

A Comparative Study of Hospital Catering Production System between Thailand and Denmark

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Abstract

In Thai public hospitals, a hospital meal demand did not come from an inward admitted patient's desire but medically indicated by a medical professional. Moreover, it will be known only after a daily bedside diagnosis of each patient. A hospital self-operated kitchen system in Thai hospitals uses static production planning by predetermined production quantity in advance of actual production for a week. Unlike in the new Danish public hospitals, patients can select their meals listed on a menu based on their health condition. Danish hospitals' centralized kitchen acted as a production hub providing postponed food to its network hospital within its area. Therefore, this paper explores how public hospitals in these two different countries manage and control their catering production systems. Two public hospitals in Thailand and one public hospital in Denmark are selected as a case study. With the exploratory research approach, a result not only explored a detail of its supply chain and operations, including inbound operations, production, and outbound operations from the selected case study hospitals in both countries. But it also reflects a different principle on planning hospital catering system between these two countries.

Keywords

Hospital Catering, Production, Comparative study.

1. Introduction

The hospital catering system plays an important role in hospital supply chain management. Supeekit et al (2015) explored that the hospital supply chain consisted of "the patient" as an ultimate customer seeking diagnosis and treatment. Hence the hospital acts as a producer of two major services in the chain; "clinical care services" from medical professionals and "supporting services" such as medical supply, medicines, and food (especially for the inpatient department, also known as IPD, where patients are admitted into a hospital for one or several overnight stays.

Controlling the operations of the hospital catering system is complex and challenging since it is one of the most diverse within the healthcare business (Hartwell et al, 2007). The objective of hospital catering is to provide food that meets the nutritional and medical requirements, satisfies the patients, improves morale, and is microbiologically safe (Hartwell and Edwards, 2001). A well-managed delivery system along with other logistics activities of meal services to hospital wards will help the hospital achieve both its food safety and financial goals (Goeminne et al, 2012).

Thailand is a developing country located in southeast Asia, with a population of 70 million with a GDP per capita of 7,223\$ in 2018. Thailand introduced the Universal Cover Scheme (UCS) in 2002 as a main social health insurance program covering approximately 75% of the total population. Under this program, most services were free of charge at public hospitals (Paek et al, 2016). While Denmark is a Scandinavian country with a population of around 5.8 million and GDP per capita of 61,350\$ in 2018. Denmark provides free healthcare to all residents funded by taxes. One of the major differences between these two countries is the hospital catering system. In Thai public hospitals, IPD patients are not allowed to select their meals like in a restaurant but automatically are provided meals indicated by a

medical professional upon their health conditions, while for Danish IPD patients, their new hospital logistics system allow a patient to select their desired meal from a menu in the hospital in all regions (Ministry of Health, 2016)

Therefore, this paper aims to contribute to a gap in managing the hospital catering supply chain by exploring and comparing from inbound to outbound operations. In other words, from purchasing raw materials until delivery to the patient's bedside in both countries, using a public hospital as a case study. The possibility of improving operations by implementing what has been found in each country is also discussed.

2. Literature Review

Barrie (1996) was among the first papers to study about provisioning the operations of hospital catering system, by using the case of UK, for the whole supply chain by complying every process with the food safety act of 1990 and the food hygiene regulation of 1995, aimed to prevent an occurrence of foodborne diseases, start from the arrival of ingredients, storage, preparation, cooking, portioning, until delivery. The results confirmed that even though catering staff is mainly responsible for providing hospital food, but the prevention of foodborne diseases also involved nurses and staff in the supply chain. Any staff that handles, prepares, processes, and distributes food, must strictly follow the food safety and hygiene procedures.

Later in 2006, Griffin (2006) summarized three different types of hospital catering systems; a *Conventional system*, a system that uses a menu prepared by a hospital self-large-scale-kitchen. A meal will be prepared daily from basic ingredients with preparation, cooking, assembly, finishing, and delivery in the trolleys to the site of consumption on the premises. *The convenience system* uses menu items that have been prepared off-premise and have been stored in a form that can be easily prepared with only simple heating. This system can also be considered an outsourcing system. *The Cook-chill/cook-freeze system*, a system where a menu was fully cooked in a central kitchen, which can be either inside or outside a hospital. All processes from cooking to serving are strictly temperature controlled. The temperature during cooking must be at least 70°C for a specific period of time before being put through a rapid chilling process to lower its temperature to be not more than 3°C within 90 minutes. The food must be kept frozen during the whole transportation process and consumed within 24 hours after being thawed.

