Politecnico di Torino

Home Delivery in the Healthcare Sector. A Literature Review and an Empirical Analysis

Master's Thesis in Management Engineering

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A mia Madre e a mio Padre,

A mio fratello Daniel,

A nonna Rosalba,

e, infine,

a te, Matteo,

perché lo meriti,

per averci tenacemente creduto fino in fondo,

e per essere all'altezza in ogni situazione,

con la personalità e i modi

del bravo ragazzo di sempre.

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Introduction

In the past few decades, the healthcare field has been grown exponentially because of increasing general awareness and globalization (Dixit *et al.*, 2019). The Healthcare Supply Chain (HSC) is a complex and highly regulated system, including all stages from research and development to manufacturing, distribution, and delivery of pharmaceutical products to patients. (Nsamzinshuti *et al.*, 2017; Yang and He, 2023). In this global context, home delivery could be a key element to shape the accessibility and efficiency of pharmaceutical care. As the healthcare industry evolves, the home delivery of drugs, currently considered a niche service, could become an essential element in the pharmaceutical care. (Nsamzinshuti *et al.*, 2017; Yongpraderm *et al.*, 2022). Home delivery has the potential to overcome geographical and physical barriers, ensuring essential medicines reach patients in rural areas, elderly or with limited mobility (Kavanagh *et al.*, 2022) or with limited time to have a medication pick-up from the pharmacy. The integration of mobile apps and online platforms, supported by pharmacists for a certain type of drug, make easier the ordering process (Saiyed and Patel, 2021), enabling a correct home delivery, crucial for patient health safety. On the other hand, national and international regulations play a key role in the practice of home delivery of medicines, addressing issues such as quality standards and professional responsibility (Nsamzinshuti *et al.*, 2017; Yang and He, 2023), as well as a careful consideration about legal requirements and protect personal data and patient privacy is needed (Saiyed and Patel, 2021). Thus, the opening section of this work highlights some results about how the HSC appears through the implementation of the home delivery for pharmaceutical products. Subsequently, a well-structured questionnaire has been designed and administered to evaluate customer's opinion about the pharmaceutical products home delivery, analyzing several influencing factors that lead to the choice between home delivery and medication dispensing.

Research background

Healthcare supply chain plays a key role to ensure a timely distribution of pharmaceutical products to the patients. In this context, home delivery is an emerging area of interest, which could potentially offer benefits in terms of convenience and accessibility for customers (Tyagi, 2024). Nevertheless, its implementation presents different challenges to be addressed to create an optimal system ensuring an efficient service (Jirjees *et al.*,2024). Most studies have focused on traditional supply chain models, without addressing in detail the specific challenges and innovative solutions in the pharmaceutical context as the home delivery could potentially be (Carter and Easton, 2011). The management of the pharmaceutical home delivery supply chain needs careful planning to balance timeliness, reliability, and safety. This gap in research was relevant during the COVID-19 pandemic, when the digitalization of pharmaceutical services increased the need for a fast and secure distribution system (Carter and Easton, 2011). Currently, despite the growing importance of the issue, literature remains scarce of a systematic and comprehensive view of current practices and emerging solutions in this field. Empirical research examining the operational models used within the HSC for home delivery is still limited.

Thesis goals

Consequently, exploring the challenges, opportunities and implications for the various stakeholders involved in the SC, this research initially aims to shed light on the home delivery model within the pharmaceutical industry by means of a Systematic Literature Review and leveraging a well-structured questionnaire to give more details about customers opinion about several influencing factors for choosing this potential type of service rather than medication dispensing, answering the previously mentioned research questions.

Summary of the content of thesis chapters

To reach these results, a total of five chapters have been structured. The thesis can be divided into two sections, as it firstly proposes a general overview of the HSC context followed by a Systematic Literature Review about the home delivery service within this sector and subsequently presents the results of a statistical analysis highlighted by a tailor-made questionnaire.

The first chapter briefly describes the HSC giving some information about its key elements, actors and flows within the SC. The second chapter proposes a Systematic Literature Review, analyzing different HSC model supporting the home delivery. Then, the third chapter is dedicated to the design, administration and data collection of a questionnaire used to show customers opinion about the door-to-door delivery for pharmaceutical products. Consequently, the results of the statistical data analysis and its key findings are shown. Lastly, in the fifth chapter a discussion of the thesis results is outlined, concluding with giving academic and practical implications as well as limitations and recommendations for future research.

Summary of achieved results

The results obtained through this thesis highlighted the dynamics of the home delivery service in the pharmaceutical sector, firstly analyzed through a Systematic Literature Review (SLR) and subsequently conducting an empirical analysis on a sample of consumers. The SLR, aimed at answering four specific research questions, identifies the main drivers pushing towards home delivery, the benefits and the limitations of this service. Furthermore, this work explored various logistical models, often developed during the COVID-19 pandemic, supported by different types of actors and warehouses as key points of the model. The empirical analysis, conducted through a questionnaire, revealed various consumer perceptions and preferences. The application of the Kruskal-Wallis test identified some statistically significant relationships between demographic variables and factors influencing the choice between home delivery and in-store pharmacy pick-up. These results provide a more detailed view of the dynamics influencing the adoption of home delivery in the pharmaceutical sector, highlighting the importance of considering the different perspectives of consumers and their experiences with e-commerce.

Chapter 1. Healthcare supply chain and home delivery

Healthcare supply chain (HSC) is a special type of SC in which healthcare goods are produced, transported and consumed. HSC begins with suppliers of drug manufacturer and finish at patient (basically customer) to fulfill the need through a definite delivery channel (Dixit *et al.*, 2019). The World Health Organization defined it as the management and delivery of medical materials, such as medicines, medical devices, and equipment, according to patients needs over time and across different levels of the healthcare system, to ensure they are available in a timely and efficient manner, supporting patient care. The success of the HSC is based on several factors including timely delivery of medical supplies, efficient transportation of materials and people including medical personnel and patients, effective inventory management and proper coordination among the stakeholders (Raj *et al.*, 2024). Recently, the HSC is indeed undergoing a significant transformation thanks to the integration of e-commerce platforms and the related use of home delivery services (Miozza *et al.*, 2024). This phenomenon emerged particularly during the COVID-19 health emergency, when the demand for medicines and healthcare products increased drastically. Nevertheless, this type of service is still underdevelopment compared to other delivery categories (Nsamzinshutia *et al.*,2017; Srinon *et al.*,2022).

This chapter aims to outline a general overview about the HSC, followed by the key points about the innovative service of pharmaceutical products home delivery.

1.1 HSC: a brief description

The HSC is a vast network of processes and components that ensures the timely manufacture, distribution, and dispensing of medications and healthcare supplies to patients. HSC management is the process of managing the flow of medical supplies and information between all parties involved in the delivery of healthcare services, including suppliers, providers, customer and patients. This process includes managing the sourcing, production, distribution, and delivery of medical supplies, as well as tracking their usage, cost, and disposal (Tyagi, 2024). Healthcare supply chain therefore is unique and different from other industries. It is a complex network consisting of many different parties at various stages of the value chain (Kritchanchai,2019). The stakeholders from the supply side and the demand side have different interest in operating healthcare supplies. The suppliers were driven for profit maximization while the healthcare providers focus more on cost and patient safety. Consequently, it is very challenging to implement the concept of supply chain and logistics management within healthcare context (Kritchanchai, 2019). Considering the interdependence among the stakeholders involved in the HSC, building a network map could be helpful to have a clear picture of how they are linked and connected (Fig.1).

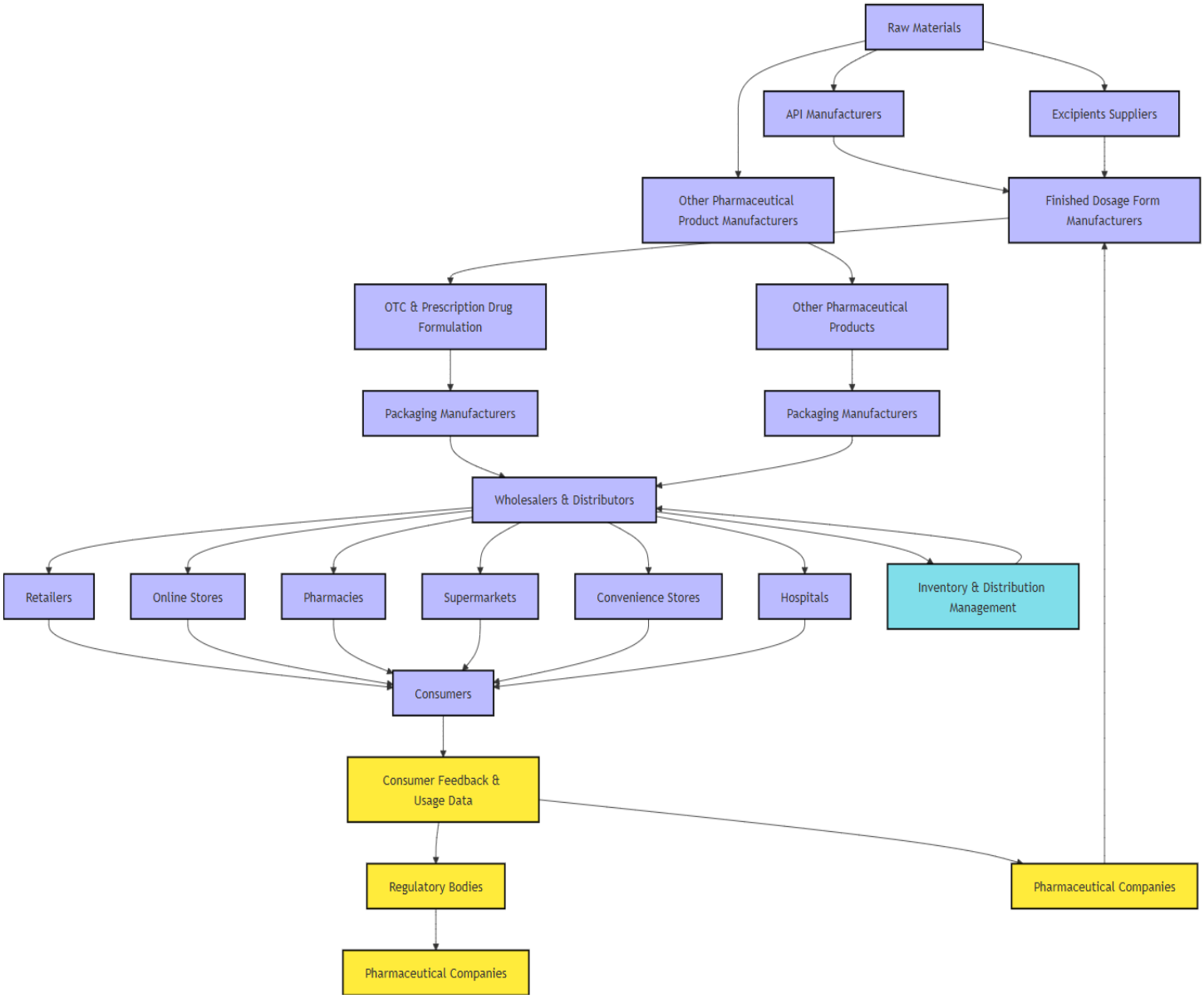


Figure 1. HSC top-bottom map

Drug distribution is a complex process based on a dense network of actors and flows, with the aim of ensuring that products travel along the chain in a safe and efficient way, until they reach the final consumer (Tyagi, 2024; Raj *et al.*, 2024). While there are similarities in the distribution flows, there are differences in regulation and control of consumption. The process for both types of drugs begins with raw materials, which include active pharmaceutical ingredients (APIs) and excipients. The raw materials are then sent to the manufacturers of finished pharmaceutical formulations, which, through the combination of ingredients, give birth to the drug in its final required form (Nsamzinshutia *et al.*, 2017). Once the drug is produced, it is transferred to the packaging manufacturers, who will add all the necessary information for both logistics (labels) and consumers (instructions) (Chaomuang *et al.*, 2022). They are then delivered to wholesalers and distributors, who will then manage the distribution of the drug at the various points of sale, ensuring its continuous availability.

For OTC medicines (Over-The-Counter), which can be purchased without a prescription, the outlets are pharmacies, supermarkets, convenience stores and online shops, which supply the product directly to consumers. For prescription drugs, which require a valid doctor's prescription to be dispensed, on

the other hand, distribution is exclusively to pharmacies, hospitals or other health facilities where the product will be dispensed only after the presentation of the prescription (Nsamzinshutia *et al.*, 2017). When the drug reaches consumers, they can provide feedback on the efficacy of the product received, which is a good way to improve product safety (Jirjees *et al.*, 2022; Raj *et al.*, 2024); in fact, the feedback is sent to regulators and pharmaceutical companies, so they will be responsible for making the necessary changes, such as changes to labelling or the development of new formulations and characteristics of medicinal products (Raj *et al.*, 2024).

