



Comparison of food waste using the PDAT and comstock methods in inpatients in Bengkulu

Perbandingan sisa makanan menggunakan metode PDAT dan comstock pada pasien rawat inap di Kota Bengkulu

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Abstract

Food waste is an indicator of the quality of hospital nutritional services. A high percentage of waste indicates low patient intake and may affect the nutritional status and recovery. This study was conducted in May 2025 at Harapan Dan Doa Hospital, Bengkulu City, in the Safa, Marwah, and Mina wards, where food waste exceeded the standard (<20%). This study aimed to compare the Pictorial Dietary Assessment Tool (PDAT) and Comstock methods for measuring patient food waste. A descriptive cross-sectional design was applied to 50 inpatients selected through accidental sampling method. Data were collected through observation using both methods. The Mann-Whitney test was used to analyze differences, and sensitivity and specificity were assessed using cross-tabulation. The results showed no significant differences between the two methods across all food categories ($p > 0.05$). PDAT was considered more accurate because it uses photographs of meals before and after consumption, making the assessment more objective. Meanwhile, Comstock relies on visual estimates, which may introduce bias. Both methods had high sensitivity (>80%), indicating good agreement. In conclusion, the PDAT and Comstock tools are suitable for evaluating patient food waste and monitoring the quality of nutrition services in hospitals.

Keywords: Comstock method, PDAT method, plate waste

Abstrak

Sisa makanan merupakan indikator mutu pelayanan gizi di rumah sakit. Persentase sisa makanan yang tinggi mencerminkan rendahnya asupan pasien sehingga dapat memengaruhi status gizi dan penyembuhan. Penelitian ini dilakukan pada Mei 2025 di RSUD Harapan dan Doa Kota Bengkulu pada ruang Safa, Marwah, dan Mina, dengan sisa makanan melebihi standar (<20%). Tujuan penelitian adalah membandingkan metode *Pictorial Dietary Assessment Tool* (PDAT) dan *Comstock* dalam mengukur sisa makanan pasien. Penelitian menggunakan desain deskriptif potong lintang dengan 50 pasien rawat inap yang dipilih secara accidental sampling. Data dikumpulkan melalui observasi menggunakan kedua metode. Analisis perbedaan hasil dilakukan dengan uji Mann-Whitney, sedangkan sensitivitas dan spesifisitas dianalisis dengan tabulasi silang. Hasil menunjukkan tidak terdapat perbedaan signifikan antara kedua metode pada semua kategori makanan ($p > 0,05$). PDAT dinilai lebih akurat karena menggunakan foto makanan sebelum dan sesudah dikonsumsi sehingga lebih objektif, sedangkan *Comstock* hanya mengandalkan perkiraan visual yang berpotensi bias. Kedua metode memiliki sensitivitas tinggi (>80%) yang menunjukkan kesesuaian baik. Kesimpulannya, PDAT dan *Comstock* dapat digunakan untuk mengevaluasi sisa makanan pasien serta memantau mutu pelayanan gizi di rumah sakit.

Kata Kunci: *Comstock, Pictorial Dietary Assessment Tool, Sisa Makanan*

Introduction

Nutrition services are a crucial component of supplementary medical care in hospitals, functioning to support patient recovery by providing nutrients tailored to clinical conditions and nutritional statuses (Emiliana et al., 2021). Food waste is an indicator of the effectiveness of nutrition services, reflecting the proportion of meals consumed by patients (Izzah & Nurulfuadi, 2021). High levels of leftover food can negatively affect nutritional status and prolong hospital stays (Lestari et al., 2023).

Hospital quality standards generally set a tolerance limit for leftover food at $\leq 20\%$. For instance, Jemursari Islamic Hospital in Surabaya evaluated the quality of its nutrition services based on three criteria: timely delivery or distribution of meals (100%), proportion of leftover food from patients ($\leq 20\%$), and accuracy of diet provision for patients (100%) (Lestari et al., 2023).

