

## Article

# Procedure for an effective quick and targeted distribution of product to final beneficiaries by a social food bank

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**Abstract:** Humanitarian food banks throughout Europe periodically deliver baskets of food products to vulnerable families. These entities occasionally receive large, unexpected, quantities of perishable products, sometimes very specific (e.g., gluten-free, vegan), to be distributed urgently. The highly random nature of these arrivals has hindered their study in literature. The purpose of this work is to define a procedure for an effective quick and targeted distribution to beneficiaries, of large quantities of sometimes very specific perishable products. The research methodology starts with an in-depth on-site analysis of a real food bank, interviews with managers and beneficiaries, and definition of the procedure requirements. Next, the procedure is designed, defining how to select the appropriate beneficiaries for the targeted distribution, using free and common-use tools to announce the product distribution and allow the collection request by interested beneficiaries. It is technically easy-to-use, taking into account that food banks' workforce is composed mainly of volunteers, with a high turnover. Training material is prepared for volunteers and beneficiaries to overcome the digital gap. The procedure is validated with the network of small food banks El Rebost, from Terrassa (Spain): 129 lots of food products have been successfully delivered to targeted beneficiaries.

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## 1. Introduction

Food insecurity is defined as the lack of physical, social and economic access to sufficient, safe and nutritious food that meets the daily energy needs of a person leading an active and healthy life [1]. This has also been a serious problem in developed countries, even before the COVID-19 pandemic [2]. Indeed, around 13.5 million people, representing 2.7% of the European population, suffer from food insecurity [3]. These values are increasing significantly due to different factors: first, the COVID-19 pandemic and the transitory fall in employment led to a reduction in the economic capacity of the population and, therefore, in the possibility of acquiring food [4]; secondly, the war in Ukraine has caused food shortages in supermarkets and significant price rises that have affected vulnerable people [5].

In this context, Europe has an established network of non-profit entities like food “banks” mostly formed by volunteers [6], which have been proven to be highly resilient to social crisis like COVID-19 [7], and manage the periodic delivery of food baskets to the most vulnerable people [8]. These entities receive scheduled arrivals of food products

from the EU and food banks, distributing them to beneficiaries (either individuals or families) through a system of pre-defined monthly basket collections [9]. The basket to be delivered is prepared specifically for each beneficiary, taking into account the family members (amount, babies, children...) as well as food restrictions due to allergies, intolerances or factors of age, culture or religion [10]. In addition to the scheduled arrivals of food products, these food banks occasionally receive significant unexpected quantities of perishable products, which sometimes may be very specific (e.g., gluten-free, vegan). Delivering this unexpected product through the usual basket distribution channel may inevitably lead to delivering large quantities of products close to expiry to a few beneficiaries with an already scheduled basket collection, even if they are not the most appropriate according to the characteristics of the product. Thus, to achieve a quick and equitable distribution to more beneficiaries, an alternative channel to the usual basket distribution is needed.

Literature regarding social food distribution has analyzed the supply and distribution processes. In particular, some studies design routes adapted to the particular characteristics of food banks: a high frequency of perishable food collection and distribution to remote areas, for example [11] and [12]. Additional features to the routing problem scope, such as modeling uncertainty in demand [13], considering storage capacity [14], or balancing the nutritional value of the products received [15], have also been assessed. In a broader approach, Martins et al., [6] design the supply chain from food banks to smaller entities and then to beneficiaries, determining the optimal capacity of vehicles and warehouses, to obtain an economically, environmentally and socially sustainable solution. Kaviyani-Charati et al., [16] address the same problem from a stochastic approach and find a compromise solution between economic, environmental and social aspects. On the other hand, the role of supermarkets as key actors for supplying food to charity organizations has also received increasing attention. Although supermarkets are usually reluctant to disclose their surplus product forecasts [17], this practice has been recently promoted by governments [18], and Giuseppe et al. [19] determine when it is economically profitable for a supermarket to provide food banks with near-expired products. Regarding the daily operation of food banks, Mohan et al., [20] present a warehouse simulation and planning of needs to optimize the space and distribute more food without additional investment. González-Torre et al. [21] focus on the human resources of food banks' smaller distribution centers in Europe and analyze the impact of a high-turnover staff, mainly composed of elderly volunteers [22], on the efficiency of product distribution. More recently, ESADE school studied 12 initiatives of entities and companies distributing near-expired food who have promoted a digitization of their processes, thereby reducing inefficiencies [23]. However, the interaction with the final beneficiaries is usually omitted in technological initiatives due to the existing digital gap in the impoverished groups that usually require food assistance from these entities [23]. Overall, existing literature has therefore focused in optimizing the collection, storage or distribution of scheduled food donations, but unexpected arrivals require specific tools that consider their highly random nature and, usually, the urgency of distributing the products to the final users. Gibson et al. [24] specifically stated the need for such research regarding the donation of fresh products, which must also be delivered urgently.

In this context, the objective of this work is to define a procedure for an effective quick and targeted distribution of products to the beneficiaries. The developed procedure is able to urgently distribute unexpected near-expired product that may be very specific, such as gluten-free or vegan food. In particular, the procedure assists in targeting the beneficiaries for the distribution, presents a notification process to beneficiaries and also allows an appointment request by the interested beneficiaries. The tools used and processes developed are free and easy-to-use, to take into account the financial constraints of the entities and the technological skills of the volunteer staff and final beneficiaries. The procedure has

been designed in close collaboration with the network of small social food banks El Rebost, in Terrassa, Barcelona (Spain), and has been entitled "Bon Profit" ("Enjoy your meal"). The management staff of El Rebost confirm the success of the project, applied to one food bank of the network, that has allowed a notable improvement in the management of unexpected product distribution. Specifically, 129 lots of food products have been successfully delivered to targeted beneficiaries.