In addition to medicines, the distribution process also includes other pharmaceutical products such as medical devices, food supplements and cosmetics, which follow a similar flow to OTC, being sold in pharmacies, supermarkets and online shops (Saiyed and Patel, 2021). Despite there are some differences between pharmaceutical products, the HSC's objective remains to ensure that products are available and used in an effective and safe way for end consumers (Tyagi, 2024).

Although it is not the focus of this project, we can show a short overview about the blockchain technology that can be applied and evaluated within this SC to optimize the process and ensure that this goal is achieved. Blockchain can improve supply chain transparency, traceability and security by reducing the risk of counterfeit drugs and dispensing errors. Blockchain allows the creation of an immutable and transparent record of each transaction, offering significant potential to improve traceability and security in the distribution of medicines. Particularly, it can help to combat counterfeiting, which is a growing threat to public health, by allowing each product to be assigned a unique digital identity so that all actors in the supply chain can recognize genuine products sold (Tyagi, 2024). It is also used in the management of raw materials: the implementation of a blockchain-based SCRM system provides a secure and transparent information exchange chain for raw materials, thus ensuring the integrity of the products supplied (Dash *et al.*, 2024).

1.2 Healthcare products home delivery: Key features

Globally, home delivery is becoming more and more common for different products. Even the home delivery for pharmaceutical and HSC products is a growing trend. Pharmaceutical delivery services also rely heavily on digital platforms and technologies. In a rapidly digitizing world, the ability to offer real-time delivery tracking, ensure medication safety, and provide customer support has become paramount (Kumar and Kaur, 2018). Privacy and data protection are also crucial in this service, as customer information, including medical details, must be carefully handled and protected to ensure compliance with privacy regulations, such as the General Data Protection Regulation (GDPR) in Europe. A vital aspect of pharmaceutical home delivery is pharmaceutical counseling services. Being able to speak with a healthcare professional about how to use medications correctly and address any concerns is a significant benefit of home delivery services (Kumar and Kaur, 2018). Generally, target public for this service is suitable for people who, for some reasons, are unable to visit the pharmacy for medication dispensing, such as elderly, patients with mobility issues and residents in rural areas, etc. (Lin *et al.*, 2020). The geographical location of patients also plays a significant role in the accessibility of pharmaceutical home delivery services. While most deliveries are concentrated in urban areas, patients in remote areas may face challenges accessing this service. This geographical disparity highlights the need for greater investment in infrastructure and distribution networks to ensure that patients in all areas, including rural locations, can benefit from home delivery services (Kavanagh *et al.*, 2022).

The operational aspect and the challenges of the pharmaceutical home delivery are relevant to understand how this type of service works. The operational process is different among all the pharmaceutical products, particularly between OTC drugs and prescription medications (Fig.2) For the first ones, the process includes different steps, starting with obtaining a valid doctor's prescription, followed by the approval by a pharmacist, and, lastly, sending it to a wholesaler distributor for preparing the order that includes payment details, contact information, and the delivery address. Within this process a key role is performed by the pharmacist for the validation of the prescription and medication dispensing, assisted by telemedicine providing remote patient assessments and enabling online prescription services, making healthcare more accessible, particularly in areas where healthcare services may be limited (Hammour *et al.*, 2022; Srinon *et al.*, 2022; Kritchanchai *et al.*, 2024). In some cases, pharmacies and IT departments within hospitals have integrated their operations, allowing for more seamless management of orders and prescriptions (Wattana *et al.*, 2022). Such collaboration between healthcare and technology is key to providing high-quality and efficient pharmaceutical home delivery services (Kavanagh *et al.*, 2022). The latter, combined with other pharmaceutical products such as cosmetics, vitamins and mineral supplements, intimate hygiene and oral care products, etc., follows an easier flow as it does not require prescription for purchasing this type of products by a physical or online pharmacy (Nsamzinshutia *et al.*,2017).

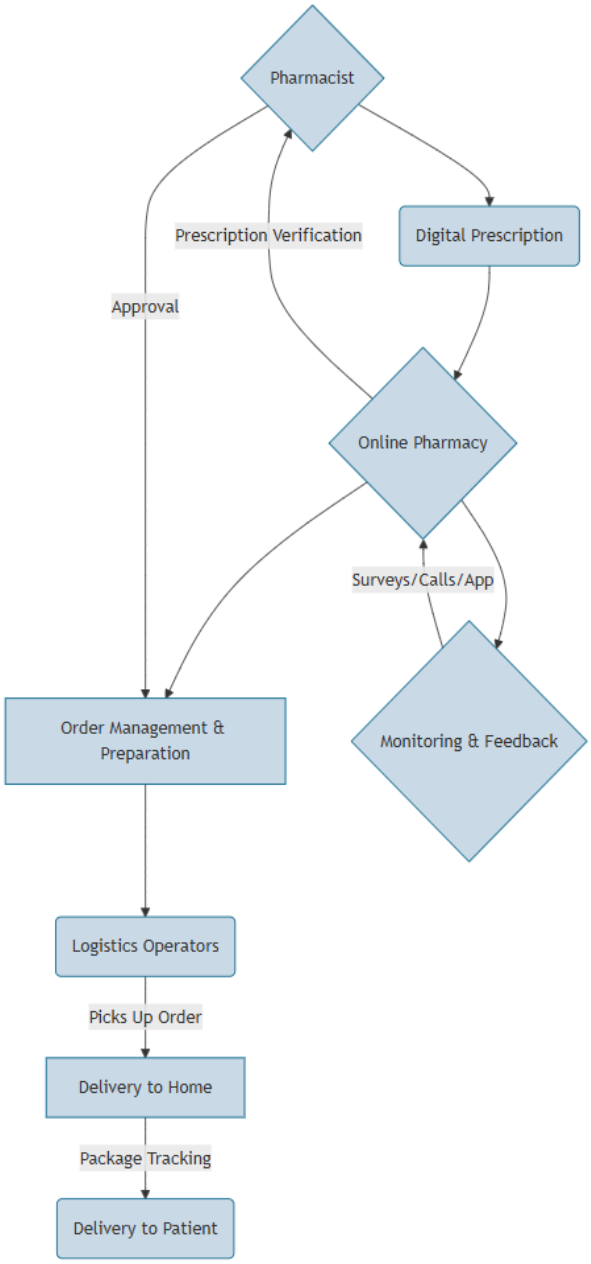


Figure 2. Prescription medication home delivery process flow

Then, the medications are stored and prepared for shipment. The storage could be carried out by different type of warehouses based on the network model used (Fig.3). For instance, wholesaler distributors warehouses, which provide pharmacies and hospitals, may create new specific departments to better organize the home delivery for final customers, being equipped with authorized pharmacist to manage the order (Srinon *et al.*,2022). When healthcare facilities are used to support home delivery, it is essential to determine the appropriate number of healthcare professionals and volunteers, such as pharmacists, nurses, and delivery personnel, based on the volume of patients being served. Alternatively, there could be used physical healthcare facilities, such as clinics, serving as hub for the door-to-door delivery service. Generally, these facilities can have sufficient space for the storage of medical supplies and can manage orders and coordinate delivery to patients, as it has been done during the Covid-19 pandemic (Kritchanchai *et al.*,2024). When healthcare facilities are used

to support home delivery, it is essential to determine the appropriate number of healthcare professionals and volunteers, such as pharmacists, nurses, and delivery personnel, based on the volume of patients being served. Additionally, unconventional facilities such as gas stations have been used as micro-consolidation centers, so they could be used for the last mile, enhancing the last-mile delivery efficiency (Nsamzinshutia *et al.*,2017).

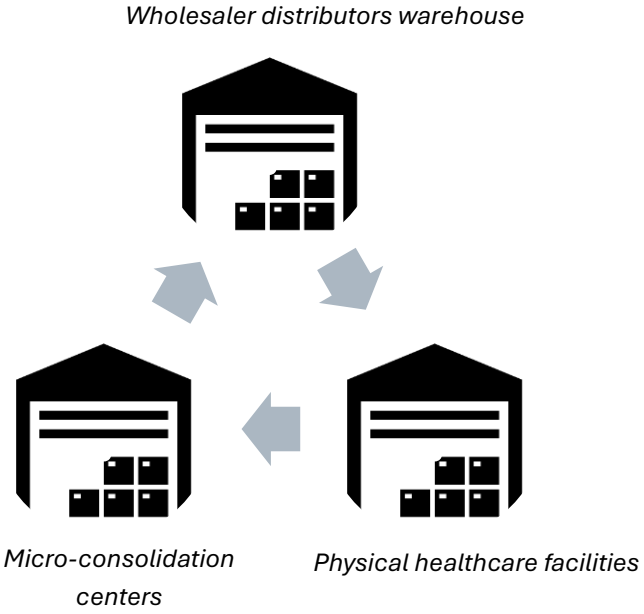


Figure 3. Different warehouses types

The need for specific storage conditions and compliance with good distribution practices for pharmaceutical products. Therefore, the suitability of service stations as micro-consolidation centers in terms of hygienic conditions would depend on their ability to ensure and maintain such standards, potentially including the need for dedicated, clean areas with temperature control, if required by the drugs being handled. In this context, even the government authorities play a relevant role in identifying suitable facilities to serve as primary or secondary warehouses, thus helping to enhance the home delivery service in more areas (Kritchanchai *et al.*,2024).

Moreover, even storage conditions are another relevant aspect for pharmaceutical home delivery. For instance, many medications, particularly those requiring temperature control, may not be suitable for delivery unless they are stored under the correct conditions. Ensuring the integrity of the pharmaceuticals during transportation requires careful attention to temperature control and other environmental factors, which could be difficult to maintain during delivery (Kavanagh *et al.*, 2022; Raj *et al.*, 2024). Packaging is an important consideration of pharmaceutical home delivery as well. Packaging must be designed to preserve pharmaceutical products, especially those requiring specific storage conditions like medicines which require temperature control during transportation. This ensures that the quality of the product is kept intact until reaching the patient (Miozza *et al.*, 2024). Proper packaging also helps avoid contamination and damage to pharmaceuticals during transit, ensuring that their effectiveness and safety for use and consumption.

The distribution of prescription medications is highly regulated to ensure that medications are dispensed safely and in accordance with the law. There are strict guidelines on who is authorized to dispense prescription medications, and this regulation ensures that medications are provided only to

those with valid prescriptions (Nsamzinshutia *et al.*, 2017). These regulations add complexity to the home delivery process but are essential to ensure patient safety and prevent the risk of illegal or unsafe dispensing.

However, several barriers must be addressed, including delays in delivery, delivery charges, and the risk of incorrect medication being delivered (Jirjees *et al.*,2024). Delivery is managed by numerous actors within the supply chain network, each one with a specific role. Firstly, pharmacist and clinics staff are crucial for medication packaging preparation. Clinics staff, which includes healthcare workers and auxiliary staff, are tasked with verifying patient addresses to attach the related labels to the medication parcels, ensuring the medication reaching the correct patient, which is crucial for adherence and effectiveness of the treatment. These parcels are then organized into boxes according to geographic areas. This logistical step is vital for efficient delivery, especially when using various means of transport such as Uber or Community Health Workers (CHWs). Additionally, pharmacists coordinate with different delivery systems, including private companies, non-profit organizations (NPOs), or even volunteers' drivers as well as Uber, ensuring that medication is efficiently transported from the pharmacy to the patient's home (Brey *et al.*, 2020; Srinon *et al.*,2022).

Then, physical delivery could be carried out by different actors, depending on the context (Fig.4). In some cases, volunteers provide with the service (Hammour *et al.*,2022; Kritchanchai *et al.*,2024). At the same time, with the help of non-profit organizations, the deliveries may be carried out CHWs (Brey *et al.*, 2020). Lastly, in the subsequent section, it will be seen how the integration between pharmacy department and IT department within a University Hospital could be a further approach in which volunteer physicians deliver pharmaceutical products to patients home (Hammour *et al.*,2022), as the IT department also uses the hospital's electronic system to collect patient requests to make pharmacists review digital medical data to ensure prescriptions are appropriate. In particular, the home delivery service was organized with the aim of guaranteeing access to medications for those unable to go to the pharmacy or hospital due to mobility issues, chronic conditions, or home restrictions due to Covid-19.

