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Kawtar Retmi, Fatima Ouzayd, Cécile Godé, Btissam Ennafah

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## **Hospital Food Supply Chain: When Digitalization Supports Hygiene Requirements in Hospital Catering**

### **Chaîne logistique alimentaire hospitalière : Quand la digitalisation vient en soutien des exigences d'hygiène en restauration hospitalière**

Kawtar RETMI

Research and education fellow at the institute of biological sciences

Mohammed VI Polytechnic University

Benguerir Morocco

[kawtar.retmi@um6p.ma](mailto:kawtar.retmi@um6p.ma)

Fatima OUZAYD

Professor at Smart System Laboratory (SSLab)

ENSIAS

Mohamed V University

Rabat, Morocco

[ouzayd@gmail.com](mailto:ouzayd@gmail.com)

Cécile GODÉ

Full Professor, management science

Aix-Marseille Université, CRET-LOG

EA881 Site Pauliane-MEGA 424, chemin du Viaduc 13080 Aix-en-Provence

[cecile.gode@univ-amu.fr](mailto:cecile.gode@univ-amu.fr)

Btissam ENNAFAH

Affiliate professor at the institute of biological sciences

Mohammed VI Polytechnic University

Benguerir Morocco

[btissam.ennaffah@um6p.ma](mailto:btissam.ennaffah@um6p.ma)

**Abstract**— Hospital is a complex supply chain made up of multiple structures, stakeholders, operations, as well as information and material flows. Due to the Covid-19 pandemic, hospital overcomes several major challenges these last few months, which leads to consider its supply chain digitalization as a priority to improve healthcare and hospital services quality. Interesting in the specific service of hospital food, this article asks: How does digitalization support hygiene requirements in the hospital food supply chain? It describes the modelling and design of a hospital catering application, which aims to build a digital catering area in support to hygiene requirements.

**Keywords**— Digitalization, hospital catering, hospital food supply chain, hygiene requirements

**Résumé**— L'hôpital est une chaîne logistique complexe composée de multiples structures, parties prenantes, opérations et flux matériels et d'informations. En raison de la pandémie de Covid-19, l'hôpital a surmonté plusieurs défis majeurs ces derniers mois, qui l'ont incité à accélérer la digitalisation de sa chaîne logistique pour améliorer la qualité des soins et des services hospitaliers. Cet article se penche sur un service spécifique de la chaîne logistique alimentaire, celui de la restauration hospitalière, et pose la question suivante : Comment la digitalisation vient-elle en soutien des exigences d'hygiène dans la chaîne logistique alimentaire hospitalière ? Il décrit la modélisation et la conception d'une application de restauration hospitalière, qui vise à construire une cuisine digitale en respect des exigences d'hygiène.

**Mots-clés**— Restauration hospitalière, digitalisation, chaîne logistique alimentaire hospitalière, règles d'hygiène

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## Introduction

Digital technologies are fuelling the futuristic vision of a 100% digital hospital of tomorrow. Digital technologies bring automating repetitive tasks and structures information exchanges and the timing of healthcare activities ([Geffroy et al., 2017](#)). The immediate gain of hospital processes digitalization is costs optimization, decrease of information loss and redundancy, acceleration of communication between professionals, and better fluidity of the patient's care path ([Deloitte, 2018](#)). It also improves the patient's experience and quality of life ([Gopal et al., 2019](#)). Regarding extreme situations ([Godé, 2010; Godé, 2015](#)) hospitals used to face with since the COVID-19 outbreak, digitizing their supply chain became a priority to quickly deliver the right product to the right patient at the right time.

Improving healthcare delivery through digitalization entails providing product quality for patient well-being, in respect to hygiene and safety rules. This is the focus of this article which asks: How does digitalization support hygiene requirements in the hospital food supply chain? We are especially interested in the hospital catering supply chain, as it faced major challenges during the pandemic while nutritional care is supposed to play a key role during recovery from the virus. After reviewing logistics in hospital catering and its hygiene requirements, this article describes the digitalization modelling and design of a connected catering at the Benguerir hospital (Morocco).

## Hygiene Requirement in Hospital Food Supply Chain: Insights from Hospital Catering

Hospital food supply chain is designed to provide nutrition to patients, from procurement to disposal, through waste management ([Carino et al., 2020](#)). It is considered as the most complex systems in hospitality industry, based on multiple stakeholders and services ([Do Rosario, V., Walton, K., 2019](#)). Regarding the latter,, it consists in different food services, including kiosks, fast-food outlets, and meal solutions served in workplace catering ([Engelund et al., 2007](#)).

Literature interested in hospital food supply chain provided very few works focus on hospital catering logistics. Existing research always associated such logistics with collective catering, where large quantities of food are prepared and served to groups of consumers – the elderly in retirement homes, children in canteens, sick in hospitals ([Mezhoud, 2009](#)) – and covers the services necessary for the preparation and delivery of meals to people working or living in communities, including health sector (hospitals, clinics, retirement homes) ([Fassel, 2008](#)).