The procedure and application presented in this work aim to answer the three following research questions. Their statement and answer throughout the document constitute the work's scientific novelty for academic research regarding food distribution to final beneficiaries in need:

- Which criteria and features should be taken into account when targeting beneficiaries for a product distribution and how should the beneficiaries be classified for proper targeting?
- Which requirements should be considered when defining communication channels with beneficiaries and, consequently, which features should technological tools have?
- How can staff and beneficiaries, with sometimes low technological skills, be managed when implementing a channel for urgent food distribution?

The rest of the document will answer these questions while defining and implementing the procedure for a quick and targeted distribution of near-expired food in El Rebost. The document is organized as follows: in Section 2, the main characteristics of El Rebost are presented; Section 3 presents the research methodology applied in this study; Section 4 describes how beneficiaries are targeted and the various stages of the proposed procedure. Section 5 presents and discusses the results of seven real deliveries made and Section 6 displays the project's outcomes for El Rebost and the beneficiaries. Finally, Section 7 concludes the study and mentions possible lines of research and future application.

## **2. The Network of small social food banks El Rebost**

El Rebost is the network of small social food banks in Terrassa, province of Barcelona, Spain, coordinated by Creu Roja ("Red Cross") and the city council. Since 2009, it has the purpose of distributing food among the most vulnerable families (either of one member or several), which come to collect a basket once a month as a complement to their basic nutrition. The families are transferred from the municipal Social Services, since they need a nutritional support and have the necessary resources to cook the food they receive.

Figure 1 shows the supply chain of food products from arrival to delivery to the families. Food products managed by El Rebost have 3 main sources: The European Union; donations from both production and distribution entities and individuals; and, to a lesser extent, purchases made by El Rebost itself in supermarkets. At its internal facilities, the food is received in a warehouse (Figure A1 of the Appendix) and then distributed on a picking area (Figure A2 of the Appendix) to facilitate the preparation and delivery of the baskets.

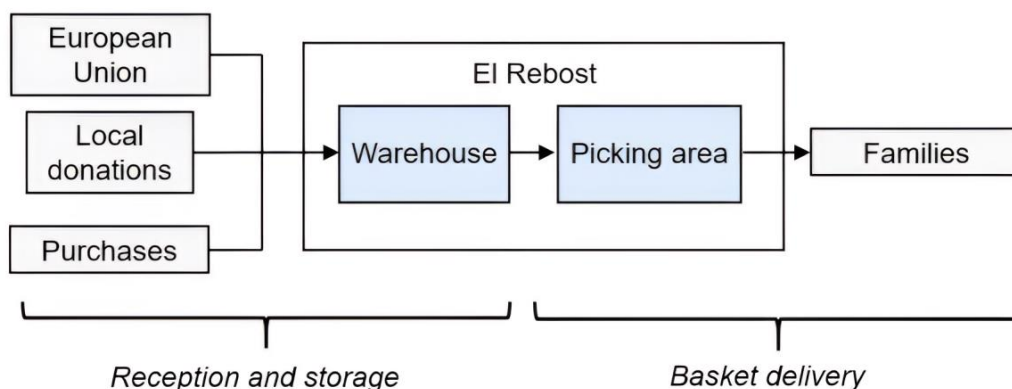


Figure 1. Food supply chain.

Regarding the reception and storage, as introduced, the products come to El Reboost from the following three different sources:

1. The European Union sends food twice a year in large quantities, through the Fund for the European Aid to the most Deprived (FEAD) [25]. This food is stored in a warehouse (Figure A1), and constitutes approximately 40% of the total 453,000 kg of products handled annually by the entity.
2. Local donations from both production and distribution companies in the area, as well as from local initiatives, constitute approximately 56% of the entity's annual product. Almost 80% of these are weekly donations from a larger food bank in Barcelona, which regularly sends food products (perishable and not perishable) to smaller banks.
3. El Reboost itself buys, in local supermarkets, essential products not available in stock to complete the baskets. This portion of the product input is, however, low (4%).

Regarding the basket delivery, El Reboost prepares and delivers around 500 baskets a week, only within the food bank of the network studied. These are given to the families in their pre-defined monthly appointment. The precise composition of the baskets is determined at the beginning of each week according to the products' availability and depending on the following characteristics of the families:

- Size: larger families logically receive more product, although proportionally less amount, than individual members, since the basket must present a variety of products.
- Presence of children or babies: families with children or babies are specifically provided with cookies or baby food, among others.
- Allergies or intolerances: celiac, lactose intolerance or beneficiaries with hypercholesterolemia are considered when distributing particular products, such as gluten-free, if available.
- Culture or religion: for example, a significant percentage of the beneficiaries are Muslims, who are offered halal meat, if available, or extra fish, if not.