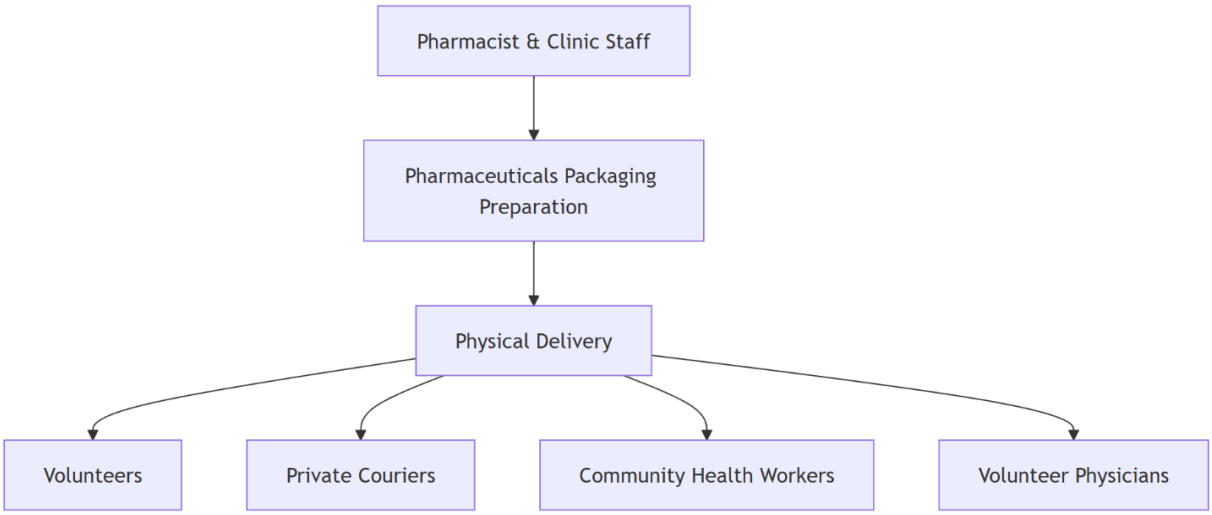


Figure 3. Different warehouses types

In conclusion, pharmaceutical home delivery could represent an innovative and transformative approach to healthcare, providing greater access to medications and boosting the efficiency of the healthcare system (Jirjees *et al.*,2024; Wattana *et al.*,2022). Altough the service is still developing and facing some challenges, its benefits could potentially surpass the outlined drawbacks (Hammour *et al.*,2022). By ensuring regulatory compliance, enhancing logistical coordination, and integrating digital technologies, pharmaceutical home delivery can continue to grow and improve healthcare delivery worldwide (Nsamzinshutia *et al.*,2017). With careful planning and investment in infrastructure, this service has the potential to revolutionize how pharmaceutical products are delivered to patients, ensuring safe, reliable, and accessible care for everyone (Lin *et al.*, 2020).

Chapter 2. Systematic Literature Review

This chapter presents a Systematic Literature Review (SLR). A review is deemed "systematic" when it is based on clearly formulated questions, identifies relevant studies, appraises their quality, and summarizes the evidence using a specific methodology (Khan *et al.*,2003).

A short illustration of the protocol of the conducted SLR is presented below (Fig.5).

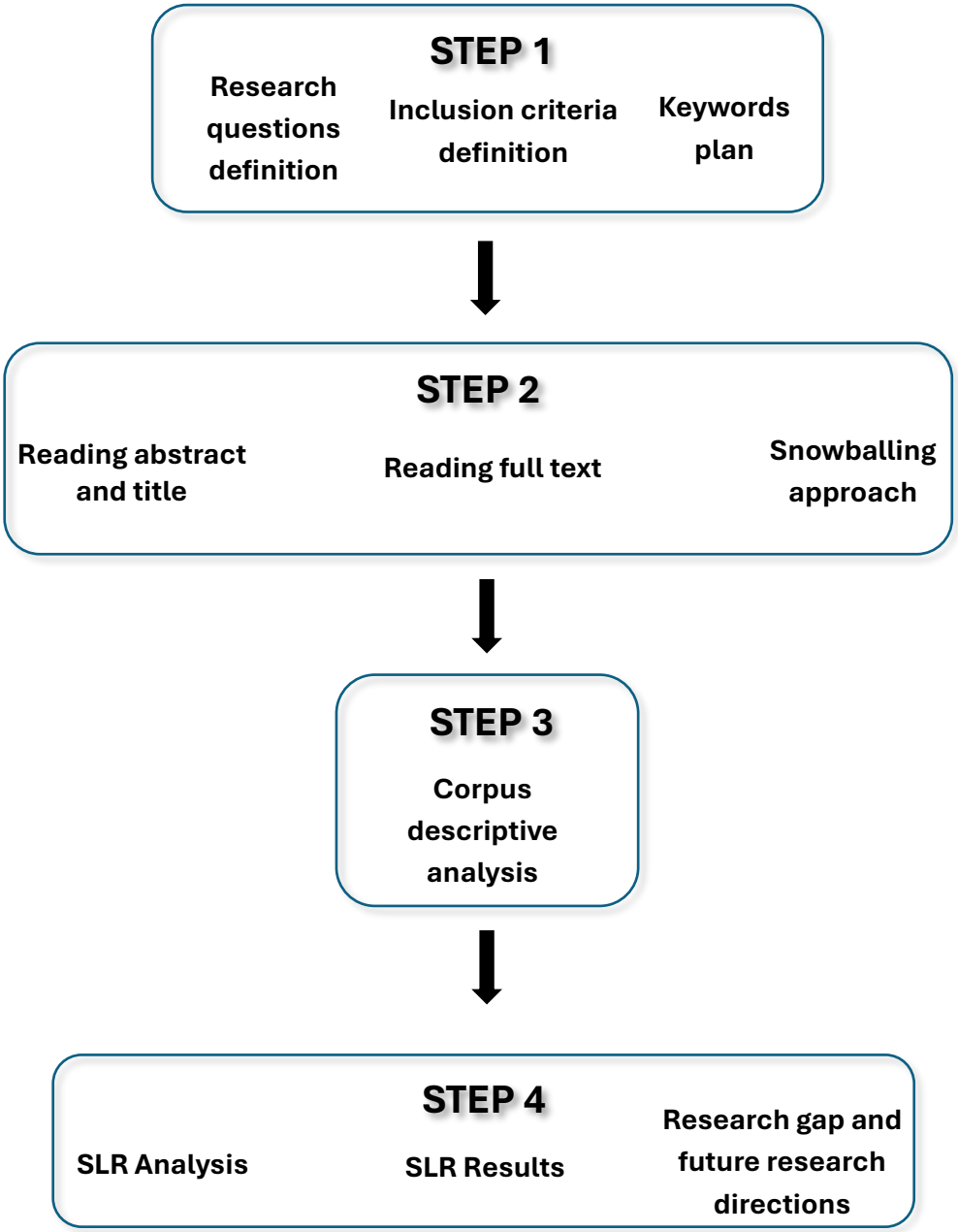


Figure 5. SLR protocol

In this chapter, SLR aims at understanding the significant trends and the existing gaps in the scientific literature related to the home delivery of products traditionally sold by pharmacies, trying to outline its drivers, benefits and limitations, as well as the supply chain network models leveraged to make this service possible.

2.1 Research Questions

As briefly mentioned in the introduction section, this work aims to answer at four research questions. They have been formulated as follows:

RQ1: What are the drivers of home delivery of products sold by pharmacies?

RQ2: What are the benefits of home delivery of products sold by pharmacies?

RQ3: What are the limitations of home delivery of products sold by pharmacies?

RQ4: What are the possible logistic models for home delivery of products sold by pharmacies?

To answer these questions, a SLR approach has been applied.

2.2 Inclusion/Exclusion Criteria

As illustrated in the **table 1**, inclusion and exclusion criteria have been selected according to the SLR protocol. The search was conducted based on the lists of keywords subsequently mentioned and on the inclusion criteria. The database used for the research was Scopus, recognized as one of the most complete bibliometric databases of scientific and technical peer-reviewed literature (Vila et al. 2020). Choosing article review, conference paper, review, and book chapter as document types allowed to include in the literature review all the prominent contributions on the researched topic. The selection of 2017-2024 time frame allowed to focus on the most recent documents, as they could be more relevant in the context of rapid scientific and technological developments, showing recent trends and progresses in the selected subject areas of business and management, engineering and pharmaceutics. In fact, home delivery of products traditionally sold by pharmacies is a relatively new research topic in the scientific landscape.

Table 1. *SLR inclusion/exclusion criteria*

Inclusion criteria	Description
Language	English
Document type	Article review, conference paper, review, book chapter
Reference database	SCOPUS
Subject areas	Business and management, Engineering, Pharmaceutics
Time frame	2017-2024

2.2.1 Keywords

With the goal of making the research more exhaustive, in the first step of the methodology, a list of keywords was identified, as reported in **Table 2**. The first list, developed on three levels, was generated to collect papers to organize the corpus for the SLR.

Table 2. Keywords

Keyword 1	Keyword 2	Keyword 3
Drug	Home	Delivery
Pharmaceutical product	Door-to-door	Delivery driver
	E-commerce	Delivery benefit
		Delivery limitation
		Delivery impact
		Delivery effect
		Delivery customer satisfaction
		Delivery community perception
		Delivery patient satisfaction
		Last-mile delivery
		Distribution
		Distribution network
		Distribution model
		Distribution trend

2.3 Papers selection based on abstract, title, and full text.

Launching the list of keywords, a total of 2.245 papers resulted. Most of these papers were coherent with the inclusion criteria, except for those irrelevant for the research aim. In fact, reviewing the papers based on abstract and title, papers out of the research scope were removed from the corpus, resulting in a total of 47 papers, of which only 27 had the full text available. The second step of the papers selection was refining the list of selected papers. After reading the full version of these documents, other articles were excluded as they did not give precise information about the SLR topic in this work, but for the general overview of the HSC or different types of delivery service, excluding the home one. Approximately 37% of them remained in the corpus, resulting in a total corpus of 10 papers.

2.4 Papers selection based on the Snowballing approach

The last step of the SLR protocol involved the snowballing approach, a technique which distinguishes forward and backward directions (Voicu and Babonea, 1997). The first helps to explore the development over time of a certain study. It starts with an initial document and ends up examining all the papers citing that specific document. The latter helps to discover theoretical foundations of a previous research and its developing over time. It looks at articles cited by a document itself. After conducting snowballing, the preliminary corpus was slightly enlarged, yielding a final corpus of 13 papers. The details of the analysis of the final corpus and how it was performed are reported in the following sections.

2.5 Results

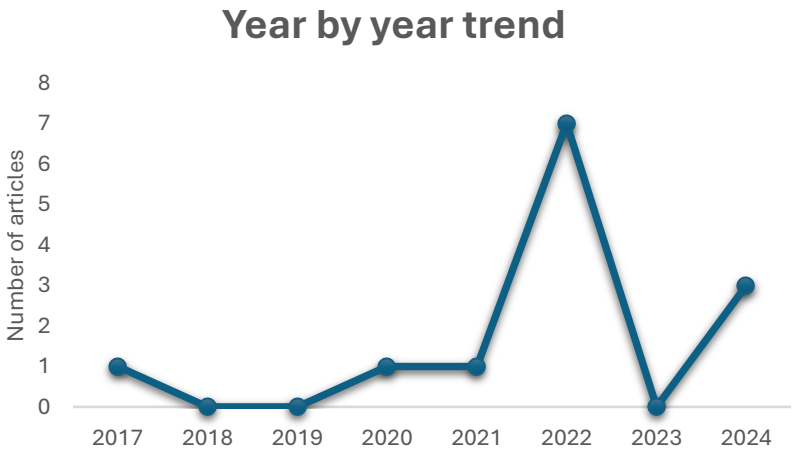
Through the available and selected sources, this section provides an in-depth overview of the literature analysis findings, proposing a summary of key outcomes and ongoing challenges.

2.5.1 Corpus descriptive analysis

After the identification of the corpus, it was analyzed with the aim to examine the main characteristics of the studies and different variables such as publication year, study type, methodology used, geographical area, and context. The goal of this section is to provide a clear overview of the corpus composition, highlighting temporal trends, the most commonly used methods, and prevalent research areas.

Year-by-year trend

The topic analyzed is relatively recent; the time frame chosen for the research of the articles constituting the corpus spans from 2017 to 2024 (Graph 1). The trend in the number of articles per year shows a gradual increase starting from 2019, peaking in 2022, representing 54% of the articles in the corpus. This peak is likely influenced by the pandemic situation caused by COVID-19, during which home delivery saw a strong increasing trend within the community, as it allowed ordering medicines online, avoiding crowded places for safety and convenience reasons, making the topic a critical issue at the time.

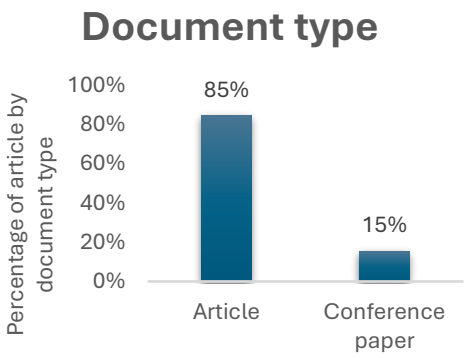


Graph 1. Year by year trend graph

The home delivery of drugs, medical supplies and pharmaceutical products remains a quite relevant topic even in the post-pandemic context, drawing insights from the "lessons learned" during the Covid period. The lower number of articles could be attributed to the reduction in scientific attention to the topic as the pressure from the pandemic eased.

Document type

Regarding the type of document, it is shown a predominance of journal articles (85%) over conference papers (15%), despite the topic of home delivery of pharmaceutical products still being in development (Graph 2).