Food waste can be assessed using various methods, including the Pictorial Dietary Assessment Tool (PDAT), which involves taking photographs of meals to facilitate the estimation of leftover food (Nisak et al., 2019). In contrast, the Comstock visual method offers advantages such as simplicity, cost-effectiveness, and minimal time requirements for its use. Consequently, this technique is frequently employed to evaluate food waste in institutions that provide meals on a large scale, including hospitals (Fadilla et al., 2020). Both methods are practical, efficient, and widely used in hospital nutrition service.

A study by Budiningsari (2018) at Dr. Sardjito General Hospital, Yogyakarta, indicated that nutrition staff preferred the PDAT method over the Comstock visual method, which provided results comparable to the weighing method. Moreover, among individuals with chronic conditions such as diabetes, measurements of food waste using the PDAT and Comstock did not show significant differences (Budiningsari et al., 2018).

To date, few studies in Indonesia have explored the differences in the implementation of the PDAT method for evaluating patient food waste. Therefore, this study aimed to investigate the differences in food waste measurements obtained using the PDAT and Comstock methods directly, as part of efforts to improve the accuracy and application of nutrition service

quality evaluation. Considering the importance of monitoring patients' nutritional intake during hospitalization, the need for effective food waste assessment methods, and the lack of local research comparing the PDAT and Comstock methods, this study is warranted. Additionally, this study contributes directly to enhancing hospital service quality and serves as a scientific resource for future studies on hospital food service management.

Methods

This study employed a quantitative, descriptive approach using a comparative cross-sectional design conducted at Harapan Dan Doa Hospital (RSHD) in Bengkulu City in May 2025. The sample comprised 50 patients selected using accidental sampling. The sample size was determined based on the Lemeshow formula, considering a population of 253 individuals, $Z = 1.96$, and $\alpha = 0.05$.

The inclusion criteria for this study were inpatients in the Safa, Marwah, and Mina wards, patients receiving meals according to their health conditions or hospital standards, and patients provided with general hospital meals without specific dietary restrictions. The exclusion criteria included patients with digestive problems requiring liquid or pureed diets and those who had difficulty or were unable to consume food via nasogastric tube (NGT).

In this study, inpatient food waste data were collected through direct observation using two visual approaches: the Pictorial Dietary Assessment Tool (PDAT) and the Comstock method. The collected data included primary data, namely the estimated food waste of patients at each lunch meal, and secondary data, including patient characteristics such as age, sex, ward, and diet type, obtained from hospital medical records.

The PDAT method involved using images of divided meal plates (staple food, animal protein, and plant-based side dishes) and shading the portions remaining after the meal according to the visual plate. Shading was then converted into percentages following the scoring guide (0%, 25%, 50%, 75%, and 100%) (Faridi et al., 2022). The Comstock method involves observing leftover food and assigning scores based on visual estimation, where a score of 0 indicates no leftovers (0%) and a score of 4 indicates that

the food was entirely uneaten (100%). Scores were recorded for each food component using an observation sheet. The secondary data included general information on inpatients.

As the data were not normally distributed, differences in food waste measured using the PDAT and Comstock methods for each food category were analyzed using the Mann-Whitney U test. Additionally, the sensitivity and specificity of the PDAT method for detecting patient food waste were calculated. Sensitivity represents the method's ability to identify the presence of leftover food, whereas specificity indicates the method's ability to correctly recognize the absence of leftover food. All

statistical analyses were conducted using SPSS version 23 (Budiningsari et al., 2016).

This study was approved by the Health Research Ethics Committee of STIKes SAPTA BAKTI (No: 144/FB/KEPKSTIKesSaptaBakti/2025).

Result and Discussion

A study conducted on 50 inpatients at Harapan Dan Doa Hospital in Bengkulu City compared food waste measurements using the Pictorial Dietary Assessment Tool (PDAT) and the Comstock method, as shown in Table 1.

