



Research on Community-End Logistics Treatment Countermeasures Based on Epidemic Prevention and Control Requirements

Chennan Zhang^(✉), Han Xu, Ziyi Zhang, and Weiwei Liu

Business School, University of Shanghai for Science and Technology, Shanghai 200093, China
Cindyzycn@126.com, weiweiliu@usst.edu.cn

Abstract. Under the background of epidemic prevention and control, ‘residential economy’ came into being, which puts forward more stringent requirements for the logistics system: considering the change of residents’ online consumption before and after the epidemic, the load of the logistics system during the epidemic prevention is calculated. Under the priority guarantee of prevention and control requirements, the terminal logistics during the community blockade at the peak of epidemic situation should be reasonably handled. In this paper, the prevention and control requirements of public health events are included in the design considerations, and the development mode and technical means of the future community are integrated. A new non-contact terminal logistics processing mode and a logistics processing system based on big data are proposed to realize the orderly operation of logistics express under epidemic prevention and control, and become a powerful guarantee for the normal operation of society. Through reasonable calculation, the paper lays out cabinets and optimizes the form and site selection of express cabinets, which can not only solve the disordered problem of express logistics terminals within the community, but also meet the requirements of epidemic prevention and guarantee the transportation of materials in case of public health emergencies.

Keywords: Public Health Events · Novel Coronavirus Epidemic · Online Shopping · Express Logistics · Express Cabinet

1 Introduction

Under the background of public health emergencies such as epidemics, social activities of residents are limited, which, to some extent stimulates the development of ‘housing economy’ such as shopping online [1]. During this time, e-commerce platforms and takeaway platforms grow explosively and people’ demand for express has increased. Traditional logistics system, in the context of the outbreak of the epidemic, lacks human and material resources, which is difficult to support it.

During the fight against coronavirus, many scholars have put opinions on the optimization design of the logistics system [2]. Qiuying Bai analyzed the overall situation of logistics system, and put forward relevant suggestions for emergency logistics [3, 4].

Yang et al. improved the emergency logistics management mechanism of government from the perspective of logistics management. Lv et al. [5] have proposed intelligent logistics to optimize emergency logistics capability from three dimensions to improve emergency [6]. Chen et al. used blockchain technology to jointly build an emergency logistics system based on epidemic response and realized the integration and promotion of the emergency logistics system. The terminal of the logistics distribution problems cannot be ignored. Lijuan Que [7], Chenjing Yao [8] has analyzed the contradiction between the supply and demand of logistics distribution since the outbreak of the epidemic. Zhu et al. [9] used the perspective of game theory to build a model of logistics enterprises sharing logistics distribution resources with third-party service platforms and proposed some policy suggestions.

Driven by epidemics and other factors, the intelligent and shared logistics system has become the trend [10]. However, through the literature review of the above aspects, the following problems are still found in logistics: Although the concept of intelligence is widely mentioned, the acceptance of community is still low, and it has not been implemented. There is few literature researches on express delivery. When the number of cabinets is determined, the demand for it in the district is not investigated, which leads to the random accumulation of packages in most districts. There is no reasonable management plan for packages, which is easy to cause the disorder of residents' express delivery and aggravate the risk of virus transmission. To sum up, the research on the whole logistics system finds that logistics terminal distribution in the community needs to be solved urgently. It is quite necessary to optimize the logistics terminal system by investigating the practical problems, provide a more safe and reliable logistics system for the community, and ensure the stable operation of the community in the special period.

2 Survey of Terminal Community Logistics

For the terminal logistics in the community, the author investigates the practical problems and the urgent needs of residents in various types of residential areas by means of questionnaires and field investigations.

2.1 Questionnaire and Analysis

The questionnaire was used to investigate the changes of residents' online shopping characteristics before and after the epidemic, and the residents' attention to the safety of express parcel transmission process. When designing the questionnaire, we consider the influence of basic conditions such as age and income on online shopping habits to improve the accuracy of the questionnaire. The results are shown in Fig. 1.

During the lockdown, in order to ensure basic living, the frequency of online shopping increases. It is mainly used to obtain daily necessities, fresh food and epidemic prevention items. Under the lockdown, the sales of offline entities are depressed. The inconvenience of travelling makes online shopping become the main way for residents to solve their daily needs, which puts higher requirements for the safety, speed and disinfection of the whole logistics transmission.

