

**Original****A Fully Automatic Rice Cooker Was Cost-Effective in A Hospital Kitchen**

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**ABSTRACT** *Background and purpose.* Recent soaring prices and labor cost hikes have put pressure on hospital meal service operations, and cost-cutting measures are challenging. In this research, we assessed cost-effectiveness by changing from a conventional gas-type automatic rice cooker (conventional) to a fully automatic rice cooker (FARC). *Methods.* This research was conducted in the kitchen of a 457-bed acute care hospital in Tokyo (49 kitchen employees, providing approximately 1,000 meals per day). The data include retrospectively compiled data from a diary, comparative research of the conventional method (6 months from April to September 2022,) and the FARC method (6 months from October 2022 to March 2023) with a staff of 6 cooks. *Result.* The average time for rice-cooking operations for the two methods was 57.5 ±3.09 minutes for the conventional method and 11.3 ±1.53 minutes for the FARC method, with a difference of 46.2 minutes. If this difference is extrapolated on the assumption of preparing rice 3 times a day (breakfast, lunch, and dinner), the reduction in preparation time will be 2.3 hours a day, or 847.8 hours a year. This difference reduced rice-cooking labor by 106 days. The difference in total cost (yen) is 2,717,328. The FARC purchase price can thus be offset in about 2 years. *Conclusion.* This research showed how working time could be shortened, costs reduced and the initial cost would be offset in 2 years if kitchen equipment was changed from the conventional gas-powered automatic rice cooker to the FARC. The cook's workload could also be significantly reduced.

**Keywords:** a fully automatic rice cooker, cost-effectiveness, Japanese hospital kitchen

**INTRODUCTION**

The most important staple food in Japan is rice. According to the Diet and Lifestyle Survey - FY2022 by the Ministry of Agriculture, Forestry and Fisheries (1), rice was the most common staple food at 40%, followed by bread at 16%. In previous research, we reported that approximately 61.5% of patients over 65 years of age admitted to an acute care hospital who were prescribed a normal diet were malnourished (2). In such cases, the previous study has reported that soft rice or porridge is prescribed for medical safety reasons (3). Therefore, cooking rice is done three times a day, every day, as cooked rice, soft rice, and porridge are often prescribed as staple foods for hospital meals. In addition, it has been our experience that in acute hospitals with more than 300 beds, cooks have to come to work around 4:00 a.m. to prepare breakfast, contributing to cook shortages and labor cost hikes.

Placing heavy pots of rice on a wheeled cart requires considerable physical effort, especially for female cooks. Preparation for cooking rice can be done the day before, but for sanitary reasons, weighed, washed,

and watered rice must be stored in the refrigerator if it is not cooked immediately after soaking. As for cooking rice for breakfast, the first thing the cook has to do when they arrive is to take all the pots of rice out of the refrigerator, put them in the rice cooker, and start the cooking process. This is one of the reasons why the cook has to come so early, and one of the factors responsible for cook shortages and labor cost hikes.

This research aims to clarify how time for rice-cooking operations can be shortened and costs reduced if the kitchen equipment is changed from a conventional gas-powered automatic rice cooker (conventional) to a fully automatic rice cooker (FARC), taking advantage of the hospital's move to a new building.

**MATERIALS AND METHODS**

This research was conducted in the kitchen of a 457-bed acute care hospital in Tokyo (49 kitchen employees, providing approximately 1,000 meals per day). We compared the average time for rice-cooking operations and labor costs required for cooking rice with the two types of rice cookers (Fig. 1) based on the working hours recorded in the "hospital meal work diary". Both periods were 6 months (the conventional method; April to

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September 2022, the FARC method; October 2022 to March 2023). Six cooks were involved in the rice cooking. For rice cooking, two conventional automatic rice cookers (6 pots) and one fully automatic three-dimensional rice cooker (6 pots) were used. About 10 kg of rice was used for each meal, and three types of rice were cooked: cooked rice, soft rice, and porridge. The pots weighed 4.0 kg/ per pot and with rice and water, it becomes 12-14 kg. Five pots were needed to cook one batch of rice.

In the conventional method, apart from the automatic rice cooking, weighing, washing the rice, adjusting the amount of water, and moving the pot were all done manually. With the FARC method, simply setting an empty kettle was all that was required, and weighing,

washing the rice, adjusting the amount of water, moving the pot, and cooking rice were all done automatically. Time for rice-cooking operations was calculated from the daily "hospital meal work diary". Labor costs were calculated from the "salary contract schedule". Accommodation costs were calculated from "rental contracts". Equipment costs were calculated from the equipment manufacturer's invoice.

Ethics: Subjects were informed of the purpose of the survey, their right not to participate in the survey, considerations for personal information protection, and data handling, and consent was obtained. For the implementation of this research, a research protocol was prepared and approved by the Research Ethics Committee of the hospital.