### 3. Materials and Methods

This section presents the research methodology applied in this study, which consists of 6 phases:

#### 1. Analysis of the El Reboost network of social food banks

An analysis of all the processes of El Reboost was carried out from September 2020 to March 2021. During this time, frequent visits to the center were made to understand the food supply chain of El Reboost. Daily interaction with both El Reboost managers

and volunteers was established, involving non-structured interviews and frequent questions. This interaction led to the formulation of potential opportunities of improvement in the day-to-day operation of the center:

- Digitalization of the information between El Rebot and Red Cross coordination;
- Enhancing the features of the IT system used, for example, to assist with configuring the baskets;
- Raising community participation to increase donations, and
- Improving the urgent delivery of near-expired food.

The latter opportunity was selected as the purpose of the study due to its high impact capacity. Before project implementation, an unexpected arrival of near-expired product was distributed through the usual basket collection channel. This process, however, was not efficient and could lead to some products being discarded, for two reasons:

- Significant quantities of products were delivered to the few families with already scheduled basket collection, instead of carrying out a more equitable distribution to more beneficiaries.
- Products are not delivered to the most appropriate beneficiaries according to the characteristics of the products. Those beneficiaries are therefore supplied with an unplanned and perhaps non-desired product, which are key drivers for food waste [26].

Thus, a new channel for the quick and targeted distribution of food product to vulnerable population was sought. This problem definition also led to the formulation of the three research questions presented in the introduction of the document, which will be answered later on.

## 2. Analysis of the beneficiaries

During the visits to El Rebot, a significant amount of time was also devoted to informal conversations with beneficiaries, who were either coming to collect their monthly basket or were registering for the first time. This analysis allowed the most common food constraints due to allergies or diet (gluten-free, lactose intolerant or vegetarian) to be identified, as well as the beneficiaries' use of technological tools. In this regard, a formal survey of 509 beneficiaries was also carried out in December 2020 to find out how many used mass communication platforms (e.g., WhatsApp) on a daily basis. A significant number of the beneficiaries (306, 60.11%) responded they had mobile data, and 297 (58.34%) said they use WhatsApp regularly. These numbers are considered big enough by El Rebot managers to establish mass communication channels with the beneficiaries who use this kind of technology.

## 3. Definition of the requirements for the solution

To quickly and efficiently distribute the near-expired food, an agile notification and appointment system has to be established so that the targeted beneficiaries can come, quickly and in an orderly manner, to collect the specific product offered. The solution designed needs to observe some requirements, both for the notification and the appointment request, in accordance with the conclusions of both the analysis of El Rebot and the above-mentioned beneficiaries.

Regarding the notification to the beneficiaries:

- It must be done quickly and massively
- It must allow targeting the beneficiaries for notification, depending on the quantity of product received and its characteristics.
- As many of the beneficiaries are unfamiliar with digital platforms, it should employ a tool with an easy to use intuitive interface, which can also be easily managed by the volunteer staff of El Rebot.
- It should not represent an extra cost for El Rebot.

Regarding the request for an appointment to collect the product:

- Appointments must be distributed in enabled time slots, with a maximum capacity that ensures the agile distribution of the product.
- El Rebost should be able to keep track of the appointments made by the beneficiaries.
- For the same reasons as the previous process, it should employ a tool with an intuitive interface which is easy to use by the beneficiaries and to be managed by the volunteer staff of El Rebost.
- It should not represent an extra cost for El Rebost.

#### 4. Definition of the procedure

A procedure to achieve the effective distribution of near-expired perishable food was defined according to the requirements noted. Within the procedure, special attention was given to how the appropriate beneficiaries for a specific product distribution would be selected, as well as to which technological tools should be used for communication. Benchmarking was performed here to determine the most appropriate tools. This phase of the research method is carefully explained in the next section 4 (subsections 4.1 and 4.2).

#### 5. Project implementation

Multiple training materials were developed for both volunteers and beneficiaries, together with sessions to deal with doubts and queries among the volunteers. This phase of the research method is explained in subsection 4.3.

#### 6. Results and outcomes discussion

The results were examined from a critical perspective to extract the strengths and weaknesses of the developed procedure, identifying some boundaries of the current scope of the solution, which will be further extended in the future. The results are presented and discussed in sections 5 and 6 of the manuscript. The fulfillment of the three research questions presented in the Introduction is shown in the Conclusions section.

### **4. Procedure for the quick and targeted delivery of unexpected food**

This section presents the solution established for an urgent and targeted distribution of near-expired food products among the beneficiaries of El Rebost. The section first explains how beneficiaries are classified for subsequent targeted distributions (4.1). Then, the procedure is described from a product's arrival to its delivery (4.2). Finally, the preparation carried out for the project implementation is detailed (4.3).

#### *4.1. Beneficiaries classification for targeted distributions*

When an unexpected product with a close expiration date is received, the number and specific beneficiaries to be notified must be selected, taking into account the:

- Quantity of product: All the product should be delivered and waste should be avoided. To ensure that, an enough quantity of beneficiaries should be contacted. At the same time, calling to many beneficiaries may be frustrating if the product expires quickly and beneficiaries are unable to book an appointment. Thus, an appropriate balance must be sought between quantity of product and quantity of beneficiaries contacted.
- Characteristics of the product: Beneficiaries should be selected according to the characteristics of the product, considering: age (i.e.: babies or children), food restrictions due to allergies or intolerances (i.e.: celiac), culture or religion (i.e.: vegetarian, halal).