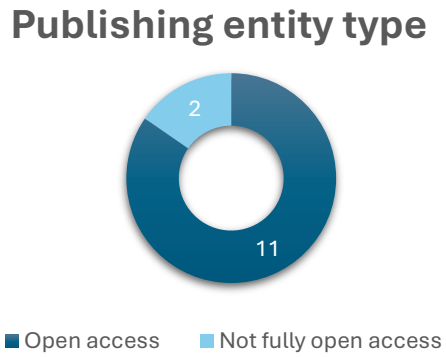


Graph 2. Document type graph

Journal articles usually address more in-depth and mature research and publish comprehensive and rigorous studies, as opposed to the preliminary works typical of conferences. However, the fact that most of the papers in the corpus were published in journals may be because many of them appeared in open access journals. Indeed, open access journals, which allow rapid dissemination of research, very often publish contributions on topics that are still in their infancy or preliminary works, to encourage and promote academic debate on new themes.

Publishing entity type

Most of the articles making up the corpus were collected from 'open access' sources, accounting for about 85% of the corpus. Out of these sources, 18% are constituted by open access journals.



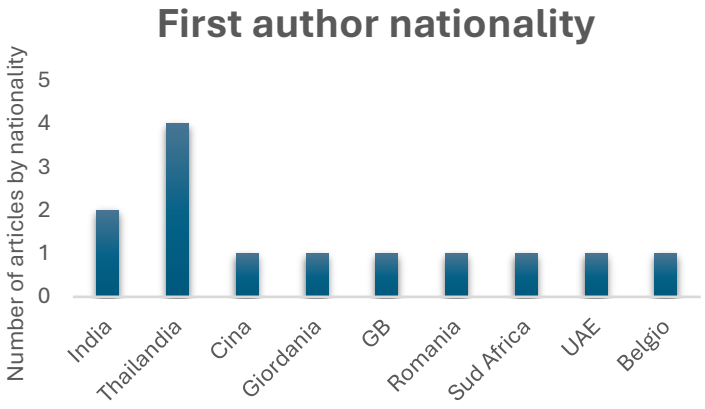
Graph 3. Publishing entity type graph

The reason behind this is likely the willingness of these journals to accept the publication of works in their early stages, covering topics that are still underdeveloped. In contrast, the remaining 15% of

the corpus comes from 'not open access' journals and provides insights into the management of pharmaceutical product distribution in a pandemic context like COVID-19 (Graph 3).

First author nationality

Looking at the chart regarding the nationality of the first author (Graph 4), which refers to the country of origin or the nation of affiliation of the researcher who appears as the first author of a scientific article and conventionally who has contributed the most to the research writing, it is evident that 69% of the corpus originates from East Asian countries (Thailand, India, Jordan, China, Saudi Arabia), with only a limited portion coming from European-bordering countries (United Kingdom, Belgium, and Romania).



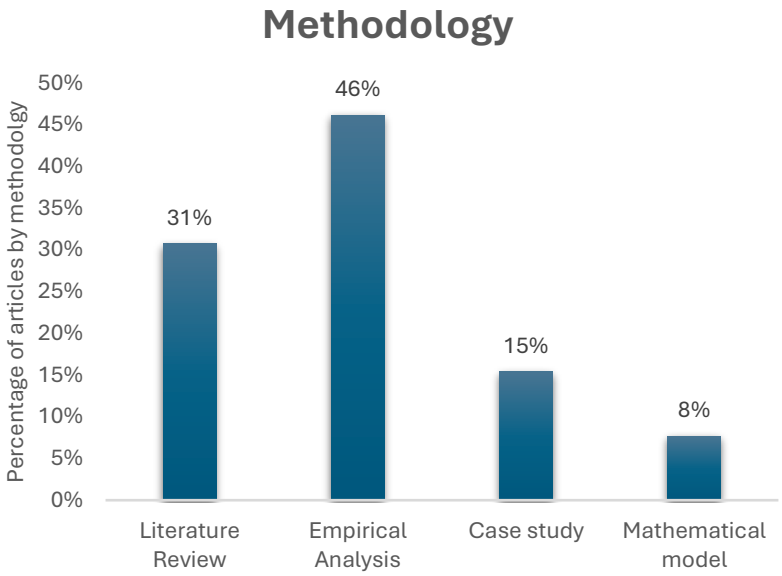
Graph 4. First author nationality graph

The likely reason for this is related to the pandemic situation caused by COVID-19, which had a significant impact on East Asian territories. These regions faced tremendous challenges due to both the high population density, which facilitated the exponential spread of the virus, and the infrastructural and organizational inefficiencies, as poor road networks and unreliable delivery models that weren't suitable to sudden sustain the increasing demand, making it difficult to deliver pharmaceutical products quickly and efficiently as well as limiting accessibility to supporting the technology in some remote areas of less developed countries. Therefore, this may have prompted explorations of the home delivery topic to provide timely solutions and potentially consider it as a future emergency plan.

Methodology

The methodology used in the papers reflects the immaturity of the discussed topic. As it is a relatively new subject, the scientific literature is lacking, quantitatively, information related to the issue at hand. Furthermore, without a solid knowledge base on the topic, it is difficult to approach it mathematically with the aim of optimizing the home delivery drug distribution system. Moreover, since this service is still not widely spread, there have not been enough case studies generated from which to conduct more in-depth analyses. In fact, only 8% of the corpus uses this type of methodology. Instead, there are many empirical analyses, approximately 46% of the corpus, and the reason for using this methodology could be the desire to explore how customers and the other relevant stakeholders evaluated and might evaluate, even in the future, a home delivery service for pharmaceutical products. Finally, the presence of some papers implementing literature reviews, accounting for 31% of the corpus, is probably due to the aim of illustrating, in general terms, how the

supply chain for home delivery of pharmaceutical products is currently addressed by literature (Graph 5).

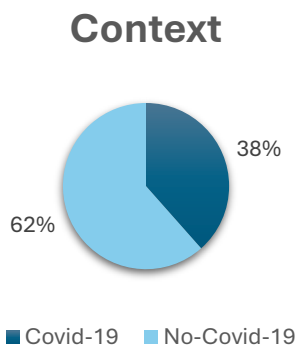


Graph 5. Methodology graph

Therefore, these outcomes highlight the promising potential for the development of the research on home delivery drug distribution networks because there are many areas than can be further to be explored.

Context

Some of the articles related to the home delivery pharmaceutical supply chain, particularly 38% of the corpus, refer to the COVID-19 pandemic context for several reasons (Graph 6). First, the pandemic had a significant impact on the production, distribution, and accessibility of medications, especially regarding vaccines and COVID-19 treatments. This highlighted several aspects as follows.



Graph 6. Context graph

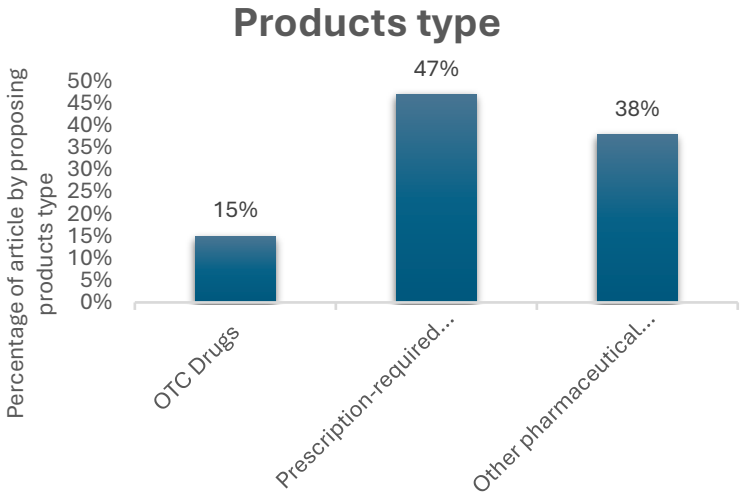
The need for new logistical solutions: the distribution of life-saving pharmaceutical products presents complex logistics, as it requires advanced infrastructure within the supply chain to maintain, for instance, effective temperature for products, to ensure timely delivery to avoid the deterioration of the products and also to keep up with the strict regulatory standard and documentation for safety. This, drove companies to seek innovative solutions to respond quickly to the demand for this type of

medication. For instance, products such as vaccines or those one used for certain chronic diseases, maybe require strict storage and transportation conditions, that is why they paved the way for improving home delivery systems under challenging conditions to be adapted to ensure a more efficient and rapid delivery to reach patient's home safely. The need to strengthen healthcare systems: the management of medicines and vaccines became a crucial aspect of the pandemic response, attracting global attention and an influx of resources to improve healthcare supply management. In this context, the introduction of electronic prescriptions supported the home delivery of pharmaceutical products. Thus, the pandemic forced companies and governments to rethink the pharmaceutical supply chain. The articles regarding the Covid-19 context are particularly relevant because they discuss the supply chain redesign and help understanding how the system responded to a global health crisis and how future performance can be improved. Other articles, however, were written independently of the global health crisis, because it could be argued that the issues raised during the pandemic may remain relevant even in normal times, so that maybe the home delivery service could be a solution for those issues, such as guarantee a better accessibility to the pharmaceuticals, that maybe research wants to better investigate.

In summary, while the pandemic undoubtedly influenced the pharmaceutical supply chain, daily challenges and long-term issues continue to be a central topic of study and discussion in the sector, justifying the presence of articles that focus on a non-pandemic context.

Products type

15% of the articles in the corpus refer to Over-The-Counter (OTC) medications, 47% to prescription-required medications, and the remaining 38% focus on generic pharmaceutical products (Graph 7). This distribution is due to the differences between these types of products, which affect their accessibility, purchasing methods, and home delivery processes. Specifically, for OTC medications, since a prescription is not required, there are no significant barriers to their distribution, as they can be easily purchased through e-commerce platforms that allow home delivery.



Graph 7. Products type graph

On the other hand, specific medications, particularly those used for chronic treatments, require more attention because they must be authorized by a prescription (this explain the 47% of the articles most of them with a significant focus on chronic diseases) and follow a different distribution process,

which typically involves a pharmacist or an online pharmacy service before home delivery, as it needs a valid doctor's prescription and a pharmacist to validate it before medication dispensing and subsequent appropriate door-to-door delivery service.

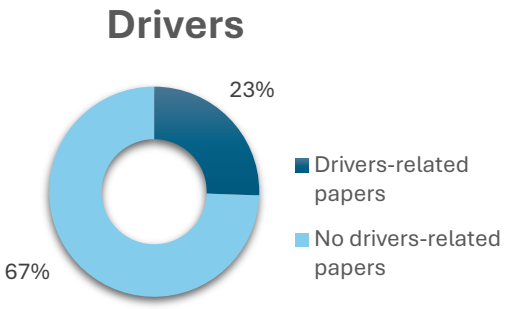
In summary, the difference in pharmaceutical products highlighted by the articles in the corpus reflects the distinct needs and dynamics of these two segments of the pharmaceutical market.

2.5.2 Home delivery of pharmaceutical products: drivers, benefits and limitations

The following section will focus on the analysis of home delivery of medications, examining in detail the factors that promote its adoption, the benefits it brings to patients and the healthcare system, as well as the challenges and limitations that hinder its widespread.

Drivers (RQ1)

The analysis of literature on the home delivery of pharmaceutical products highlights several factors that could push to the choice of this kind of distribution method. 23% of the corpus gives information about the drivers of this service (Graph 8). **Table 3** summarizes all the aforementioned drivers.



Graph 8. Papers discussing drivers graph

Particularly, 17% of the selected papers focus on healthcare treatments and management. This group specifically focuses on health management and continuity of care, so it is separated into its own category distinct from physical accessibility, emphasizing the need for a fixed and periodic request for medication supplies for patients who has serious health issues and/or chronic diseases. The drug home delivery would be vital to meet these types of patients, as it could allow the regular refill of medication, delivering them at home, to avoid a large number of pharmacy visits. Then, it could be crucial for people with fixed drugs demand usually for a quite long duration treatment with chronic diseases (Nsamzinshutia *et al.*,2017).

Further 34% of the papers, equally divided, discuss about sector growth and health emergencies. The first, pertains to the evolution of the sector, its adaptation to technology, and the growing demand for online pharmacies, which represents a broader change compared to the other factors. The latter, stands out for its urgent nature, related to crisis situations or immediate needs, distinguishing it from other categories that deal with access, management, and adaptation. Naturally, one of the drivers that could be taken into account is the health emergency. For instance, during the Covid-19, the drug home delivery has been crucial for people life. This is translated into the need to reduce overcrowding and unnecessary visits to pharmacies and accordingly reduce the load on pharmacies (Jirjees *et al.*,2024).

In this regard, it will be helpful in contributing to prevent the spread of similar virus in the future. In addition, a modern driver in this context is rapid growth of dispensing volume within online pharmacies; delivery services could be a mean to improve access to pharmaceutical care, increasing adherence particularly for the elderly (Kavanagh *et al.*,2022).