Edwards and Nash (1999) summarized another two different operating systems; operations in which meals are *plated in the central production kitchen* and meals *plated and served in the wards*. In the system where food is *plated in the central kitchen*, details of the patient's meal were gathered from the daily diet report sheet. Once being cooked and plated, plates and trays were loaded into temperature-controlled trolleys. There are two major routes for this transportation; transport to the ward-kitchen where they keep the trolley stored at 8°C. Or other routes where the food is loaded into the heated trolleys for transport to the wards. Whereas, a system where food is *plated and served in the wards*, also known as "cold bulk" system, catering staff place all cooked food in a foil container, loaded into the refrigerated trolley, and transported to the wards. Re-heating to 80°C will be done by ward hostess around 45 minutes before service time. Once being re-heated, food will be transferred to a heated trolley and moved to the ward corridor, where a meal will be assembled prior to the patient's order.

Other than those previous three types of catering system, Freil et al (2006) also categorized a catering system, using the case of a Danish hospital, with an old system (fixed) and a new system (individualized). The *Fixed system* is a system where a hospital fixes its menu into at least three main meals; breakfast, lunch, and dinner. Each meal will consist of three menus with different nutrition requirements e.g. fat content corresponding to the specific percentage of energy ($E\%$). The staff on the wards will decide which menu is most appropriate for the patient. Hence the kitchen will produce according to a fixed-pre-determined planned schedule (or MPS) while in the new *individualized system*, each patient is allowed to choose from a menu-cart consisting of a first course, the main course, and a dessert. This new individualized system is found to be similar to a system called the *Meals on Wheels* system in Belgian hospitals (Goeminne et al, 2012).

Therefore, this paper aims to contribute by filling a research gap on exploring a different hospital catering production system between Thai public hospitals, a hospital in a developing country, with public hospitals in Denmark, a developed country with almost nine times higher GDP per capita. Moreover, this paper is also oriented towards a perspective of operations management in the hospital catering system, which received less attention compared to those that were food safety oriented. This paper has selected a newly-opened Thai public hospital as a case study on discussing the possibility of implementing a system found in a newly opened Danish public hospital. And vice versa.

3. Methods

This paper selected a case study of public hospitals in both Thailand and Denmark. For Thailand, two public hospitals were selected as a case study while for the Danish public hospitals, we have chosen one public hospital with three locations that has just been officially opened to be a case study, a primary data were gathered from an interview with doctors and nurses, administrators, dieticians, and head of a food production. While secondary data were gathered from various sources, including information in publications from both Thai and Danish Ministry of Health.

The first objective of exploring and comparing the public hospital catering system was analyzed by using information gathered during September-December 2019 of two selected hospitals in Thailand, a newly-opened hospital with a 400-bed capacity and another one aged more than 50 years with a thousand-bed capacity. The newest hospital in Denmark symbolizes the Danish public hospitals was chosen as a case study is located in the South, a somatic hospital with three premises under the same medical and management umbrella. The data were explored into three major operations in the supply chain; Inbound operations, starting from the planning of ingredient purchase until stored in the kitchen. Production operations, including all transformation operations of input ingredients to be patients' meals, as the same as the ordering process from a medical professional to the catering staff. Outbound operations, starting from a plated meal on a tray in a delivery cart, unloading at destination wards, and load back the used trays.

4. Results and Discussion

4.1 Thai public hospitals catering management system

Both selected hospitals share the same catering operating system except they newly opened hospital in 2019. They just changed from a convenience system that has outsourced all hospital meals to an external kitchen to conventional catering systems with a self-operated central production kitchen like another public hospital in Thailand. Both hospitals' management levels believed there is no single public hospital in Thailand with an individualized system that allows patients to select their own choice of meals like in Denmark. They also believed that the Meals-on-Wheel system where patients can select a cooked meal available on a trolley never existed in Thai public hospitals either. Somehow, they all confirmed those two systems only existed in a private hospital where patients will be charged based on their selected choice of meals.