- **Potential food need:** Beneficiaries usually come to receive the monthly basket a specific week (the first, second, third or fourth week of each month). This feature allows to conform heterogeneous groups of beneficiaries who could be in major need as their last basket collection has been more weeks ago. For example, if a product has to be distributed in the fourth week of a month, the beneficiaries that usually come in the first week could be selected, since they have been the longer without any nutritional support.
- **Warning time:** If the warning time between notification and collection is large enough, in general, beneficiaries should have time to organize themselves to go and collect the product. In contrast, if the warning time is very short, only beneficiaries living close to El Rebot may be able to pick up the product, and they are the ones that should be selected. Moreover, beneficiaries living near El Rebot may also be more likely to collect low-value products, such as bread.

To be able to take into account these criteria when selecting the beneficiaries that are notified of the product distribution, all the beneficiaries registered in the “Bon Profit” project have been classified in different groups according to 3 characteristics:

1. **Type of beneficiary:** To be able to adapt the targeted beneficiaries to the different characteristics of a product, one group of beneficiaries is established for each of their following types:
  - Families with 1 child
  - Families with 2 children
  - Families with 3 or more children
  - Families with babies (children up to 2 years)
  - Celiac
  - Beneficiaries with lactose intolerants
  - Beneficiaries with hypercholesterolemia
  - Vegans or Vegetarians
2. **Basket week:** To fulfil the food needs of the beneficiaries, four specific groups are defined, according to the week for collecting the basket:
  - the first week of the month
  - the second week of the month
  - the third week of the month
  - the fourth week of the month
3. **Proximity:** For distributions of low-value products and with a short warning time, beneficiaries living near El Rebot (no more than a 15-minute walk) are grouped.

In addition, to take into account the quantity of product available for distribution, as it has been mentioned, very high ratios of notified beneficiaries versus available lots of product should be avoided to prevent dissatisfaction among beneficiaries wishing to collect a product but being unable to because it has run out. According to El Rebot data, some of the established groups might potentially include too many beneficiaries, if they are all notified, compared to the product usually distributed. These most crowded groups, which are: families with 1 child, families with 2 children and beneficiaries living near El Rebot, can therefore be divided into sub-groups. In this last case, for example, families living near El Rebot may, if necessary, be divided in three possible sub-groups (Proximity-G1, Proximity-G2 and Proximity-G3; without any differences among the sub-groups) with the sole purpose of being able to target smaller groups of beneficiaries. Likewise, two sub-groups are defined for families with 1 child (1child-G1 and 1child-G2) and for families with 2 children (2children-G1 and 2children-G2). When there are different sub-groups of the same type, a consistent rotation among them will be established to balance the food deliveries among all those beneficiaries.

Consequently, the final sub-group definition is detailed in Table 1, dividing the 17 choices of sub-groups according to the three main characteristics: Type of beneficiary (one beneficiary can belong to more than one type), Basket week (one beneficiary will be categorized in only one week) and Proximity (one beneficiary living in the surroundings of El Rebot will only be categorized in one sub-group of Proximity). For example, at the beginning of the project a family with two children, one of them celiac, that usually collects the basket in the second week of the month and living near El Rebot, will be categorized in four different sub-groups: 2children-G1, Celiac, Week2, and Proximity-G1. Alternatively, a single-beneficiary without any allergy or alternative diet choice, collecting the monthly basket usually in the first week and not living close to El Rebot will be categorized only in the sub-group Week1.

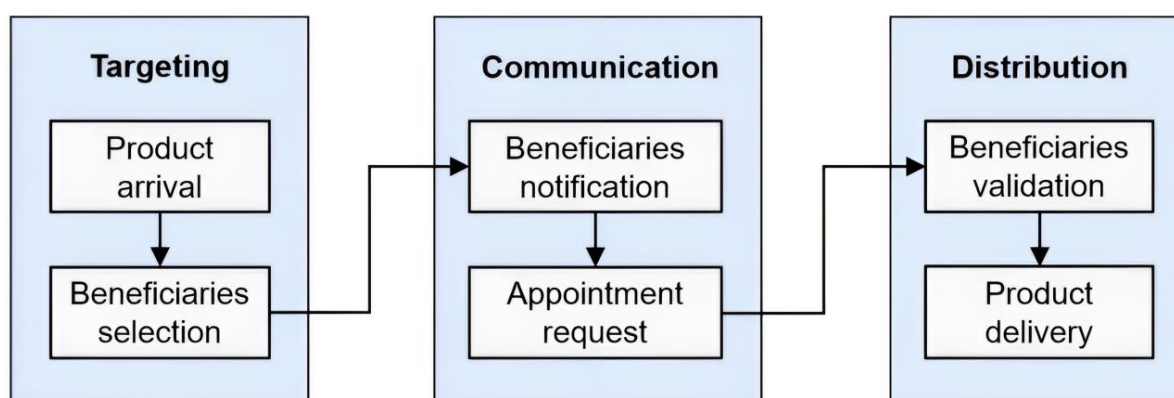
As mentioned, following El Rebot's request, when distributing a product only one sub-group will be notified at a time; all beneficiaries sharing that particular feature will then be able to make the appointment to collect the product. The possibility of managing successive notifications to different sub-groups, to increase the chances of complete product distribution, will be further studied as a future research.

**Table 1.** Division of beneficiaries in groups according to the three characteristics (type, week and proximity).

Type of beneficiary		Basket week	Proximity
1child-G1	Babies	Week1	Proximity-G1
1child-G2	Celiac	Week2	Proximity-G2
2children-G1	No lactose	Week3	Proximity-G3
2-children-G2	Hypercholesterolemia	Week4	
3+children	Vegans/Vegetarians		

#### 4.2. Procedure description

Figure 2 shows the process of decisions and actions from the moment a product is selected for urgent delivery until the delivery is completed. It compresses three stages: targeting beneficiaries, communication between El Rebot and beneficiaries to notify the product delivery and make an appointment and, finally, distributing the product.



