the food served SOP, and processing (cooking) SOP so that they are specified according to the type of food. In addition, there are needed to be evaluation periodically for food ingredient processing SOP, quality control checking SOP, food serving SOP, food administration accuracy SOP, saltwater fish preparation SOP, shrimp and milkfish SOP, and plant-based side dish SOP. Some new SOP also need to be made as soon as possible, notes on served food SOP and food processing steps SOP<sup>24</sup>.

The reported high plate waste on various studies show that there is a lot to be done to support the patient's nutritional needs. It is also important to note that zero-percent waste should not be a target, because every patient's appetite is different. Dealing with an ill patient, there are a lot of requirements that cannot be ignored. Some actions can be done to reduce plate waste until  $\leq 20\%$  according to the food administration quality standard e.g. given therapy stipulation, diet administration, and others<sup>25</sup>.

In the end, it is important for all hospitals to observe their own performance and try to find an effective solution to improve the patient's nutritional intake and reduce plate waste .

## CONCLUSION

Based on the acquired results, it is concluded that the constraint that causes plate waste is the unsuitability of food aroma, food flavors, and food presentation with the patient's expectations. The recommendations for process improvement are focused on internal policy related to hospital nutrition service, food ingredient processing SOP, quality control, food serving guidelines, food administration accuracy, saltwater fish preparation, shrimp and milkfish preparation, and plant-based side dish preparation in the hospital nutrition unit. It is also supported by the employee's competencies and their obedience to the set procedures because it is directly related to the planning, processing, and food serving process in the ward.

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