Fig 1. Conventional gas-type automatic rice cooker (left), and new FARC (right).

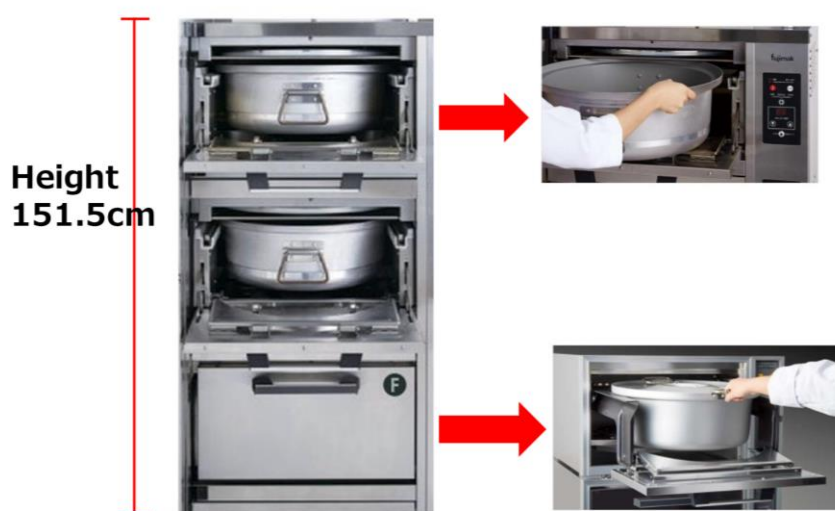


Fig 2. Moving the pots of a conventional type of rice cooker

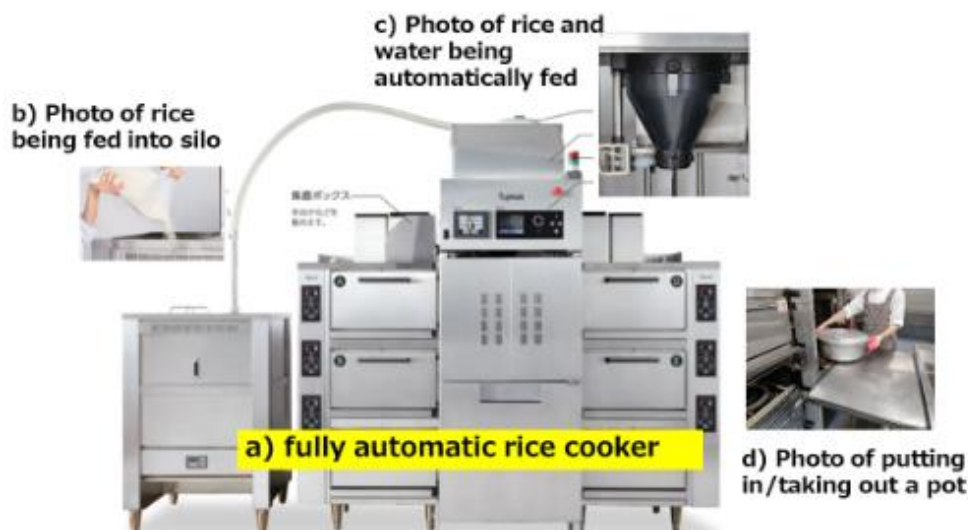


Fig 3. Photographs show a) FARC, b) feeding rice into the silo, c) inside of the rice and water supplier, and d) putting in/taking out a pot.

## RESULTS

The average time for rice-cooking operation was  $57.5 \pm 3.09$  minutes for the conventional method and  $11.3 \pm 1.53$  minutes for the FARC method, with a difference of 46.2 minutes. If this difference is calculated for preparing rice 3 times a day (breakfast, lunch, and dinner), the reduction in preparation time will be 2.3 hours a day, or 847.8 hours per year. This difference can be said to have reduced rice cooking labor by 80%. Assuming that the cook works 8 hours a day, total labor will be reduced by 106 days. When converted to labor cost, the cost of the conventional method is 3,662,000 yen per year (labor cost plus accommodation cost) and that of the FARC method is 416,100 yen per year (no accommodation), so the difference is about 3,245,900 yen per year. The difference in total cost (yen) was  $3,947,714 - 1,230,386 = 2,717,328$ . The FARC purchase

price/difference of total cost =  $5,700,000 / 2,717,328 = 2.1$ . Thus the FARC purchase price can be offset in about 2 years.

In addition, the workload of cooks can be significantly reduced. In the conventional process, apart from the automatic rice cooking, weighing, washing the rice, adjusting the amount of water, and moving the pot were all done manually. The cooks had to leave for work at 4:00 a.m. to prepare breakfast. At the hospitals under research, for such cooks, accommodation was prepared. With the FARC method, once the empty pot was set the day before and the reservation program for the rice cooking operation was set, weighing, washing the rice, adjusting the amount of water, moving the pot, and cooking the rice were all done automatically. So in the case of the FARC method, cooks could come at 7:00 a.m. and start cooking rice. No accommodations were needed.