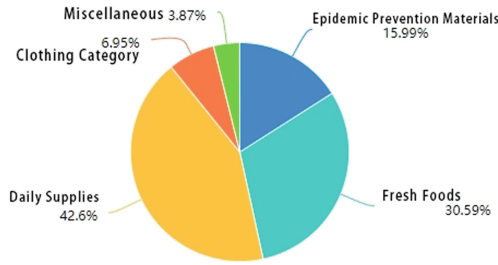


Fig. 1. Statistics of online shopping items of residents during epidemic prevention.



Fig. 2. Statistics of ways for residents to receive express packages.

Table 1. Risk marking intention in package transportation.

Would you like to add risk markers for parcel transportation	number	proportion
yes	2652	86.1%
no	435	13.9%

Through the analysis of shopping preferences of residents at different ages, we conclude the types of daily parcels and the terminal logistics needs in the community through the age structure of community members. The results show that the main objects of online shopping for residents at all ages are daily necessities, followed by fresh food. Fresh food is not easy to store, their requirement of express delivery and terminal delivery are higher. At the same time, the possibility of carrying viruses in fresh food is also large, so it is important for the disinfection of fresh food and the safety treatment of the transmission process.

Taking the family as the unit, the daily average package number was investigated to calculate the daily average package number of the whole community. According to the calculation, the average number of parcels per day in most families is less than one, and the average number of parcels per day in very few families is more than four.

In order to make an accurate judgment on the rationality and safety of the terminal logistics service in the community, we investigate the way of taking express logistics that is now widely used. The survey shows that the residents' way of receiving express is mainly to go to the express distribution center by themselves. The division of regional high, medium and low risk also makes people pay attention to the routet of express logistics. About 90% of the respondents think that it is necessary to add relevant information

about the risk level of the region where parcels has passed. The survey results are shown in Fig. 2 and Table 1.

2.2 Field Investigation and Analysis

At the same time, the team carried out field survey in Yangpu District of Shanghai, visited more than 20 communities, including commercial housing communities, mixed communities, military communities, scattered communities and old communities, basically covering the current common housing types.

Through field observation, we know the community's scheme of obtaining or sending logistics express during the peak period of the epidemic, and insight into the inaccurate problems of community terminal logistics. In the process of field research, it also carries out further exchanges with residents to get their expectations and suggestions for express logistics.

Through the observation of express receiving points such as express cabinets and guards in the community, as well as the investigation of the staff around the express logistics area, it is found that there is often a phenomenon of express spillover. For the collection and distribution of express delivery, there is also a lack of personnel organization and scheduling. For the residents receiving logistics parcels, piling up at the same time is also a common phenomenon. This will increase the risk of virus transmission to some extent, and greatly reduce the effect of epidemic prevention and control.

In addition, the survey found that the proportion of elderly people in some communities is large, there are difficulties for them to get medication and medical treatment is also difficult to them. The complex procedures does not take into account the needs of the elderly.

2.3 The Summary of Problems

After summarizing the above survey results, it is found that there are the following main problems in the terminal community logistics:

- parcels are stacked randomly and disinfections are not enough, it is difficult to meet the requirements of epidemic prevention.
- during lockdown, the number of parcels increased sharply, which brings more pressures to deal well with these parcels.
- lacking of classification for parcels and the accuracy of service is not enough.
- the way of collecting to current cabinet is still unreasonable. During the lockdown, the courier is forbidden to enter into the community, so, the current single-door cabinet is not convenient. The number of cabinets lacks quantitative analysis, which may lead to imbalance of supply and demand.
- the community lacks the management of terminal logistic, it may become the virus transmission center.

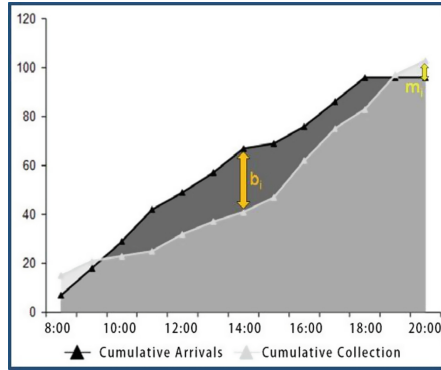


Fig. 3. Schematic diagram of express quantity changing with time.

3 Logistics Terminal Treatment Scheme Considering Public Health Incident Prevention Requirements

In view of the problems existing in the terminal processing mode of logistics express in the community, this paper puts forward some improvement strategies, mainly considering the number and layout of cabinets.