50% of the corpus, instead, presents the accessibility and mobility topic. These three factors are interconnected because they all relate to physical access to the pharmacy, whether due to time constraints or mobility issues. Drug home delivery is designed to enhance convenience and accessibility for patients, particularly those with the inability to access the pharmacy due to time or ways constraints or ways to get the pharmacy and those with limited mobility (Kavanagh *et al.*,2022); so the target public for this solution (home delivery) would be people who do not have time to go to a pharmacy. It also could be essential for some elderly patients who live in a rural area and may have no other way to get to the pharmacy, maybe due to a lack of public transport (Kavanagh *et al.*,2022).

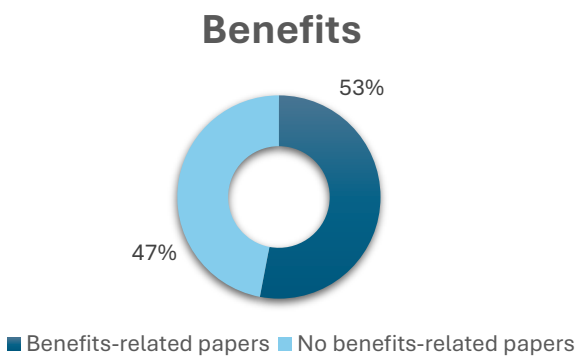
In this regard, the theme of home delivery arises, which would become a solution to the needs and requirements outlined.

Table 3. *Drivers of Home Delivery in Pharmaceutical Supply Chain*

Drivers of Home Delivery	Description	References
No time to get pharmacy	Lack of time to visit the pharmacy	[5]
No ways to get the pharmacy	Lack of access to transportation	[6]
Limited mobility	Physically challenging accessing the pharmacy	[12]
Fixed regular medications refill for long-term treatment	Need for regular refills, e.g. for chronic treatments	[5]
Rapid growth of dispensing volume within online pharmacies	Increasing use of online pharmacies	[6]
Health Emergency	Need for medication during health emergencies	[12]

Benefits (RQ2)

Within the corpus, approximately 53% of the articles (Graph 9) shows several advantages that home delivery would bring to the pharmaceutical supply chain and to people who are willing to use the service, listed in the **table 4** below.



Graph 9. Papers discussing benefits graph

Specifically, 29% discusses the convenience and efficiency topic as well as accessibility and inclusivity. The first topic highlights factors related to the practical and economic aspects of services, emphasizing convenience and operational efficiency. The second category focuses on the accessibility and inclusiveness of services, aiming to ensure they are available to everyone, regardless of age, disability, or economic resources. Additionally, 14% of the papers presents a safety and reliability topic, as its factors are related to safety, reliability, and the proper management of medications, which are essential for building trust between customers and pharmacy service providers. Lastly, 12% faces public health and protection argument, focusing on the contribution of pharmacy services to public health, especially in terms of protection from health risks and emergencies.

However, they are often related to the use of Internet, from which it is easier to order drugs online. The internet has made things simple and easy. Patients can now order drugs online and have those products delivered after submitting a prescription from a registered medical professional, for instance, contacting a pharmacist by phone or e-mail or through an E-Pharmacy, a pharmacy that distributes drugs and medicines online and distributes it to consumers (Saiyed and Patel, 2021). The services provided are different, in relation to the national legislation and the status of each country (high, low and middle income population) For example, in the US there is the integrated chronic model, where the patient with chronic conditions goes to the community pharmacy to fill a new prescription, after which the patient uses the online pharmacy for home delivery of the prescribed medicines, whenever needed. With the application of the drug home delivery, patients affected by chronic diseases are guaranteed a continuous access to the medications needed without leaving home for picking up the medicines after the prescription. In Romania, the online pharmacy represents the community pharmacy authorized to dispense and retail medicines without medical prescription and other products provided by law (Over-The-Counter - OTC, dermato-cosmetics, homeopathies, food supplements, etc.). It has been also considered a more advanced system, with the recent development and implementation of Electronic Health Record (EHR), systems that have begun to implement in many countries, including Belgium (Milieu, 2014). The idea would be to automatize the exchange of information between the physicians and the wholesalers. This can also contribute to decrease printing costs, and mitigate risks of misreading or falsification, etc. A e-health platform would be accessible

to the customer, who could check and update his details, see the expiration dates of his prescriptions, decide on the planning of the deliveries, etc. (Nsamzinshutia *et al.*,2017).

In this context, through the use of the Electronic Health Record system, the accuracy and timeliness of home delivery could be facilitated, for instance, reducing errors by ensuring the correct medication to the right patient avoiding misreading of paper prescription that could be a significant risk for patient's health and improving efficiency of the healthcare delivery system by an improved and faster communication between healthcare providers and pharmacies to enhance the delivery process in terms of timing. Delivery services remove barriers and enable patients to receive their medicines in a consistent, timely fashion. This view is also seen in literature with many authors describing how pharmacy delivery services increase patient access to medicines, particularly vital for the elderly and those in rural areas where a pharmacy may not be within walkable distance (Kavanagh *et al.*,2022). People who live at a great distance from a conventional pharmacy, the elderly, people with disabilities, those with a hectic daily schedule, everyone can be benefited by the convenience and ease with which medicines can be purchased online and shipped to their home (Saiyed and Patel, 2021). Anyone can login to the internet, go to an E-pharmacy website and buy any prescription medicine you desire in only a few minutes. Purchasing of drugs from E-pharmacies allows a buyer to save money (Saiyed and Patel, 2021). Several research studies (Saiyed and Patel, 2021; Hammour *et al.*,2022; (Jirjees *et al.*,2024) suggested that procuring of prescription drugs online, and having them delivered at home, could save a fraction of the cost, also because shipping fees could be less than the cost of travelling to a conventional pharmacy, if the latter is relatively far from your home or workplace, taking less time and effort than visiting to the drugstore and standing in line to have your medication (Saiyed and Patel, 2021).

From empirical research of 2022 regarding the drug home delivery in Romania which was conducted on 323 patients aged between 25-85 years, the 55.1% of the respondents were satisfied with the transportation charges imposed for home delivery of medicines and the 62.5% of respondents were satisfied with the speed of delivery. Moreover, the 77.7% of respondents said they trusted that they receive exactly the requested medicines from the home delivery. Another critical issue that draws attention is that drug home delivery, during the Covid-19 in Thailand, positive influenced the Drug-Related Problems (DRP). These are a series of circumstances such as nonadherence to the prescribed therapy, lack of understanding on how to take the medications and which dosage to take, and changes in packaging or drug brands or packaging. The introduction of the home delivery ensured patients to have their medicines delivered at home, avoiding gatherings. These findings suggest that patients involved in a home drug delivery program reduced DRPs (Saiyed and Patel, 2021), for instance, having lower levels of nonadherence, fewer conditions that required additional medications and fewer adverse drug reactions, maybe because they receive the correct dosage or they did not forget to take the medicine having it delivered at home without going to the pharmacy. Moreover, it reduces the risk of exposure during pandemics (Jirjees *et al.*,2024). During the pandemic, the delivery of pharmaceutical products has been given a number of attention because it reduced the risk of COVID-19 transmission by reducing in-person contact between individuals (Hammour *et al.*,2022). The main benefit of this service has been the decrease of overcrowding and unnecessary visits to pharmacies and accordingly the load on pharmacies. In addition, it allowed the patients to receive their medications without interruption during critical times such as the pandemic (Jirjees *et al.*,2024). Furthermore, medication dispensing protocols and measures were immediately designed and

established to benefit patients who could not attend the hospital or clinics as a result of mobility problems, those who suffered from multiple chronic medical conditions, or those confined to home quarantine as a result of the coronavirus. This approach could provide a solution that could help people obtain their medicines during the pandemic.

In summary, among the multiple positive aspects are the online pharmacy service price and willingness to pay for it (Jirjees *et al.*,2024), which suggests that convenience is valued, transportation charge imposed for home delivery of medicines and the speed of delivery at home, as demonstration of that timeliness and cost-effectiveness are important factors in the decision to use home delivery services (Mihaela Manoliu-Hamwi *et al.*,2022). For consumers, the main advantages are related to convenience in terms of time, cost, and service quality, as well as the mitigation of counterfeiting risks and the guarantee of privacy and personal information security (Nsamzinshutia *et al.*,2017; Saiyed and Patel, 2021; Kavanagh *et al.*,2022).

Furthermore, when purchasing online, the advantage could lie in meeting the patient's needs, as e-commerce platforms often offer a wide range of pharmaceutical products that may not be available in physical stores, so people choose to get them by home delivery (Hammour *et al.*,2022). Additionally, home delivery can be particularly beneficial for individuals with limited mobility, such as the elderly and disabled. Home delivery also provided significant benefits during the pandemic, primarily because the prompt delivery of medications saved lives and contributed to a decrease in drug-related illnesses. Moreover, it reduced the risk of public exposure, thus minimizing human contact, particularly in pharmacies, to help prevent the spread of the virus.

Lastly, several advantages related to the home delivery service of involved stakeholders have been highlighted, such as a reduction in the use of paper for prescriptions (using online pharmacy an electronic prescription could be done) and an improvement in the quality of medical prescription services, increasing both their effectiveness and convenience for patients (Nsamzinshutia *et al.*,2017).

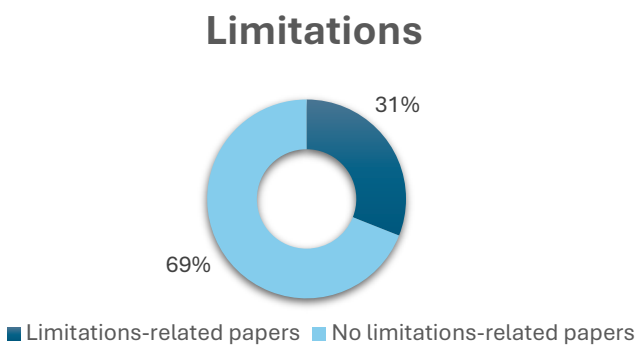
Table 4. *Benefits of Home Delivery in the Pharmaceutical Supply Chain*

Benefits of Home Delivery	Description	References
Cost convenience	Cost savings from pharmacy using home delivery	[1][6]
Time saving	Time reduction spent on pharmacy visits	[1][6]
Match patient need	Customized service to the patients' needs	[7]
Correct medicines	Precise product delivered	[10]
Serves the elderly	Care for elderly need	[12]
Serves disabled people	Care for disabled need	[12]
Makes it more comfortable pharmacy services more efficient	Enhanced comfort and efficiency in pharmacy services	[12]
Decrease of drug related problems	Medication issues related reduction	[2]
Decrease printing costs	Printing expenses reduction	[5]

Mitigate risk of misreading and falsification	Decrease of errors and fraud risks	[5]
Human lifes saved	Lifesaving through proper medications delivery	[7]
Online pharmacy service price	Optimal pricing offered by online pharmacy	[1][10]
Transportation charge imposed for home delivery of medicines	Optimal delivery fee	[10]
Trust the pharmacist checks products before delivery	Confidence in pharmacist's activity	[10]
Delivery speed	Fast delivery	[10]
Reduces the risk of exposure during pandemics	Decreasing exposure to pandemics	[12]

Limitations (RQ3)

Despite the benefits drug home delivery could introduce in the pharmaceutical supply chain, its application remains limited in some ways. 31% of the corpus highlights some limitations of this kind of service (Graph 10).



Graph 10. Papers discussing limitations graph

Most of the papers, approximately 34% of them, faces the crucial topic of errors and inaccuracies in medications, as it focuses on the risks associated with medication management, particularly errors that could compromise patient health. These errors are among the main concerns in the pharmaceutical sector. 44%, instead, discusses accessibility and inclusivity topic (22%) as well as logistical and service issues category (22%), as they addresses accessibility aspects, focusing on how pharmacy services can be more inclusive, especially for more vulnerable groups and dealing with issues related to logistics and service, including delivery difficulties and additional costs that may affect the overall customer experience, even if it is often free as (Jirjees *et al.*,2024) said. Lastly, 22% of the corpus outlines regulatory and legal and data security and protection topics, concerning legal and regulatory aspects, which are crucial to ensure that services comply with current laws and focusing on the protection of sensitive information, an increasingly important issue for companies handling personal data. **Table 5** provides the list of mentioned benefits.