The Covid 19 pandemic revealed the major role played by hospital catering logistics. It has been shown that an efficient food delivering process is essential to promote the health and nutritional status of patients ([Do Rosario, V., Walton, K., 2019](#)). This entails following severe hygiene requirements, depicted in Table 1.

Table 1. Hospital catering hygiene requirements

Building	The catering organization must be divided into several spaces and zones. Considering the potential risk of contamination between the different areas (clean / dirty) or raw / finished products, it is however advisable to separate them as much as possible. If this separation cannot be achieved, a separation ‘in time’ is necessary. The most frequent areas are: Staff rooms, changing rooms, toilets, staff cafeteria / cafeteria, etc. Reception and storage areas: quay, food store and non-food store, refrigerators; Preparation and ‘set up’ areas; Production areas. The design, layout and dimensions of the premises, as well as the equipment and layout, must be designed to allow good hygiene practice. The production process must be monitored from start to finish to avoid contamination of food by, inter alia: personnel; other food or raw materials; harmful; equipment; the materials; the water; the air; sources of external contamination.
Room requirements	Order and cleanliness are basic conditions for good premises hygiene.
Stores	The walls and floors are made of easily washable materials. The shelves are preferably removable and washable.
Vegetable	In this room, it is important to physically separate the dirty areas from the clean areas, and also with regard to raw materials as equipment and personnel.

Hot kitchen	The hot kitchen forms a separate entity. Customers, staff and residents should not experience any noise or smell from cooking activities. Access to the kitchen is strictly limited to authorized and competent persons. Protective clothing (headdress, blouse, shoe protector) must be provided for visitors wishing to access it. The flow of cooking activities goes in the direction of preparation. This current will be displayed on the layout plan with a clear distinction between dirty and clean areas, as well as between the areas reserved for prepared food and unprepared food.
Cloakrooms	The changing rooms are outside the kitchen, but preferably close to the kitchen. The changing rooms are equipped with lockers, sinks and showers. Work and personal outfits are separate. Contact between dirty and clean (or personal) clothing should be avoided.
Refectory	Eating in the kitchen is prohibited. Staff have a separate dining room or canteen. The toilets must not communicate directly with the kitchen. They are preferably reserved exclusively for kitchen staff and must be provided in sufficient numbers.

## **Digitalization of the Benguerir Hospital Catering**

### **Research Settings**

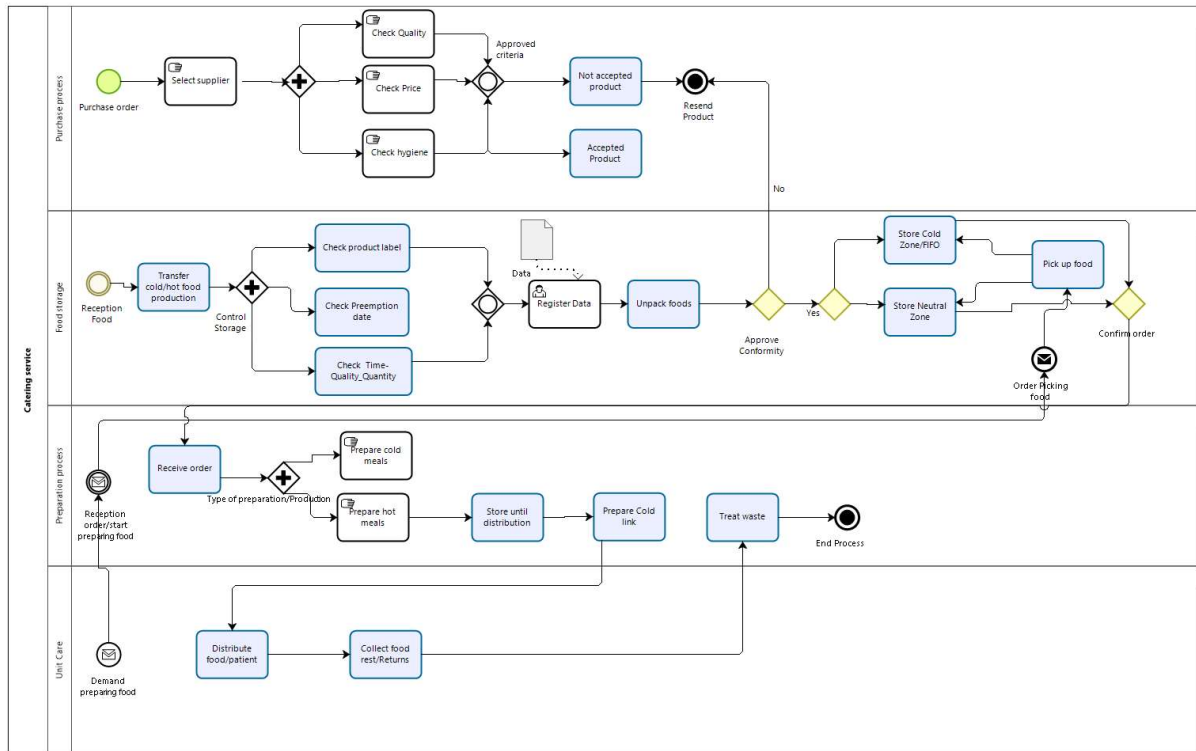
During the pandemic in Morocco, the lack of management, staff and equipment in public hospital has certainly contributed to the spread of the Covid-19, hospitals becoming incubators for the disease. Notably, at the hospital catering level, there was little practical clinical advice and knowledge for nutritional care and safety during recovery from the virus.