**Figure 2.** Description of the procedure for the urgent distribution of unexpected product.

##### Targeting:

- **Product arrival:** A near-expired product with a specific characteristic arrives unexpectedly and must be urgently delivered.
- **Beneficiaries selection:** Beneficiaries are selected according to the quantity and characteristics of the product, warning time and food need. Although the procedure designed allows selecting beneficiaries sharing at the same time two or more features (for example, being celiac and living near El Rebot), in this early stage of the project



El Rebot prefers to select only one sub-group of beneficiaries from Table 1 for the targeted product distribution. In addition, the tool designed enables managing successive notifications to different sub-groups to increase the chances of complete product distribution, which will be further studied, together with the interaction of each pair of sub-groups, as a future research.

Communication:

- **Beneficiaries notification:** Emails, SMS and instant messaging platforms have been analyzed to seek the best channel for the urgent notification of a product distribution. From the different options, WhatsApp Business has initially been chosen, since it is a free tool, its use is extended among the beneficiaries and it is flexible enough to define groups of beneficiaries for targeted distribution. On the other hand, a very low percentage of beneficiaries use or even have an email account; and SMS, despite reaching the great majority of the beneficiaries, are discarded due to its prohibitive cost.
- **Appointment request:** After receiving a notification, beneficiaries can request an appointment for collecting a lot of the product. The distribution is organized in specific time slots to ease the global organization of every internal process of El Rebot. Among the tools available, Doodle has initially been chosen to organize the appointment request, since it allows to set a maximum capacity for each time slot to achieve an agile product distribution, it is a free tool and its use is widespread among the beneficiaries. It also allows to limit the amount of total appointments for the available lots of the product being distributed. Thus, a link to a Doodle is sent to the beneficiaries along with the notification message via WhatsApp Business; they can choose the available time slots that best suits them for collecting the product. Other on-line applications for appointment request, such as “Timify”, “Reservio” and “HubSpot” were considered and discarded for being mostly unknown to the beneficiaries.

Distribution:

- **Beneficiaries validation:** It is necessary to confirm that the beneficiaries who come to collect the product have been notified with the message and have requested an appointment. Besides ensuring that the beneficiary can receive the product, the time of delivery can be useful for explaining how beneficiaries, unused to this kind of digital platforms and devices, can deal with the appointment request.
- **Product delivery:** Once the validation has been carried out, the product is delivered to the beneficiary. If not enough people have booked an appointment or have come to pick up the product, an extra lot could be given to those who have attended.

#### 4.3. Preparation for the project implementation

Both beneficiaries and volunteers of the food bank must be precisely informed about the procedure defined and the operative functioning of the distribution. Thus, specific documentation has been prepared.

Regarding the beneficiaries, an information leaflet (Figure A3 of the Appendix) has been prepared to explain the project. This brochure has been translated into Catalan and Spanish, the two languages commonly used by El Rebot and the beneficiaries, and consists of two parts: the upper one, which explains how to register as a beneficiary of the “Bon Profit” project, and the lower one, which shows how to make an appointment to collect a product. Also, the last basket collections before the start of the program were specifically dedicated to clarifying the “Bon Profit” project.

On the other hand, the successful daily operation of the project depends on the prompt action of the volunteers, who are in charge of creating the Doodle, notifying the beneficiaries and validating them before the product delivery. Thus, different training sessions were carried out with the volunteers. These sessions detailed the activities to be performed and how the beneficiaries are expected to react. In order to enhance responsibility among volunteers, leadership roles to some tasks (for example: notification message sending, or beneficiaries’ validation) were assigned to particular volunteers. In addition, the

following material is prepared to ease all tasks and facilitate new volunteers to understand the projects' purpose and day-to-day operation:

- Information leaflet to explain the "Bon Profit" project at the time of registering the beneficiaries (Figure A3). As introduced, this leaflet provides a step-by-step explanation on how to react upon receiving a notification and how to manage the technological tools used, to permit the easy day-to-day operation of the project.
- Information leaflets on how to create a Doodle survey, how to create and send the WhatsApp message and how to print the list of reservation appointments to ease the validation (Figure A4 of the Appendix).

## 5. Results and Discussion

Next, the results of the procedure implementation are presented (5.1) and discussed (5.2).

### 5.1. Results

During the initial 7-month period, a total of 7 deliveries were made. Table 2 summarizes the main data of the deliveries, distinguishing their characteristics and the numerical results obtained:

- Characteristics of the delivery: The food product provided and the lots available, as well as the start date and time of the first collection time-slot, the warning time and the sub-group selected for distribution. According to this information, it is possible to differentiate between morning, noon and afternoon deliveries (see the collection date row of Table 2), and called at short notice or more than 1 day (24 hours) in advance (see the warning time row of Table 2). For example, the first delivery was notified to the group Vegans/Vegetarians 27 hours in advance, while the second, targeting the group Proximity-G1, had very short notice (only 2 hours beforehand). The length of the warning time is due to the urgency of the distribution, involving expiry dates and other technical aspects: for instance, no freezer was available when the frozen cannelloni arrived (delivery 2) and they had to be distributed very urgently. Note that for notifications with less than 1 day, an immediate response was sought in the only operative proximity sub-group (G1), since the number of beneficiaries living near El Rebois was at the moment not big enough to require dividing them into different sub-groups.
- Results of the delivery: The number of beneficiaries notified, those who requested an appointment and those who actually collected the product. In total, 129 lots of product have been distributed.