4.1.1 Inbound operations

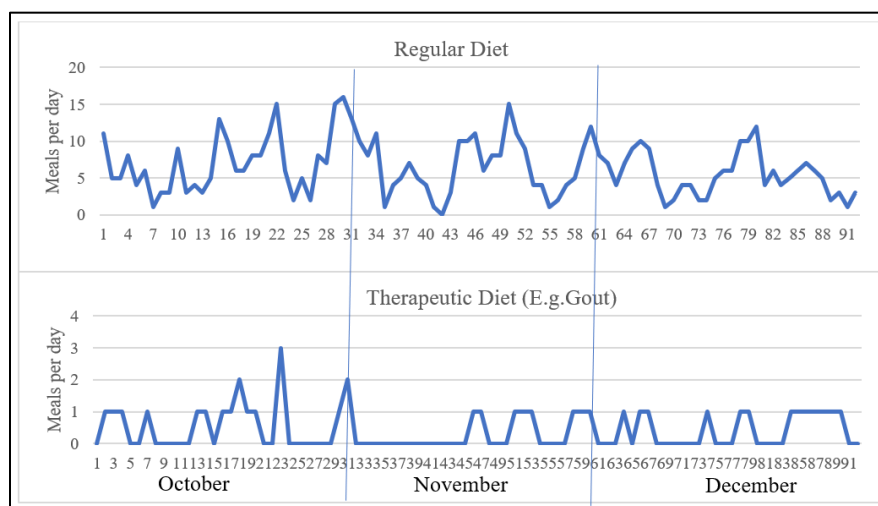
All hospitals issued production planning like master production scheduling (MPS), indicating each menu's quantity to be produced for the next 7 - 14 days based on forecasted demand. Once issued, it will be converted into a bill of materials (BOM), which indicates how many ingredients are required each day so that the purchasing department can plan its purchasing and storage. We found two purchasing models in common between both hospitals; 1) Direct purchase from a different type of vendor provides a lower cost of raw materials; 2) Direct purchase through a limited number of contracted consolidators enabling them easier operations since consolidators are responsible for delivering the right quantity at the right time, at a period in accordance with the planned production scheduling. **Table 1** shows a sample of a planned regular diet menu of Monday and Tuesday. This kind of fixed planned menu will last for two weeks and rotate to another fixed planned menu for another two weeks.

Table 1. A sample of planned regular diet menu within a week

Day	Breakfast	Lunch	Snack	Dinner
MON	Minced pork boil rice + Steamed bun + Soy milk	Rice with chicken curry + Stir-fried mushroom + Fruits	Banana cake + Low-fat milk	Rice with tofu and lettuce soup + fried fish fillet + fruit
TUE	Fish boil rice+ Dumpling+ Hot Ovaltine	Fried rice with shrimp + Soup + Milk Pudding	Coconut Jelly + Herb drinks	Rice/Tom Yum soup + Stir fried vegetable + fruit

In Thai public hospitals, all menus are predetermined. Only one menu is available for each type of diet. If it was predetermined a week ago that a regular diet is a rice with chicken curry for lunch on Tuesday, then the IPD patient will have to take that if the physician assigned them a regular diet meal. However, suppose a patient was diagnosed with the need of specific food condition. In that case, the therapeutic diet will order instead of a regular diet, e.g., gout diet, diabetic diet, which also under the same principle, all predetermined in advance for a week. The demand for a therapeutic diet is more difficult to manage since it's an irregular demand. An actual sample demand for a gout diet in **figure 1**, can be considered intermittent demand where demand patterns consist of zero and non-zero demand periods.

Figure 1 The actual demand of Regular Diet and Therapeutic Diet (Gout) from OCT-DEC 2019.



4.1.2 Production Operations

The production operations will be cooked on a batch production basis, start from the preliminary function. Staff will prepare raw materials into a ready-to-cook form for the cooking staff in the next workstation. Continue cooking in sub-kitchens based on the cooking activity, e.g., boiling zone, frying zone, blending zone, and halal zone. etc. The final process in production operations after cooking is portioning process. Hospital dieticians carefully operate this portioning process since they have to ensure nutrition intake for each meal.

However, this paper found different menus have different demand patterns. Still, a production lot size for all menus is predetermined using the latest demand quantity plus safety stock from dietician self-experience because of the static production planning. This system is said to be schedule nervousness-free in other manufacturing industries since actual demand will have no impact on a planned production schedule. Any shortage will be resulted in a backlogged order, but not for the hospital since backlogged is unacceptable due to patients' medical requirements. An ignorance in demand distribution of each menu by assuming all are menus have identical demand distribution is very risky for the catering system to have overstock and shortage.