Therefore, several barriers are strictly linked to the delivery process; particularly, incorrect medicines delivered to the patients, wrong labeling on the delivered package, late delivery of an order and, in some cases, high cost of fast delivery (Wattana *et al.*,2022; Jirjees *et al.*,2024). In addition, there are multiple restrictive factors related to legislation concerning the delivery of certain types of medications, particularly those requiring a prescription, the sharing of information for the exchange of personal data online, as well as a decreasing human interaction since not going to a public place like a pharmacy may reduce the opportunities for social interactions and potentially contribute to a sense of detachment from the community, playing a bad role in mental health and well-being (Nsamzinshutia *et al.*,2017; Kavanagh *et al.*,2022; Jirjees *et al.*,2024). As previously said, one of the strongest barriers of the drug home delivery service could be receiving the wrong order. It's truly simple to understand that assuming the wrong medicine could be a serious problem for patient's health, compromising safety of the patient as well as the efficacy of the treatment and significant risks for patient's health. Furthermore, it could cause harm to the patients who use this type of service: if the patient lives a negative experience with the delivery, it could decide to not use it, leading to a loss in faith in the service, and the pharmaceutical profession in general (Jirjees *et al.*,2024). Similar to the incorrect order, the wrong labeling on the delivered package could be another critical scenario in the home delivery service. Particularly, the patient, if does not detect the error, could take the wrong medicine and follow the wrong dosage instruction, maybe causing allergic reaction. Additionally, it could be possible to have a late delivery of an order, which affected the quality of the service. This would be a problem if the patient takes medications for acute problems and chronic illnesses, which may have an effect on medications taken regularly (Jirjees *et al.*,2024).

Lastly, one more drawback/barrier related to the MHD service is paying a delivery fee, as not all the medical home delivery services currently existing are free of charge. For instance, most community pharmacies in the UAE (United Arab Emirates) offer this service for free. On the other hand, several dedicated delivery companies offer the medication delivery service in collaboration with community pharmacies with fixed delivery fees. To compare with another country, for example, in Jordan, the community pharmacies that offer the MHD service apply a delivery fee on an individual basis, as the cost of the delivery service is added to the price of the medication (Jirjees *et al.*,2024). Furthermore, pharmaceutical e-commerce has led to the compression of home delivery time. For instance, some platforms, such as Dingdang Express (China), guarantee 28-minute delivery in urban areas. However, this requires the establishment of warehouses in different areas of a city of each city and a considerable number of couriers, resulting in high drug delivery costs. Secondly, the customer service staff of pharmaceutical e-commerce platforms are not necessarily professional physicians or pharmacists but rather sales personnel with limited knowledge of drug products. This knowledge gap poses potential safety risks for patients when purchasing drugs online, resulting in a weak customer reliance on pharmaceutical e-commerce channels (Yang and He, 2022). Indeed, it is possible to have significant limitations in some countries for the prescription drugs - which could be the most interesting products for home deliveries - whose delivery is actually strictly regulated by law. For instance, the Belgian legislation states that “a pharmacist is the only person authorized by law to issue prescription drugs” (Belgian Royal Decree published on the 22nd of June, 1960). It is therefore forbidden to drug manufacturers, or any other entity, to provide these specific products without going through a recognized professional (Nsamzinshutia *et al.*,2017). Also in the UAE, it is prohibited to dispense any controlled and semi-controlled medications via the home delivery service (Jirjees *et al.*,2024). In fact, since the e-commerce makes it easier to get your medicines delivered at home, it is

straightforward to identify a lack of medical evaluation in place, so you can have your drug prescribed remotely without having had a direct evaluation in the presence of the doctor. People are worried that online medication dispensing might limit communication with pharmacists and prevent patients from receiving appropriate medication guidance, which could result in patients being deprived of medication information that they should be aware of (Jirjees *et al.*,2024). Moreover, if you want to order pharmaceutical products, it is mandatory communicate your personal data to complete the order and delivery process. Leveraging the online pharmacy websites, it could be relatively easy to hack private information. This makes necessary for them to disclose their privacy policies, which assure that your personal information will never be shared with third parties (Saiyed and Patel, 2021). So, the negative aspects refer to the delivery of the wrong pharmaceutical product, followed by the occurrence of late home delivery. For instance, online pharmacy service could be improved by enhancing the quality of patients' counselling by telephone or e-mail through a better support from the pharmacist. Patients' satisfaction with the advice they received by email from their pharmacist was low. Instead, several people confirmed that they trust the pharmacist to check their medicines before delivering them (Mihaela Manoliu-Hamwi *et al.*,2022). This is a crucial factor because the assumption of the wrong medicine could lead to serious health consequences. So, ensuring that the correct product is delivered must be a priority.

Moreover, a study demonstrated that residence within a 1 to 5 km radius from the home to the clinic was related to a higher number of patients willing to pay for delivery service (Wattana *et al.*,2022). This suggests that convenience and the perception of easier access to services influence willingness to pay. Thus, because people don't always want or have time to go to a pharmacy for picking up medicines, so they rely on the home delivery service. Focusing on enhancing communication channels to ensure reliable and timely delivery could be helpful to reduce concerns about interactions with pharmacists and delivery delays. Additionally, implementing training and support to delivery personnel can help mitigate concerns regarding medication errors and incorrect dispensing or delivery.

Table 5. *Limitations of Home Delivery in Pharmaceutical Supply Chain*

Limitations of Home Delivery	Description	References
Medicines delivered to the wrong patients	Correct medicines delivered to the incorrect patient	[12]
Wrong labeling on the delivered package	Incorrect labeling on delivered package	[12]
Wrong pharmaceutical product	Incorrect product delivery	[12]
Late delivery of an order	Delayed delivery of medication order	[10][12]
Delivery fee	Charges for home delivery	[10][12]

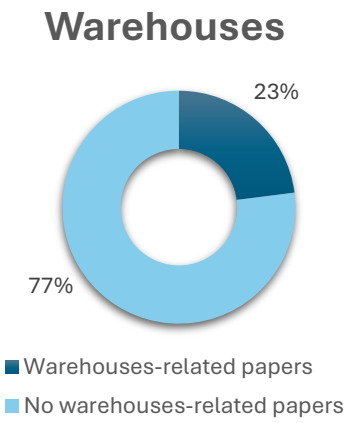
Legislation	Legal regulations affecting the home delivery service	[5]
Low protection of personal and financial data	Inadequate personal and financial data security	[3][6]
Lack of physical evaluation in place	Absence of face-to-face health evaluation	[6]
Society exclusion	No more visits in public place as the pharmacy	[6]

2.5.3 Logistic models for pharmaceutical products home delivery (RQ4)

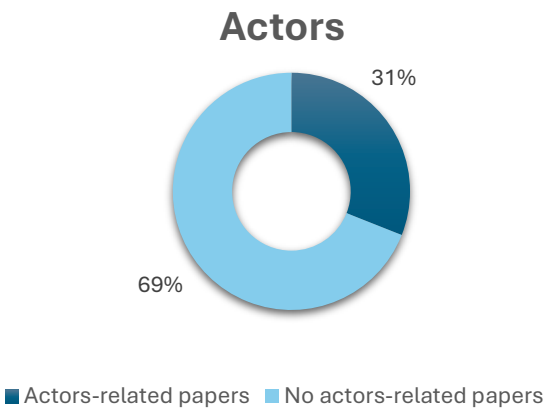
The logistic models for the home delivery of medications that emerged from the analyzed scientific literature will be proposed in this section, which aims to illustrate how different initiatives, particularly during the COVID-19 pandemic, addressed the challenge of delivering pharmaceutical products sold by pharmacy to patients' home, analyzing the roles and tasks of warehouses and actors involved in these processes.

Intermediate warehouses and involved actors

Only the 23% of the corpus highlights some information about the presence of intermediate warehouses within the supply chain for the drug home delivery service (Graph 11). In addition, 31% of the corpus proposed information about the number and type of actors within the supply chain of the drug home delivery (Graph 12). Particularly, a series of logistics models is shown.



Graph 11. Papers discussing warehouses graph



Graph 12. Papers discussing actors graph

About logistics models, all the 3 cases are related to the Covid-19 context, demonstrating the attention the pandemic situation drew to the topic. Nevertheless, the goal of this analysis is to understand how the home delivery service functioned during the pandemic, and, consequently, try to leave a few notes regarding a potential future application.

In this regard, for instance, in Thailand, a "special" model was developed through the collaboration of government, private parties, and volunteers, including physicians, nurses, logistics operators, and stakeholders in the pharmaceutical supply chain (Srinon *et al.*,2022) (Fig. 6).

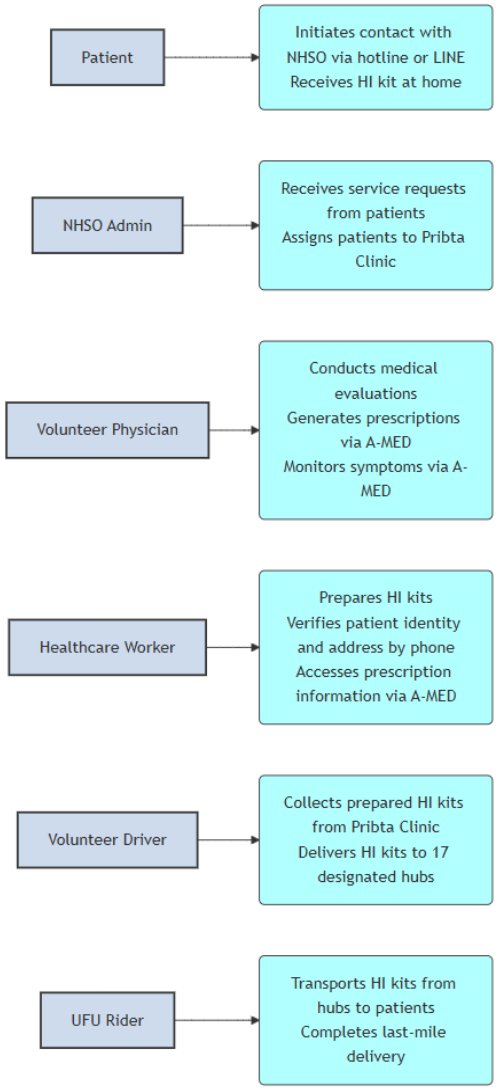


Figure 6. Roles and activities of stakeholders involved I

The model can be divided in two segments: the first one started with the doctor's assessment and the prescription of medications through an online clinic platform (Pribta Clinic). Once an order was placed, it was confirmed and processed by the clinic's staff and pharmacist. Particularly, Pribta Clinic, operating as a virtual hospital, received home isolation (HI) requests by the NHSO (National Health Security Office). Doctors, through the A-MED telehealth system, generated prescriptions which were verified by pharmacist or healthcare workers with the patient by phone; then they prepared HI kits with the prescribed medications and organized the deliveries, which were initially made by volunteers and later by riders from a Thai food delivery platform called UFU Cargo. To keep up with the large number of patients the collaboration with UFU Cargo boosted the delivery of the kits, oltrepassing the limits of the former logistics based on only volunteers. The latter, drugs were delivered to Pribta Clinic twice a week, where they were divided: one portion was used within the clinic, and the other was distributed to 120 NHSO clinics. These clinics were leveraged as warehouses where pharmaceuticals were collected before being distributed directly to patients' homes, improving efficiency and speeding up delivery. Logistics were initially handled by volunteer riders and later shifted to a private logistics agent (UFU Cargo), with PTT (a Thai oil and gas company) stations used as sub-distribution points (Srinon *et al.*,2022).

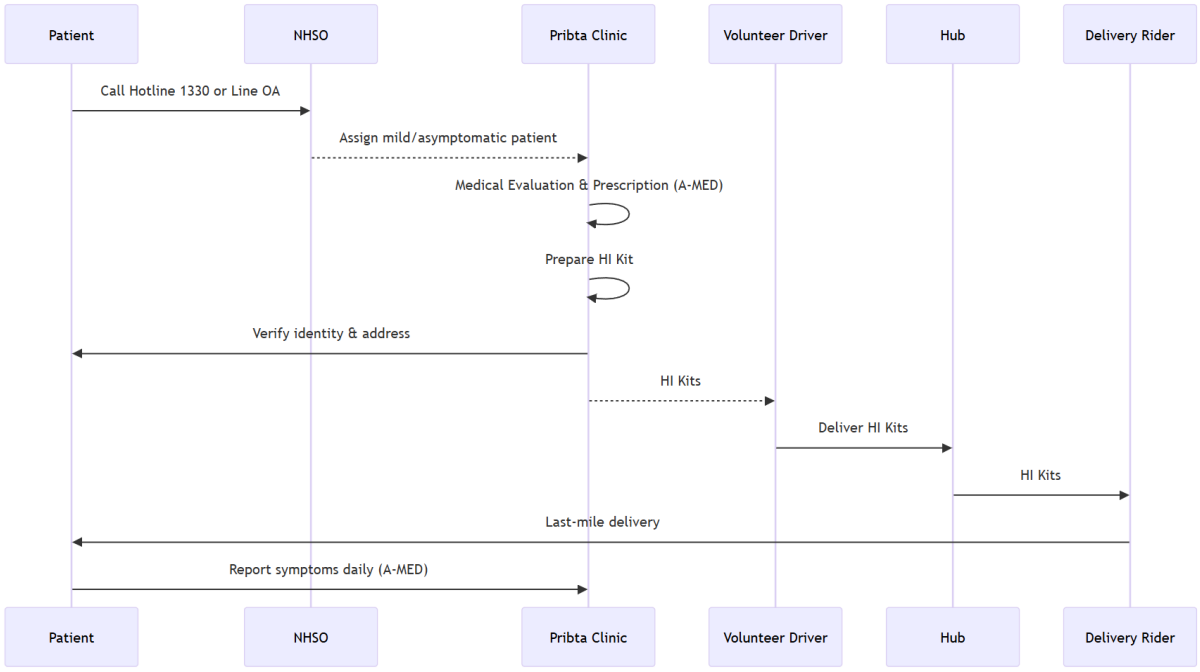


Figure 7. Thai drug home delivery model

Particularly, the clinic utilizes a logistics network involving 17 hubs as drop-off and pick-up points for the HI kits with delivery riders from UFU, handling the last-mile delivery to patients' homes (Kritchanchai *et al.*,2024) (Fig. 7). Despite the system's efforts, Pribta Clinic encountered significant delays in delivering HI kits to a growing number of patients, especially as the pandemic worsened in the Bangkok Metropolitan Area. The clinic, initially serving 20,000 HI patients, had to reduce admissions due to logistical challenges, leaving many patients without timely access to care. The delivery process involved volunteer drivers transporting kits to hubs, which then distributed the kits to riders for final delivery. However, the delays caused by this multi-step process negatively impacted patients' health, as timely access to kits was crucial for preventing severe illness. In the final delivery stage, once the HI kits reach the hubs, delivery riders take the kits to patients' homes (Kritchanchai *et al.*,2024). Shortly, a summary about the presence and the function of the warehouses involved in the process of the drug home delivery is highlighted below (Fig. 8).