**Table 2.** Description and results of the "Bon Profit" deliveries.

Characteristics	Delivery 1	Delivery 2	Delivery 3	Delivery 4	Delivery 5	Delivery 6	Delivery 7
Products to deliver	Frozen vegan pizzas	Frozen cannelloni	Frozen cannelloni and fresh pasta	Yogurt, lemon curd, bag of donuts and gyozas	Fruit, vegetables, bread and grated cheese	Gazpacho, meat gyozas, meat for broth, margarine, bread	Margarine, Brussels sprouts, squash, soy yogurts
Available lots	45	30	60	30	25	20	30
Collection date	17-mar at 16:30	26-mar at 12:30	30-mar at 12:30	3-aug at 11:00	11-oct at 17:30	11-oct at 17:45	4-nov at 10:30
Warning time (hours)	27	2	25	16	6	4	15

Sub-group called	Vegans / Vegetarians	Proximity-G1	Week2	Proximity-G1	Proximity-G1	Proximity-G1	Proximity-G1
<b>Results</b>							
Beneficiaries notified	46	97	114	122	130	129	85
Appointments	19	13	27	30	25	16	14
Deliveries	21*	15*	29*	23	24	6	11
Appointments vs notified	41.30%	13.40%	23.68%	24.59%	19.23%	12.40%	16.47%
Deliveries vs available lots	46.67%	50%	48.83%	76.67%	96%	30%	36.67%

\* the number of deliveries is in some cases higher than the number of appointments, since it was allowed to pick up a product without booking in advance.

## 5.2. Discussion

A notable engagement was reached since the first delivery, where almost 50% of the lots could be given to vegan beneficiaries (Table 2; last row). Indeed, the ratio of deliveries/available lots increased with the fourth and the fifth distribution, the latter reaching almost a 100% (96%), which proves the possibility of performing a quick and targeted product distribution. Regarding the sixth and seventh delivery, the lower engagement may be conditioned by the time elapsed since the last delivery (two months including mid-August) which could lead to some beneficiaries forgetting about the operation of the project. Apart from the usual engagement curve of a new service, with common ups and downs, in some cases other reasons could also affect the variability in participation: time between notification and collection (2 and 4 hours in deliveries 2 and 6); delivery scheduled during holidays (delivery 3, at Easter); or simply more or less attraction (regarding nutrition content or flavor) toward the product offered, as concluded by Burke et al. [27].

It is also important to discuss the percentage of appointments versus the number of beneficiaries notified (penultimate line of the table). The percentages obtained clearly show the response of different groups of beneficiaries: 41.30% for the vegans/vegetarians (delivery 1); from 12 to 20% for the subgroup Proximity-G1 (deliveries 2, 6 and 7); and 23.68% for beneficiaries collecting the basket in Week2 (delivery 3). These numbers reflect a trend in responses that may be used in the future as an indicator of how many beneficiaries to notify for a product distribution of each kind, always trying to match the appointments and collections with the currently available lots to be delivered.

Moreover, the high response of vegan beneficiaries (highest rate appointment/noted: 41.30%) could represent a promising example for other groups linked to a food constraint or diet choice: celiac or lactose intolerants, who could not be called during the project implementation. These groups can consider the notification as more specifically targeted and therefore provide a more active response. In any case, El Rebost administration emphasize their satisfaction at having the procedure in place for whenever distribution to these food-constrained groups may occur.

## 6. Project Outcomes

The project and the deliveries have been very well received by both El Rebost and the beneficiaries. In the first place, the administration of El Rebost now enjoys the possibility of selecting the appropriate beneficiaries for the delivery of a product, as well as its partial or complete distribution in an orderly manner through appointment reservations. Meanwhile, the beneficiaries are happy to receive an unexpected product outside their basket collection timeslot, via a system which for most of them find easy to use. They also appreciate the chance of actively choosing to collect a product, rather than just having it given to them, which has important behavioral benefits for users [28].

In the brief period since the project's implementation, the procedure has already had a real impact for both the entity and the beneficiaries. Table 3 lists the six main differences introduced by the procedure in relation to the improvement of quick and targeted food delivery management by El Rebost (1-2) and the impact on the beneficiaries (3-5). The particular action within the solution that has caused this improvement is also detailed in the third column.

**Table 3.** Differences in the delivery of unexpected product introduced by the developed solution.

	Before	After	Particular action within the solution
1	Distribution of the product among the beneficiaries who have to collect the monthly basket	Distribution of the product among intentionally targeted beneficiaries	For each product delivery, beneficiaries are selected according to their type (children,eliac, etc.), food need (basket week) and capacity of response (proximity)
2	The entity did not have control of the beneficiaries receiving products and the quantities received, since they lacked a management system capable to easily offering such control	The entity can easily keep track of the beneficiaries receiving products and the quantities received, since the beneficiaries themselves make an appointment	Beneficiaries are validated at the moment of delivery, checking both the notification received and their appointment request. Validation documents are kept.
3	Beneficiaries were unexpectedly given a product in their basket	Beneficiaries actively decide if they are interested in collecting the product	
4	Beneficiaries only received monthly deliveries	Beneficiaries have the possibility of occasionally receiving a complementary product, in addition to monthly deliveries	A new distribution channel, appropriate for urgent and targeted delivered, has been implemented
5	Beneficiaries and some volunteers made small use digital platforms	Beneficiaries and volunteers increase technological skills with the use of simple digital tools	Beneficiaries are requested to actively participate by deciding whether they want to collect a product and make the appointment