Table 1. Mean food waste measured using PDAT and Comstock methods in inpatients

Food Group	Measurement Method	Waste (%) Mean $\pm$ SD	Consumed (%) Mean $\pm$ SD	Difference	p-value
Staple Food	Comstock	32.90 $\pm$ 40.06	67.10 $\pm$ 40.06	-1.08	0.676
	PDAT	33.98 $\pm$ 40.57	66.02 $\pm$ 40.57		
Animal Protein	Comstock	28.90 $\pm$ 42.46	71.10 $\pm$ 42.46	-1.89	0.687
	PDAT	29.70 $\pm$ 43.69	70.30 $\pm$ 43.69		
Plant-based Side	Comstock	17.00 $\pm$ 31.75	83.00 $\pm$ 31.75	0.48	0.973
	PDAT	16.52 $\pm$ 31.62	83.48 $\pm$ 31.62		

Table 1 shows that the highest average food waste was observed for staple foods using the PDAT method (33.98 $\pm$ 40.57%). Conversely, plant-based side dishes had the lowest waste according to the PDAT estimates (16.52 $\pm$ 31.62%). Consumption was highest for plant-based side dishes based on the Comstock method (83.48 $\pm$ 31.62%) and lowest for staple foods (67.10 $\pm$ 40.06%). These findings align with those of Saputri (2022), who reported that PDAT is rarely applied in hospitals or large-scale food service institutions, whereas the Comstock method remains more common. Previous studies indicate that the differences between the two methods are relatively small, and the development of other visual assessment methods in Indonesia is limited, even though advanced methods such as digital imaging and food photography are available globally (Nisak, Ronitawati, & Citra, 2019).

Similarly, Budiningsari et al. (2023) demonstrated that PDAT is more accurate than the Comstock method because it uses pre- and post-consumption photographs, allowing for a more objective analysis of leftover food. In contrast, Comstock relies on observers' visual estimates that may introduce bias. However, PDAT has limitations, including the need for

adequate documentation tools and storage capacity, whereas interpretation-based methods are more practical but may yield less precise data owing to subjective assessment errors.

Food waste is influenced by menu diversity, including staple foods, animal protein, and vegetables. Common reasons for incomplete consumption include excessive portion size, satiety, dislike of the dish, reluctance to eat, and unappealing taste. Conversely, meals are fully consumed when patients are hungry, the portions are appropriate, the taste is appealing, and patients are motivated to recover quickly. This is consistent with Qodriatika & Nafies (2024), who reported that food acceptance is affected by taste and adaptation to the hospital environment, which may reduce appetite.

Hospitals have identified several factors related to food waste, such as disease type, ward class, and length of stay. Other factors include food appearance, portion size, menu variety, and support from family or the environment to encourage patients to finish their meals. Izzah & Nurulfuadi (2021) also found that hospital food waste can be influenced by patient sex, disease type, ward, duration of care, and meal-related aspects such as appearance, taste, aroma,

portion size, and menu variation. Environmental factors, including meal timing, external food consumption, utensils, and serving staff, also play a role.

Lestari et al. (2023) reported that food waste sensitivity in three Italian hospitals was relatively high (41.6%), with 38.5% for staple foods and 39.7% for other food types, indicating suboptimal meal delivery. Consequently, leftover food is an important indicator of hospital nutrition service performance.

Table 1 demonstrates no significant differences across all food groups between the Comstock and PDAT methods (staple foods $p = 0.676$, animal protein $p = 0.687$, and plant-based $p = 0.973$). Waste exceeding 20% was observed for staple foods and animal protein, whereas plant-based side dishes had $\leq 20\%$ waste. Patients preferred plant-based side dishes to staple foods and animal protein. Nutritionists are advised to reduce waste by adjusting meal production according to patient needs and enhancing service quality through patient satisfaction survey.