Table 1. Work time and various costs at the hospital kitchen

			The Conventional method	The FARC method
Time for rice-cooking operation	1 (round)		$57.5 \pm 3.09$ (minutes)	$11.3 \pm 1.53$ (minutes)
	1 (day)		2.88	0.57
	1 (month)	hours	86.25	16.95
	1 (year)		1,051.20	203.40
Labor cost	1 (day)		5,760	1,140
	1 (month)	yen	172,500	34,200
	1 (year)		2,102,000	416,100
Accommodation cost	1 (month)	yen	130,000	
	1 (year)		1,560,000	Unnecessary
Equipment cost	Cost*		2,000,000	5,700,000
	1 (month)	yen	23,810	67,857
	1 (year)		285,714	814,286
Total cost	1 (month)	yen	326,310	102,057
	1 (year)		3,947,714	1,230,386

\*Cost depreciation: 7 years

## DISCUSSION

This research revealed that (1) equipment costs were high, but time for rice-cooking operations and labor costs were saved; (2) the cooks' relationships with each other improved as their mental and physical workload was reduced; (3) the cooks themselves began to pursue meal quality by making use of the saved working hours.

(1) Equipment costs were high, but time for rice-cooking operations and labor costs were saved.

The FARC is expensive, so it is usually difficult to obtain approval from hospital management departments. The price of the conventional is 2 million yen, The FARC is 5.7 million yen. Before applying, we conducted a thorough cost comparison between the conventional method and the FARC method. The cost comparisons shown in Table 1 are accurate from accounting reports. Labor costs were calculated from the "salary contract schedule". Accommodation costs were calculated from "rental contracts". Equipment costs were calculated from the equipment manufacturer's invoice. Time for rice-cooking operations was calculated from the daily "hospital meal work diary". During periodic government audits, the "hospital meal work diary" records the start and end times of work each day and is checked to see if it is signed by a person who confirms it. If this is not done, the government will not be able to pay medical insurance (meal expenses) to the hospital, so these numbers are highly reliable. The start time and end time of the work will be determined according to the "work process chart". The "work process chart" is a table that lists all the work tasks in the kitchen. If work is not started and completed according to the "work process chart", meals cannot be provided according to the time set by the government (7:30 a.m., 12:00 noon, and 6:00 p.m.). The above results revealed that the FARC purchase price can be offset in 2 years due to lower overhead costs. However, what is not included in this calculation is that installing the new FARC would require renovations to the kitchen, which would further increase costs. In the case of this hospital, it can be said that it was fortunate that the system was introduced at a time when the kitchen was being rebuilt.

On the other hand, when it comes to capital investment in acute care hospitals, high-priced medical equipment is prioritized, and kitchen equipment that is not directly related to treatment is likely to be subject to budget cuts. So, We calculated the costs of the unprecedented implementation of expensive cooking equipment in the hospital kitchen and determined whether the initial costs could be offset in a short period and whether labor could be further reduced. I explained this to the hospital management department many times and obtained their approval. It took a lot of effort, time, and effort. This research was intended to confirm whether that explanation was indeed correct. Fortunately, we were able to confirm our expectations in this research.

In the future, when introducing a FARC, it is desirable to take advantage of the renovation period. We would be happy if our results could serve as a reference for those who are considering installing a FARC.

(2) The cooks' relationships with each other improved as their mental and physical workload was reduced.

Cooking rice seems like a simple task at first glance, as it is a daily routine in every household. However, cooking rice in hospitals is not so easy, especially when cooking rice for breakfast. The rice is prepared, washed, and added water the day before, stored in the refrigerator, and then started cooking at 4:00 a.m. the next day. Each pot containing rice and water weighs 12 to 14 kg, and five pots must be moved. In particular, removing the rice cooker from the refrigerator and setting it in the rice cooker is hard work, and cannot be done by workers of short stature or middle-aged or elderly female cooks with limited strength. The switch to start cooking must be made by the cooks, sometimes the dietitians in charge of food preparation. To arrive at the hospital at 4:00 a.m., one must leave home at 2:00 or 3:00 a.m. That is when public transportation such as trains and buses is not in operation. There are times when there are typhoons and times when there is heavy snow. For this purpose, the hospital needs to prepare accommodation, and the cost for this will exceed 1.5 million yen per year. In addition, the physical and mental stress caused by early morning work and heavy workloads makes it impossible to protect their healthy minds and bodies, and it is becoming increasingly difficult to secure employment for dietitians and cooks. After introducing a FARC, the breakfast cooks told us, "The rice-cooking process is now completely automated, so I can come in at 7:00 a.m. and start the cooking process. I don't want to leave this kitchen because, in other hospital kitchens, the rice cooking process starts at 4:00 a.m." "Since I started working at 7:00 a.m., I have been able to enjoy about two hours to myself after I get home. When I used to work at 4:00 a.m., I was so tired and sleepy when I got home that I just went to bed immediately. I didn't know what on earth I was working for." "When I was on duty, which required me to be at work at 4:00 a.m., it was difficult to get other cooks to suddenly change their duty. Now I am free from the pressure of what to do if I suddenly get sick or oversleep." "It was very scary and stressful because every time I asked another cook to move heavy pots of rice, they would give me a disapproving look or ignore me. Now I don't have to ask because I don't have to carry heavy pots of rice. Thanks to this, we have a good relationship, always smiling and cooperating." We received such positive feedback.