3.1 Quantity Setting of Cabinet

The imbalance of supply and demand of the cabinets can easily lead to the random accumulation of express, which has potential risks in public health emergencies.

Therefore, against the background of public health emergencies such as epidemics, in view of the online shopping preferences of residents in a specific community, a model is established based on the arrival and receipt law of express in the community, and the quantity of cabinets for each type of for the community can be obtained by it.

The accumulation of express delivery points will fluctuate over time, so in a certain research period, taking the maximum amount of express accumulation to set the lower limit of the quantity of cabinets. The amount of express accumulation at this moment is the difference between the cumulative arrival amount and the cumulative receipt amount before this time (Fig. 3).

As shown in the Fig. 3, the black curve represents the cumulative number of arrivals. The grey curve represents the cumulative number of items collected. The difference between the black curve and the grey curve at the same time is the number of parcels accumulated at this moment. In the figure, b_i indicates the maximum occupancy of the cabinet during the day. This paper refers to the volatility of cabinet occupancy rate for several continues days, and finds the maximum occupancy point during this period as an important reference index for the quantity setting of express cabinets. The model calculation formula is as follows:

$$a_j = \max_i \{b_1 + m_1, b_2 + m_2, b_3 + m_3, L, b_T + m_T\} \tag{1}$$

$$S = 75\% \max_j \{a_1, a_2, a_3, L, a_{12}\} \quad (2)$$

$$S_K = \alpha_K g S \quad (3)$$

b_i —The biggest contradiction of the day.

m_i —the surplus at the end of the day.

a_j —The biggest contradiction of the study period.

S —Total cabinet requirements.

α_K —Proportion factor of K type express cabinet.

S_K —Total Demand for Model K Express Cabinet.

3.2 Optimization of Access Mode of the Cabinet

Relatively speaking, the implementation of obturating cabinets in some districts is more convenient than the traditional shelf for epidemic prevention: it can reduce the exposure time of packages as much as possible and reduce the risk of virus carrying. However, during the lockdown in high-risk areas, the community strictly controls the entry and exit, and it is difficult for couriers to operate the cabinet, so that the express cabinet is idle. Therefore, based on the original storage mode of express cabinet, the optimization strategy is proposed. The express cabinet adopts the design of double doors. It is arranged at the boundary of the community, and the couriers and community residents operate from the inside and outside doors.

4 Conclusion

In the context of epidemic, the operation of society should meet the requirements of prevention and obey the management and organization in special periods. The highly networked modern society makes the traditional methods show their shortcomings. Based on the technology innovation scenario of future community and technical support, it can easier to know the requirements of logistics distributions. We put forward some prospects on solving the problems emerged during the epidemic.

4.1 Automatic Disinfection Cabinet

The results show that during the peak period of the epidemic, it is not clear whether the parcel is from high-risk areas, whether it has passed through high-risk regions, and whether it is in contact with high-risk person that most residents are alert to the parcels purchased online. Although the dual-door cabinet proposed in this paper can reduce some indirect contacts, there are still potential safety risks in delivery.

Automatic disinfection cabinet is a novel concept. Each express cabinet is equipped with an intelligent disinfection system. The system is composed of many ways. A 360-degree ambient micro-nozzle was set in the cabinet, and disinfection aerosols such as neutral glutaraldehyde aqueous solution, formaldehyde solution, alcohol, benzalkonium bromide solution or chlorhexidine solution were sprayed on the internal cabinet. The

inner wall is equipped with ultraviolet disinfection lamp, ultraviolet lamp use mercury lamp emitted ultraviolet light to disinfect. Ultraviolet sterilization has the advantages of colorless, tasteless and chemical substances. The disinfection cabinet automatically takes protective measures during ultraviolet disinfection, which can avoid damage to the outside. There is also a high temperature device inside the cabinet to eliminate viruses that cannot survive within high temperature. The device will not open automatically, only when it is needed, you can use this function by reserving through the phone.

4.2 Contactless Terminal Logistics

During the epidemic period, this paper gives the quantity of cabinet setting, layout and peak shifting scheme. These measures are designed to ensure the supply of living materials and reduce the risk caused by personnel aggregation. However, during the period of extremely serious epidemic situation, the residents were isolated at home and were not allowed to go out. In this scenario, it is particularly important to solve the terminal distribution problem of the parcels.

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