Patient meals were tailored according to the disease type, resulting in individualized meal plans. Measuring food waste is crucial for evaluating portion appropriateness and menu selections. Factors contributing to waste include unappealing appearance, difficulty chewing in older patients, and insufficient family motivation, consistent with Mumpuni & Saniyah (2021), who highlighted internal patient factors (physical condition, diet, sex) and external factors (taste, appearance, menu variety, and family interaction) as significant determinants of food consumption.

Muntaqoh et al. (2025) reported that PDAT is more effective due to the use of pre- and post-consumption photographs, allowing for

visual estimation of food waste. Comstock relies on subjective observations, increasing the risk of interpretation errors. PDAT also provides clearer visual data, supporting previous findings (Prayitno, 2025).

Afriza & Puteri (2018) noted that the Comstock method is commonly used in schools, hospitals, catering services, and other institutions to evaluate menus and food intake due to its practicality and efficiency in field conditions. It does not require specialized equipment or weighing, making it suitable for large-scale food production.

High food waste, particularly of staple foods and animal protein, can contribute to hospital malnutrition, prolong hospital stays, slow recovery, and increase the risk of complications and infections (Fiori et al., 2025). Therefore, food waste assessment should be integral to the continuous monitoring of patients' nutritional status. From a hospital management perspective, high food waste affects both patient health and operational cost efficiency, as wasted meals represent lost resources, including ingredients, labor and energy. Reducing waste benefits both patient nutrition and hospital expenditure (Jannah et al., 2024).

Advancements in digital technology offer new opportunities for food waste measurement. Methods such as Remote Food Photography or AI-based image recognition systems can complement or replace the PDAT and Comstock, enabling faster, more objective, and well-documented assessments (Abiad et al., 2025).

Sensitivity and specificity are used to evaluate the accuracy of measurement methods (Putra et al., 2019). Sensitivity measures a method's ability to correctly identify positive conditions, whereas specificity assesses its ability to correctly recognize negative conditions.

Table 2. Sensitivity and specificity of PDAT and Comstock methods

Food Group	PDAT / Comstock	Count (>20%)	Count ($\leq 20\%$)	Total	Sensitivity (%)	Specificity (%)
Staple Food	PDAT	17	3	50	85	86
Animal Protein	PDAT	31	2	50	93	88
Plant-based Side	PDAT	36	3	50	92	90

Table 2 shows the high concordance between the PDAT and Comstock scores for all food groups. Sensitivity and specificity values $\geq 80\%$ indicated that both methods were similarly accurate in evaluating patient food waste (Arifa et al., 2023; Najma, 2019).

Social and cultural factors significantly influence patients' food acceptance. Prior eating habits, taste preferences, and adaptation to hospital menus affect food consumption and waste. Cook et al. (2023) reported that mismatched menus are a primary reason for

hospital food waste. Waste reduction should consider cultural preferences, taste improvement, and menu variety.

The limitations include that interpretation-based methods may be less precise than the PDAT, which provides clear visual images. The timing of meal delivery and family interventions may also affect food consumption. Future PDAT development should focus on categorizing staple foods, animal proteins, and plant-based dishes for specific ingredients.

Conclusion

Food waste measurements using the Pictorial Dietary Assessment Tool (PDAT) and Comstock method produced nearly identical results. The highest average food waste was observed in the staple food group, whereas the plant-based side dishes exhibited the lowest waste. No significant differences were observed between the two methods for all food types, including staple foods, animal proteins, and plant-based side dishes.

Interestingly, both PDAT and Comstock demonstrated high accuracy, with sensitivities and specificities exceeding 80%. This indicates that both methods are reliable for assessing food waste in patients. Based on these findings, hospital nutrition services should consider implementing the PDAT as a practical alternative for monitoring food waste in inpatient wards. Further development of the PDAT is recommended for categorizing vegetable and fruit food groups.

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