The impact of the designed procedure on the food received by beneficiaries (4th difference in Table 3) will obviously depend on the frequency of the unexpected arrivals, which can fluctuate from time to time. For example, during 2020, with the COVID pandemic, El Rebost estimated that there was an unexpected of near-expired products about once a week; and the new uncertainty in the food distribution chain derived from the crisis in Ukraine, could produce a similar scenario. Had the solution developed here been ready in 2020, the beneficiaries would have had a significant increase in the food received. Indeed, the beneficiaries grouped in the four-week sub-groups (Week1 - Week4; Table 1) could have been alerted in a circular manner, ensuring perfect rotation among them and allowing, if desired, a second monthly collection of some products for all of them. The specific week selection for each delivery could be placed two weeks after having collected their monthly basket, to evenly space out their collections, or when the new basket is one week away, when there may be in more need.

## 7. Conclusions

Food banks occasionally receive significant unexpected quantities of a near-expired product, which are distributed by means of monthly basket collections. This leads to the delivery of large quantities to a few beneficiaries, who may not be suited to the product, because of its characteristics. To solve this problem, this paper presents a procedure for food banks to manage the unexpected arrivals of near-expired food products and distribute them quickly to targeted beneficiaries. The procedure has been designed in close collaboration with the network of small social food banks El Rebost, in Terrassa, Barcelona. The study has responded to the three research questions stated in the introduction:

- Beneficiaries have been grouped according to inherent characteristics, involving family members, diet choices and constraints; according to the need for any additional food support they may have and to the quick response capacity for very urgent distributions.
- The communications tools had to allow quick and massive notifications, enable targeting the beneficiaries and limiting the appointments within time-slots. They also had to use intuitive interfaces and not involve any extra cost.
- The implementation of the procedure should be preceded by training sessions for volunteers and the distribution of training materials to beneficiaries and volunteers. These materials aimed to explain the whole project and how each task should be performed. Real-time tests with a sample of beneficiaries are encouraged, to identify potential pitfalls.

The opinions collected from both the administration of El Rebost and the beneficiaries show they are highly satisfied with the project. On the one hand, the new procedure allows a more efficient distribution of products that could end up being discarded or inefficiently distributed, to target the most suitable beneficiaries for the collection and to track the deliveries made to particular groups. On the other hand, it constitutes an opportunity to increase technological capacities of volunteers and beneficiaries, and offer the latter the possibility of collecting food product outside their regular appointments.

The solution has been applied to seven real deliveries and a total of 129 lots of products have been distributed. Some of the deliveries were very successful, with a remarkable response rate (more than 40% of vegan beneficiaries notified made an appointment), and very high delivery rates (77% and 96% of the lots available were given to targeted beneficiaries in two deliveries). Meanwhile, the experience gathered and the results analysis also allow some boundaries of the current scope of the solution to be established, which will be extended in the future:

- For the sake of simplicity, the current solution does not consider making successive notifications to different groups of beneficiaries for a single product distribution in case the rhythm of appointments appears too low for complete distribution of the product. An easy and accurate management of such successive notifications will be studied. Here, the data collected regarding the percentage of appointments for each beneficiary group will be taken into account when making the successive notifications.
- The current solution is not integrated with the regular basket distribution channel of El Rebost. In a scenario of limited resources, it is interesting to note that the monthly basket can omit specific products just supplied to a beneficiary due to an unexpected arrival. These products can then be supplied to other beneficiaries who were unable to avail of the unexpected distribution since they were not notified.
- The specific tools used will also be continuously revised to reflect new technological trends and changes in use among the population.

Finally, it is necessary to point out that the designed procedure can be extremely useful for other food banks that find themselves in need of targeting the urgent distribution of a product. This project can also be adjusted for upstream stages in the food supply chain, for example, distributions from larger food banks to small centers, like that of El

Rebost. Consequently, it is hoped to extend the procedure to other entities in the food recovery supply chain.

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## Appendix

This appendix shows images of the facilities of El Rebost (warehouse: Figure A1; picking area: Figure A2) and training materials for beneficiaries (Figure A3) and volunteers (Figure A4).



**Figure A1.** Reception and Storage in a warehouse.





Figure A2. Food distribution in a picking area.

**Hem creat un nou sistema d'alertes per a productes de consum immediat o molt específics que -prèvia reserva- podeu venir a buscar encara que no us toqui la recollida de la vostra cistella**

**Què has de fer?  
¿Qué tienes que hacer?**

**Hemos creado un nuevo sistema de alertas para productos de consumo inmediato o muy específicos que -previa reserva- podréis venir a buscar aunque no os toque la recogida de vuestra cesta**

**1º Omple el formulari d'inscripció i entrega'l als voluntaris de El Rebost**

Rellena el formulario de inscripción y entrégaselo a los voluntarios de El Rebost

**2º Grava el número al teu mòbil amb el nom 'Bon Profit'**

Graba el número en tu móvil con el nombre 'Bon Profit'

**3º Envia un missatge de WhatsApp al número de Bon Profit amb el text: Vull donar-me d'alta a Bon Profit**

Envía un mensaje de WhatsApp al número de Bon Profit con el texto: Quiero darme de alta en Bon Profit