A challenge in hospital meal service operations is the daily conflicts between kitchen employees. Most of the causes are emotional stress such as fatigue, which is also the biggest reason for leaving the job. The kitchen

employee who causes the conflict may be older than the dietitian, and the dietitian's mediation and guidance may lead to resentment. If conflicts are left unresolved, communication errors can lead to human error, which can lead to the dietitian bearing the brunt of the responsibility of leaving the company. In this research, it was not possible to prove the extent to which stress was reduced, based on a survey of kitchen employee satisfaction. However, the cooks have been happily working since 7:00 a.m., humming to each other, and smiling, talking, and helping each other, regardless of whether they are seniors or juniors, including the dietitians. With the introduction of the FARC, the cooks were relieved of their mental and physical pressure and experienced the experience of engaging in cooking tasks with a smile, helping each other, and being kind to patients, those around them, and the dietitians.

(3) The cooks began to pursue meal quality by using the saved working hours.

Kitchen employees tend to be passive as they faithfully work according to the "work process chart" and detailed hygiene rules. We therefore hold regular meetings to improve the menu and quality of meals. As a result, the progress of improvement is slow, and during this time patients are provided with unimproved meals. With the introduction of the FARC, the cooks, who now have more time to work, are encouraged to discuss and reflect on their own with the dietitians, accept the dietitians' opinions honestly, and improve the quality of their meals promptly.

This research did not show the results of the preference survey, so it was not possible to prove the extent to which the quality of meals had improved. However, we feel that the quality of the meals has improved through the feedback from the patients and the opinions of the physicians and the dietitians based on the food inspection. Of course, we have received numerous comments from the patients, the physicians, and the dietitians that rice cooked in the FARC tastes great. For hospital meals, Three types of rice are cooked each time: cooked rice, soft rice, and whole porridge. The FARC does not require any human intervention from preparing the rice to cooking it. The precision equipment built into the FARC does everything, so the measurement of water depending is particularly accurate. It is assumed that the optimum amount of moisture each time results in delicious rice. In this way, being able to cook the same quality and delicious food every time helps to relieve the stress on the mind and body of the cooks.

In Japan, given the social backdrop of a declining workforce, an aging population, and soaring prices, there is a tendency to focus on cost reduction, work automation, and AI. Although they are expensive, cooking equipment can increase production. However, even with high salaries offered, the number of hospital cooks continues to decline. I think that hospital dietitians should not make the mistake of prioritizing what is important and in what order when managing hospital food service operations.

Medical treatment for injuries, illnesses, etc. is called "treatment". It includes placing the palm or fingertips of the hand on the affected area to check the condition, which is a universal medical practice. I think it's the same with hospital meals. Ultimately, the hospital meals are delicately prepared using the palms and fingertips of a person and then served to the patient. Isn't it up to the hospital dietitian to bring life into the hands of the cooks? We think so.

In conclusion, this research showed how working time could be shortened and costs reduced, the cook's workload could also be significantly reduced if kitchen equipment was changed from the conventional gas-powered automatic rice cooker to the FARC, taking advantage of the hospital's move to a new building.

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#### REFERENCES

1. Ministry of Agriculture ; Forestry and Fisheries' "Survey on Dietary Habits FY2022" 188-191. <https://www.maff.go.jp/j/zyukyu/survey/attach/pdf/lifestyle-2.pdf> (accessed May 25, 2023)
2. Hirose K, Tran PT, Yamamoto S: Decreasing Salt in Hospital Meals Reduced Energy Intake in Elderly Japanese Inpatients. *J Nutr Sci and Vitaminol*, 67 : 105-110, 2021.
3. Ueshima J, Shimizu A, Maeda K, et al: Nutritional Management in Adult Patients With Dysphagia: Position Paper From Japanese Working Group on Integrated Nutrition for Dysphagic People. *J Am Med Dir Assoc*. 23(10): 1676-1682, 2022.