- Medication Preparation Warehouse: Pribta Clinic and local clinics for the final preparation of medications for patients.
- Function: Operational warehouse where medications are prepared and packaged by pharmacist or preparation staff before being delivered to patients.
- Secondary Distribution Warehouse: PTT Stations to facilitate local distribution of medications.
- Function: PTT stations serve as intermediate distribution warehouse thanks to which logistics operators and couriers were facilitated for local delivering of medications.

These warehouses collaborate with each other to ensure a continuous flow of medications to patients, optimizing logistics and product availability (Fig. 9).

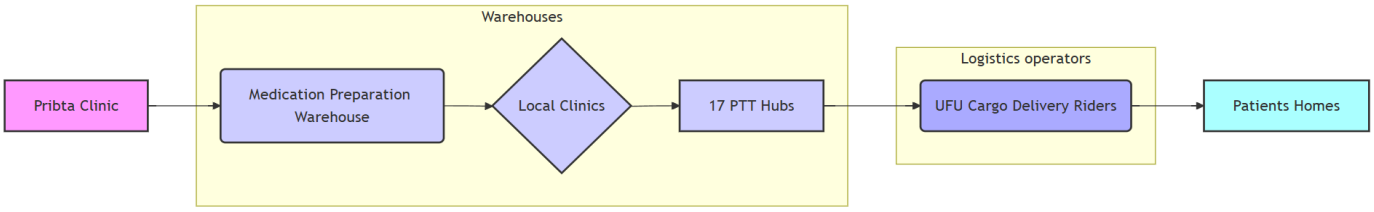


Figure 8. SC network flowchart I

This model 'hub-and-rider network', developed through the collaboration of various stakeholders, shows a smart solution for ensuring a rapid access to medications, especially during emergencies like the COVID-19 pandemic. It offered numerous benefits, particularly in terms of logistical efficiency and cost reduction. However, some challenges as volunteer dependence, logistical difficulties during peak demand, territorial coverage, management of the collaboration between different parties, logistical risks and long-term sustainability are factors to be carefully considered and must be addressed to ensure greater long-term efficiency and sustainability. So, the need of a deeper analysis of these aspects arises, aiming to improve the effectiveness and scalability of the model. Further research into tracking technologies and resource management could help overcome these barriers looking for optimizing the system for future applications.

The second model was instituted in Cape Town (South Africa) serving a large number of patients with chronic diseases such as human immunodeficiency virus, tuberculosis, diabetes, hypertension, asthma and chronic obstructive pulmonary disease (Brey *et al.*,2020). The system consisted of the following steps.

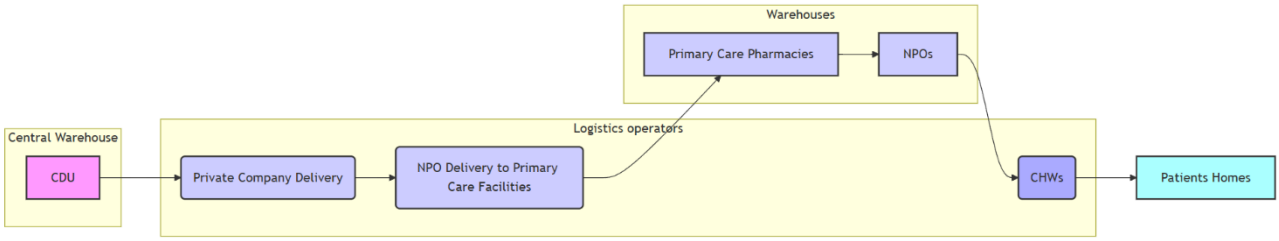


Figure 9. SC network flowchart II

A system of home delivery of medications was rapidly established to reduce the risk of COVID-19 in this vulnerable group of patients and thereby reduce the overall risk of transmission associated with the movement of people, with different stakeholders involved (Fig. 10).

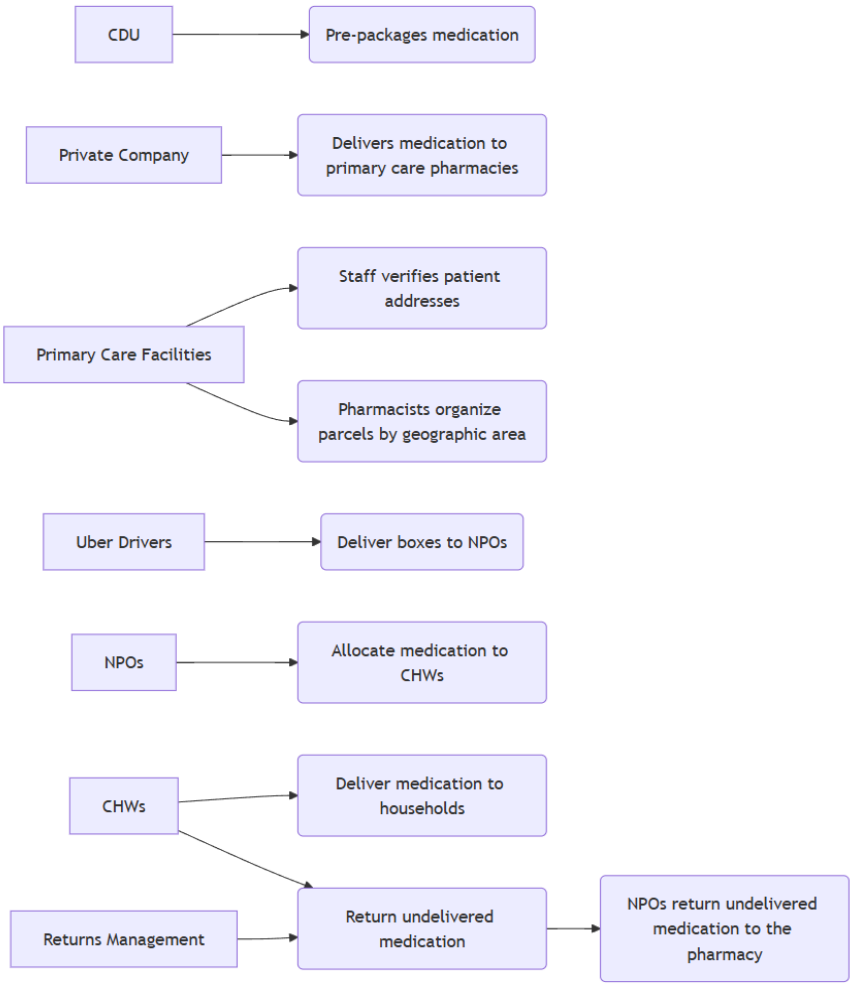


Figure 10. Roles and activities of stakeholders involved II

Medication was delivered as usual to primary care pharmacies, but then a variety of means were used to disseminate the parcels to local non-profit organizations (NPO), where they could be delivered by an estimated city-wide network of 2500 community health workers (CHWs). Each CHW was responsible for approximately 250 households, and they were grouped into teams of 10–15 CHWs each with a professional nurse coordinator.

It was estimated that 200 000 parcels needed to be delivered per month, which extrapolated to four parcels per CHW per day (Brey *et al.*,2020). This was a feasible goal and still left room for other essential tasks by the CHWs. After the first week of implementation, over 3000 parcels were being delivered per day. Innovations included various ways of delivering the parcels, including via Uber, bicycles and electric scooters (Brey *et al.*,2020). However, some problems occurred during the service, for instance, few patients had moved to other addresses during the lockdown, and parcels needed to be redirected, which was not easily accommodated by the system. The system had virtually no incremental costs as the NPOs, CHWs and CDU were already financed. The only incremental costs were for transport from the pharmacy to the NPO. These costs were minimal as, for example, the cost of using Uber per parcel was $0.04 (Brey *et al.*,2020).

In short:

1. A central dispensing unit (CDU) pre-packaged medication.

2. A private company delivered these to pharmacies at primary care facilities.

3. A team at each primary care facility called patients to verify their addresses and printed address labels to attach to the medication parcels.

4. Pharmacists and their teams organized the parcels into boxes by geographic area.

5. Drivers delivered the boxes to non-profit organizations (NPOs) by Uber drivers.

6. Non-profit organizations allocated the medication to community health workers (CHWs) according to the area they typically worked in.

7. Community health workers delivered medication to the household and returned any undelivered medication.

8. The NPOs returned undelivered medication to the pharmacy at the primary care facility.

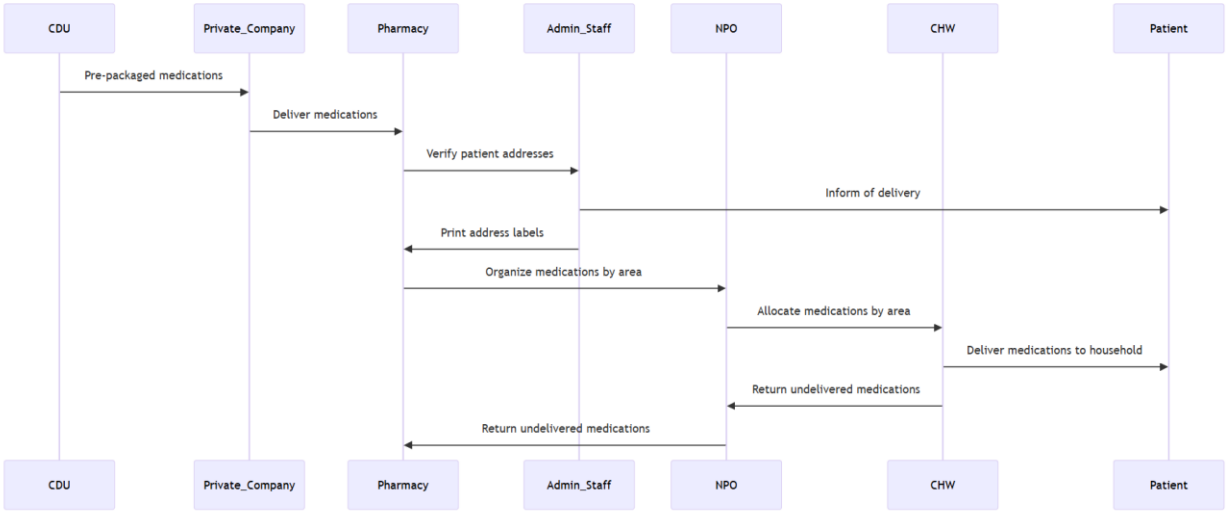


Figure 11. Cape Town drug home delivery model

The displayed model (Fig. 11) has underscored a strong ability to address the challenges posed by the COVID-19 pandemic, especially for patients with chronic illnesses. Nevertheless, it exposes some issues related to logistics, the reliability of transportation methods, and managing unexpected situations, such as changes in patients' addresses. Despite the system worked well in the emergency context, further attention may be needed in process management and in building a more robust network to ensure its long-term effectiveness.

One more relatively new model developed during the Covid-19 which it is worth analyzing came from Jordania. Firstly, since it is not normally permitted, the government authorities granted a special allowance to implement the services of home delivery and internet pharmacy. As a result, patients unable to attend the hospital due to mobility issues, patients with various chronic medical illnesses, and patients restricted to home isolation, were quickly devised, and implemented medication distribution policies and measures. This strategy could provide a way for people to get their

medications during the pandemic, they were able to have their drugs sent to their homes via a delivery service (Hammour *et al.*,2022).

To set this service up, a pharmacy department designed a well-organized approach (Fig. 12).