**Per reservar**

**1º) Quan tinguem disponibilitat, rebràs un missatge de WhatsApp amb tota la informació perquè puguis reservar la teva cistella mitjançant l'enllaç inclos**

Quando tengamos disponibilidad, recibirás un mensaje de WhatsApp con toda la información para que puedas reservar tu cesta especial mediante el enlace incluido

**2º) Fes clic a l'enllaç i entra a la web de Doodle**

Haz click en el enlace y entra en la web de Doodle

**Para reservar**

**3º) Per reservar hora de recollida de la teva cistella, a la web de Doodle escriu: " el teu nom i cognom \* el teu número de telèfon \* -> (tot seguit el mateix línc) <-"**

Para reservar hora de recogida de tu cesta, en la web de Doodle escribe: tu nombre y apellido tu número de teléfono -> (¡Todo en el mismo sitio!) <-

**Fruita + Pa + Formatge**  
por REBOST

El Rebost

Mostrar todas las horas en Europe/Madrid

Solo usted y REBOST pueden ver sus datos y comentarios.

Lista Calendario

Pepito Pérez 655555555

SEG	1	10:00	10:15
MIÉ			
SEV	1	10:15	10:30
VIÉ			

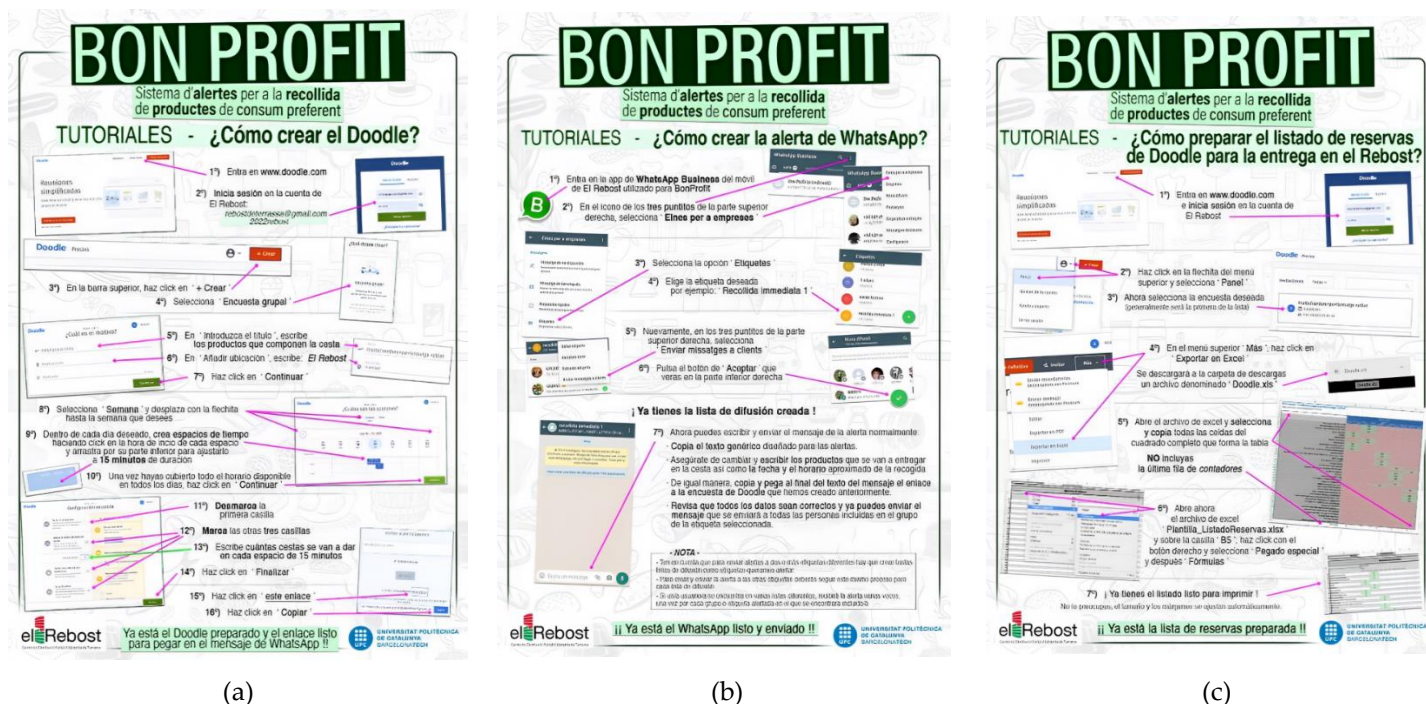
**4º) Tria el dia i la hora que desitgis fent clic al botó de la dreta i confirma a ' Enviar '**

Escoge el día y la hora que desees haciendo click en el botón derecho y confirma en ' Enviar '

**5º) Vine a El Rebost el dia i hora escollits, ensenya'ns el missatge de WhatsApp i recull la teva cistella**

Ven a El Rebost el día y hora escogidos, enseñanos el mensaje de WhatsApp y recoge tu cesta

Figure A3. Information leaflet to register a beneficiary, consisting of two parts: an upper one, to explain how a beneficiary should register the "Bon Profit" project; and the lower one, to show how to make an appointment for a product collection.



**Figure A4.** Information leaflets for volunteers about how to create a Doodle (a), create and send a WhatsApp message (b) and print the appointment list from Doodle (c).

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