4.1.3 Outbound Operations

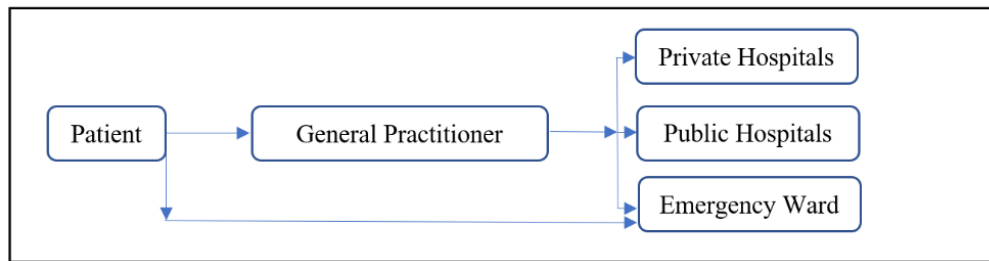
The delivery staff will load a meal into a meal tray delivery cart with a 30-40 tray capacity (one tray per bed) and re-check with a summary report. Each ward's responsible nurse will check the delivery report with their patient summary before signing on the delivery report. After unloading the last tray, the delivery staff is designed to wait 30 minutes before loading a finished food tray back into the food cart on the way back to be delivered for cleaning. They will start the same process from inbound until outbound again for lunch.

This paper found both case study hospitals are paid less attention to operations efficiency in outbound operations. For example, the delivery routing is predetermined based on staff experience while the number of patients and meals are varied. An application of operations research will improve their efficiency when compared to the use of self-experience. E.g. a three-dimensional bin packing for optimizing space in food kart before being delivered. Or a traveling salesman problem for optimizing the delivery route.

4.2 Danish public hospitals catering management system

Hospital care is free of charge for patients in Denmark. The hospital in Denmark can be classified into three types; standard, specialized, and private hospitals. Danish's access structure to a public hospital is shown in figure 2, which is quite different from the Thai system where patients always access public hospitals without a passthrough general practitioner. Every citizen is assigned to their own general practitioner, who caters to a maximum of about 2.000 patients, as shown in figure 2.

Figure 2 The access structure of Danish hospitals (Ministry of Health, 2017)



The hospital catering system in the Danish public hospital was once similar to Thailand. Patients were assigned to the predetermined meal before the country decided to change to the system where they will all over Denmark over the next couple of years be allowed to select their desired menu from the choices listed on a menu likes in a restaurant. This is because in the previous concept, with only one option available per meal, an interview with a Danish doctor in selected case hospitals found that losing patient appetite resulted in food waste and not getting nutritious food enough for the healing process.

4.2.1 Inbound Operations

When patients are admitted as an inpatient in a Danish public hospital, They are introduced to an online application, e.g., DanKost (Osler et al, 1999). The application has all the menus sorted by type of food. When a patient logs into the ordering system, they will only see the offers that fit the type of food they associate with. If a patient is ordered to have a special diet by a doctor or a dietician, this will be ordered as a special diet in the kitchen. Purchases will typically have to be put up for tender for a set number of years – typically four years. This means that the kitchen may only have to deal with a limited number of suppliers and may even have a sort of partnership where their computer systems can interact.

Although patients are allowed to select their desire meal from a listed menu, menus were also predetermined likes in Thailand, except they have an option for patients to select likes in **Table 2**. We can say that Danish public hospital is using a static-dynamic uncertainty strategy to cope with demand uncertainty. Menus are predetermined while the production quantity varies upon actual demand from patient self-order.

Table 2. A sample of listed menu

Choice	Light Dishes	Sandwiches	Main Courses	Vegetarian dishes
1	Casserole cooked on whole milk, serve with butter and cinnamon sugar.	Eggs with shrimp, Mayonnaise and lemon	Minced beef with bearnaise sauce, fried potatoes, peas.	Falafel Steak with tzatziki, tomato salad and bread.
2	Tartlet with chicken, asparagus	Fish fillet with remoulade and lemon	Steak with mashed potatoes with cooked broccoli bouquets	Vegetable lasagna with green salad
3	Airy omelet with crispy bacon, cherry tomato, served with coarse rye bread and butter	Roast beef with remoulade & roasted onions, horseradish and cucumber salad	Fried chicken with Italian tomato sauce, rice and salad	Chili Sin Carne with guacamole rice and salad

4.2.2 Production Operations

After transforming those inputs into pre-cooked food at the central kitchen, it will then be delivered to receiving kitchens and cafés at three of its premises hospital. The receiving kitchens are equipped with working tables with drawers, called 'à la carte production lines'. The central production kitchen is also the only place to makes therapeutic diets.