The town of Benguerir is endowed with a provincial hospital to strengthen local health structures and relieve pressure. In this context, a digitalization project of the Benguerir hospital catering has been carried out. The goal was to build a new catering area and automate catering processes, in order to support information reliability and provide product quality for patient well-being, in respect to hygiene and safety rules. The project mainly consists of modelling and designing the hospital information system restoration module by studying the different flows of the hospital food supply chain (from production / procurement to waste management / disposal) which provides food to patients, with no restrictions. The following describes the digitalization modelling and design of the connected catering at the Benguerir hospital.

### **Digital application modelling and design of the Benguerir Hospital Catering**

We used BPMN 2.0 (Business Process Modelling Notation) to model the processes of the Benguerir hospital catering (see the methodological note for details). The goal of the hospital catering area was to provide food cooked according to acceptable hygiene requirements. Indeed, the culinary production requires a succession of operations from the purchase of food to the distribution of meals. The following figure 1 depicts an overview of the operational processes of hospital catering.

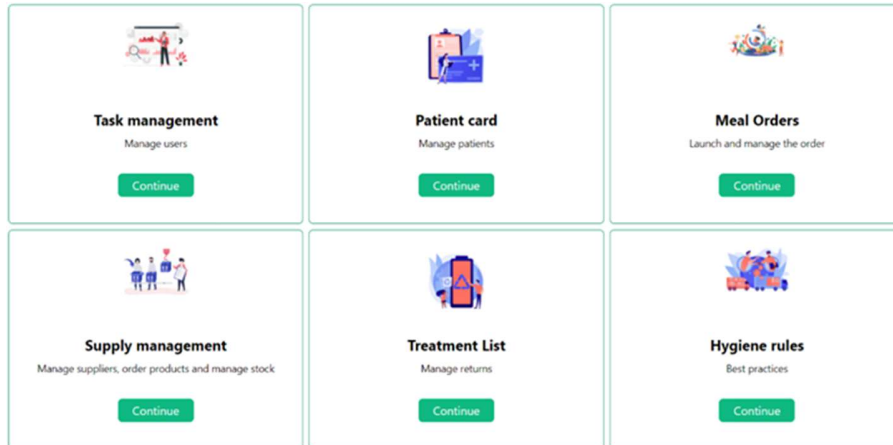
Figure 1. BPM modelling of the Benguerir hospital catering processes



Based on our BPMN model, we designed case diagrams needed to develop our application (see Figure 2 below). Our application is being tested, with a special focus on the below hygiene requirements and management. It offers a dedicated section related to hygiene rules, based on best practices of location, environment, and design of the hospital’s new connected catering space. The location of the premises has been studied to guarantee food safety. Particularly, they should be located at a great distance from polluted areas, prone to flooding and pest infestations. Consequently, the premises must be arranged in such a way as to allow the evacuation of solid or liquid wastes. Thus, the kitchen should never be used as a passage giving access to other parts of the building. A list of instructions has been drawn up to meet hygiene requirements at each level (floor, intermediate waste storage food room, fuel reserve, etc.). Regarding management of different premises, they must be separated. Each room is assigned to one of the following operations: reception of raw materials, storage and conservation, local bins and organization of workspaces. Ideally, there should be two dedicated diving rooms or areas, one for heavy cooking utensils and another for trays. The two areas should be some distance from where the food is being prepared. In addition, hospitals must have suitable positive cold rooms and / or negative cold rooms, of sufficient capacity, equipped with measuring devices (direct reading thermometer) and a temperature alarm system. All these hygiene best practices are implemented in the digital catering application, “hygiene rules” section.

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Figure 2. Front end of the digital catering application



## Conclusion

To address the research question – How does digitalization support hygiene requirements in the hospital food supply chain? – this article described the modelling and design of a digital tool aims to automate key processes and streamline operations of a hospital catering service while supporting hygiene requirements. On the one hand, modelling (using BPM) of the hospital catering processes allowed grasping complexity and specificity of food operations. On the other hand, the technical solution design allowed us to manipulate new technologies to meet customer’s and professional needs. Regarding the latter, the application offers a dedicated section related to hygiene standards requirements.

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