All pre-cooked food will be packed in portions in the production kitchen and delivered as frozen food to the receiving kitchens. However, should there be a shortage of something, there are transports between the three hospital units that make up a cased study hospital three times per day as a fixed schedule. Thus small cooling boxes can be delivered at short notice.

4.2.3 Outbound Operations

Since all patients can order room service from 09.00 – 20.00 every day, the receiving kitchen's policy is to consolidate orders every 15 minutes, cook, and be ready for the meal hosts to serve within 45 minutes. In other words, the dishes will not be made before they are ordered, and therefore, there will be no significant food waste in the kitchen from overproduction. The maximum time from a patient's orders to the time the food is served will be no longer than an hour in the case of room service. However, it's only a maximum waiting time of 30 minutes from ordering to serving in the hospital restaurants.

When the finished meal has been placed on the tray, the tray will be placed in a room service cart, and meal hosts will then bring it to the patient, whether the patient is in his/her room or the commons area of the ward. Besides the á la carte offers on the menu card, there are meal carts and/or fridges in all wards. The kitchen will refill the carts and fridges every day as arranged with the individual ward. This could be sandwiches, fresh fruit, cakes and other things that could be served as small-meals.

6. Discussion and Conclusion

This paper explores and compares a catering production system between a public hospital in Thailand and Denmark. Inbound operations from purchasing raw materials, production systems, and outbound operations from the central kitchen to the bedside of a patient were explored.

Firstly, we found that Thailand and Denmark have a different nature in its healthcare system, Thai people have direct access to a hospital even with a common flu symptom. This is because, in the Thai healthcare system, not all citizens have an individual general practitioner assigned to them as in Denmark, where the first point of contact with the health care system – unless it is an emergency – is the citizen's general practitioners. The general practitioner can then decide to have the patient admitted to the hospital. Outside of the normal hours of work for the general practitioner, Danish citizens need to call the emergency unit ahead of arriving at the hospital. Based on the conversation, a medical professional will determine if the person can visit the emergency unit or whether they are advised to wait until the next day to see their own general practitioner (Ministry of Health, 2019) Thai hospitals are therefore faced with more complicated demands, including for hospital meal, as it is more difficult to predict how many will show up at the hospital while in Denmark, the general practitioner – or the medical professional at the emergency hotline - plays a significant role in managing an inflow of patients by screening and transferring to a hospital as a planned demand.

Secondly, this paper found a different demand nature for hospital meals between the two countries. In Thailand, patients cannot select their meals but are assigned by a doctor and medical professionals. The demand is said to be a derived demand, not a direct demand like in Denmark. The orders received in the kitchen are the real demand from patients right from the hospital's offers. Hasachoo and Masuchun (2017) found that a derived demand caused difficulty in production scheduling called schedule nervousness, which is a situation when an actual demand differs from a planned schedule. This causes difficulties for Thai hospitals to minimize the inventory while making sure that all patients will have their food served on time.

Thirdly, both countries are facing the same challenges from demand uncertainty, which is different from manufacturing industries. The Thai hospital system is coping by predetermining its production in advance of actual production for weeks while the Danish hospital consolidates a demand from patients every fifteen-minutes before deciding on production quantity using postponed input from a central kitchen. These two strategies are also known as static and dynamic uncertainty strategies, which were proposed by Bookbinder and Tan (1988).

Other than a discussion under a production perspective, this research found a different role of doctors in the hospital catering systems. In Thailand, it is required that admitted patients' food must be assigned by a doctor together with medical professionals. On the other hand, in Denmark, the doctor will only interfere with the patient's choice of the menu if the patient has encountered a very special medical requirement not known at the time of admittance when it would have been entered into the digital journal. Because of such a requirement in a Thai hospital, this paper found

the difficulty of implementing an individualized concept likes in Denmark and other systems in another country, including Meals on Wheels in Australia (Krassie et al, 2000) and Canada (Roy and Payette, 2006).

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