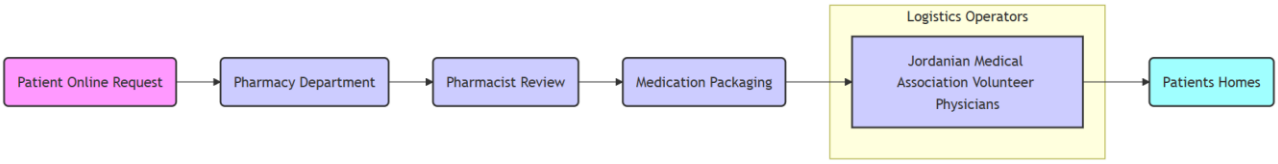


Figure 12. SC network flowchart III

The patient fills out an online form to request medication and selects a delivery service, with the option of receiving it between Sunday and Thursday. The pharmacy department at Jordan University Hospital collects the requests from the hospital's electronic system. A pharmacist reviews the patient's digital medical data to ensure the prescription is appropriate and makes any necessary adjustments. Medications are delivered in a sealed white bag with labels stating the patient's address. Through a partnership with the Jordanian Medical Association, logistics services transport the medications from the hospital to the patient's home free of charge during the quarantine period (Hammour *et al.*,2022). The delivery of medications by volunteer physicians who kept them in proper storage conditions occurred at no cost for patients, neither to the new platform created in partnership between the pharmacy department and the JUH's information technology management department, as the already existing instruments and technology has been used (Fig. 13).

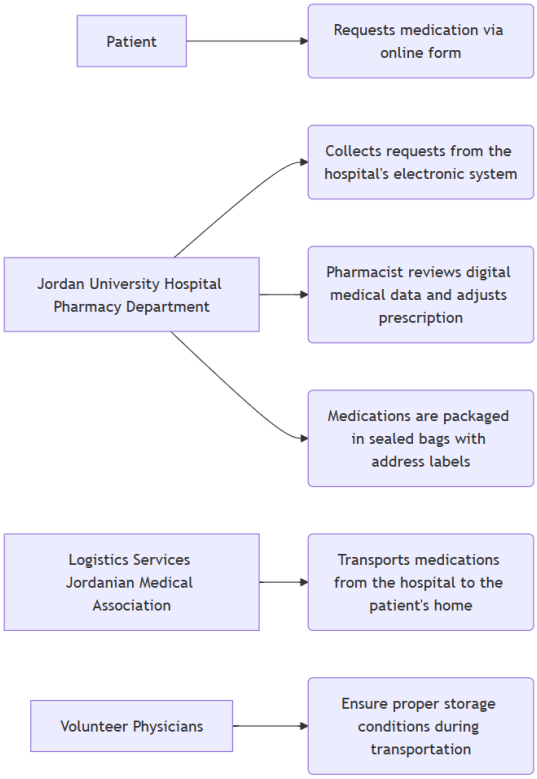


Figure 13. Roles and activities of stakeholders involved III

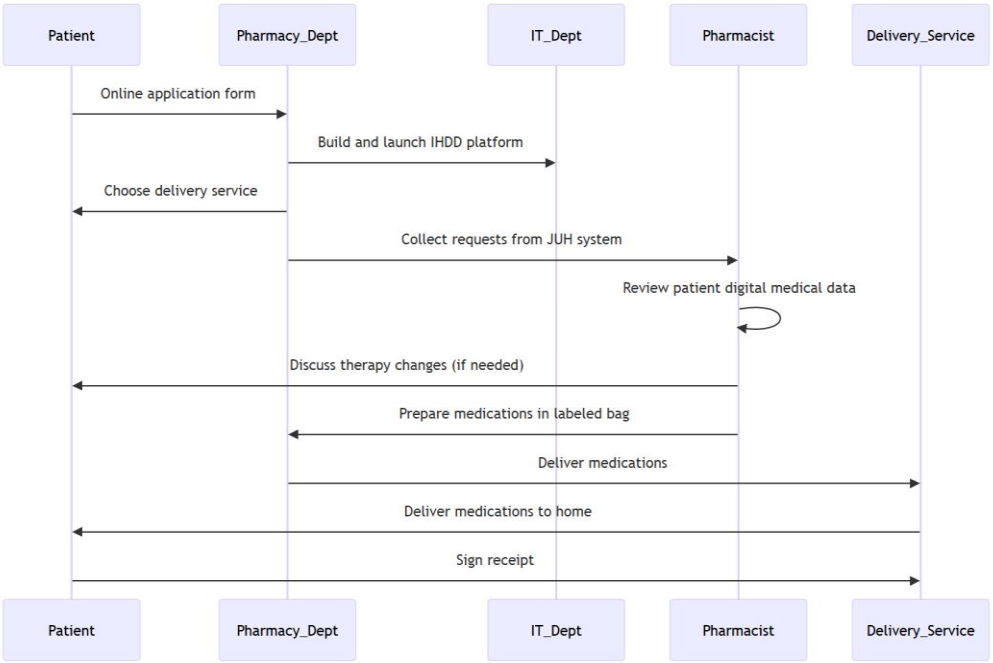


Figure 14. Jordanian drug home delivery model

This last model (Fig. 14) highlights an innovative approach implemented during the Covid-19 pandemic in Jordan. One of the model's strengths is certainly its inclusivity, as it allows patients with mobility difficulties, chronic illnesses, or those in home isolation to receive medications at home. Furthermore, a key point to underscore is the good coordination among different entities. The use of existing technology to avoid additional costs is also a positive aspect, as it maximizes the available resources. However, some areas could be improved to enhance the robustness and scalability of the model. A potential improvement concerns the possibility of extending this solution long-term. While home medication delivery was particularly relevant during the pandemic, it might be interesting to explore whether such a model could be maintained even after the crisis. For instance, there are segments of the population that could benefit from a regular delivery system, such as the elderly or patients with chronic diseases who cannot easily go to the pharmacy. It would be useful to know if the logistical resources, such as free medication transport during the quarantine period, could be sufficient to manage high demand should the service be extended to normal conditions, and how to address potential issues such as delays or distribution challenges. Additionally, entrusting medications to volunteer physicians to ensure proper storage could raise concerns about training and responsibility. Providing more details on the training and monitoring of these physicians could be a guarantee to get the correct specific storage conditions, as it would be useful in strengthening the model's credibility.

A brief overview of stakeholders involved is presented in the **table 6** below.

Table 6. *Stakeholders involved in the Drug Home Delivery*

Stakeholders of Drug Home Delivery	Type	Description	References
Healthcare entities	Clinics Hospital Pharmacies	Prescription, preparation and packaging of medications	[1][18][27][31][45]
Logistics and transport companies	Volunteer riders Private logistics company (*e.g.* Uber)	Delivery to local patient's home	[31][10]
Non-profit organizations	NPO CHWs	Delivery to local patient's home	[10]
Governmental and institutional entities	Government Professional Association (*e.g.* Jordanian Medical Association)	Supporting and management of supply chain regulation.	[1][31][45]
Patients	Local patients	Home delivery users	[1][10][13][16][18][20][27][31][45]

Number and network node types

Despite the elements highlighted in the previous paragraph, within the corpus there is a lack of information regarding the number and the type of nodes of the home delivery network. Actually, as previously seen, it is possible distinguish between stages, but not the number of nodes within each stage. There could be multiple reasons explaining this aspect of the research. The home delivery model for pharmaceutical products, although growing, may still be relatively new in terms of systematic studies or published research in major academic journals. Among all the read papers before having consolidated the corpus of this work, many healthcare logistics studies focused more on the distribution and management of pharmaceutical products at the hospital or institutional level, rather than on home delivery models. Finally, a relevant amount of analysis on pharmaceutical home delivery networks may come from industry reports or 'grey literature' rather than peer-reviewed academic journals. This type of research is less visible on academic databases like Scopus, where you can mainly discover articles published in peer-reviewed journals.

2.6 Research gap

The attention of the literature to the application of the home delivery for pharmaceutical products is pretty recent. Since the home delivery service has exponentially grown during these years, the healthcare systems worldwide sought innovative solutions to improve access to medications, especially during the COVID-19 pandemic. As a result, this systematic literature review has highlighted several key insights regarding the drivers, benefits and limitations about the drug home delivery service, the involvement of various supply chain actors within the delivery model as well as the distribution network designed for the home delivery. Despite the drug home delivery offers some benefits, such as increased accessibility and time convenience for patients (Nsamzinshutia *et al.*,2017; Saiyed and Patel, 2021; Chaomuang *et al.*,2022; Kavanagh *et al.*,2022; Hammour *et al.*,2022; Jirjees *et al.*,2024), it also underlines a few limitations like incorrect medications, delayed deliveries, and poor labeling, making the accuracy of the orders and the delays critical areas of research (Nsamzinshutia *et al.*,2017; Yang and He, 2022; Kavanagh *et al.*,2022; Jirjees *et al.*,2024). The review also reveals regulatory barriers, for example, on the delivery of prescription-required medications in some countries, such as Belgium and the UAE (Nsamzinshutia *et al.*,2017; Jirjees *et al.*,2024). However, another key insight is the role of warehouses and supply chain actors in the drug home delivery process. For instance, in Thailand, the integration of community health centers and local clinics as "secondary distribution warehouses" during the pandemic situation allowed for multiple localized deliveries (Brey *et al.*,2020); warehouse operations were crucial for the smooth functioning of drug home delivery, as they permitted a continuous flow of medications to patients, optimizing logistics and product availability. Nevertheless, information on the exact number and type of nodes within the supply chain are insufficient. Furthermore, the logistics models adopted during the COVID-19 pandemic, such as the “hub-and-rider” systems seen in Thailand and South Africa, demonstrate both the opportunities and challenges of scaling drug home delivery networks, particularly in crisis contexts (Brey *et al.*,2020; Kritchanchai *et al.*,2024). These models emphasize the importance of collaboration among healthcare providers, logistics partners, and volunteers, while revealing the logistical challenges, including delays and reliance on volunteers, which could affect service quality in non-emergency contexts. Moreover, the review highlights the lack for technological developments in pharmaceutical home delivery. Technology-driven solutions, such as drones, autonomous vehicles, and AI-driven logistics, are still undergoing testing, and there remains a lack of substantial research in academic literature regarding their application and long-term sustainability in pharmaceutical logistics. Lastly, while drug home delivery has the potential to innovate the pharmaceutical supply chain, the current literature emphasizes the need for improvements in service quality, regulatory clarity, and technological innovation to ensure its widespread, effective, and safe application. The development of efficient networks strengthening the supply chain collaboration is critical to overcome existing challenges and ensuring the long-term sustainability of the home delivery of pharmaceutical products. Regarding, instead, the customer's point of view (*i.e.* the patient, recipient of the delivery service), being the focus of this research work, the literature analysis highlights some gaps related to the potential experience of the home delivery service of products sold by pharmacies, as well as the exploration of the multiple factors that influence the choice compared to direct withdrawal in pharmacy. As we have seen above, the literature has revealed numerous advantages over home delivery but also significant limitations. However, research has so far failed to adequately investigate the specific reasons why customers prefer home delivery service over direct pick-up at a pharmacy thorough empirical analysis. Aspects such as convenience and accessibility of

service, reliability of deliveries, supporting technological innovations, possibility of delays or errors in the delivery of purchased products, respect for privacy and personal data, and also psychological and behavioural factors as well as socio-demographic and geographical factors are crucial for the user in choosing one mode rather than another. To date, the gap lies in the insufficient research on how these elements can influence the final decision on the choice of a certain service and its customer satisfaction by taking a consumer perspective. The literature has helped to identify some of the general advantages and disadvantages of home delivery of pharmaceuticals, neglecting, however, to analyze the specific needs and reasons why the customer may be either in favor or against taking up the choice of using this service.

2.7 Future Research Directions

Despite the growing interest in pharmaceutical home delivery, few research gaps in the literature remain. Particularly, there are limited information regarding the number, type, and adequate position of supply chain nodes, and how these affect delivery efficiency and service quality. Consequently, future research should focus on enhancing the optimal configuration of the supply chain nodes involved in the process of the home delivery, investigating how those nodes could be placed strategically enhancing coordination among the supply chain actors, and examining their impact on the quality of the service. Furthermore, there is scarce research on the sustainability and scalability of the distribution models in non-crisis context. Addressing this gap will be relevant in informing the future development of pharmaceutical products home delivery service and ensuring its effectiveness and widespread adoption by reducing errors during the process of the delivery. Moreover, research on the integration of advanced technologies, such as drones, autonomous vehicles, and AI, is still limited, with most studies focusing on operational aspects rather than innovations that could streamline the process. Investigating those emerging technologies could be helpful to understand the long-term scalability of the home delivery as they could be a key for the development and consequent continuity of the service. Additionally, also the global regulatory landscape needs attention, as the regulatory challenges, especially those surrounding prescription drugs, are a crucial barrier for the evolution of the home delivery. Future research should focus on addressing these technological gaps and further explore the integration of advanced technologies to optimize delivery times, reduce costs, and improve patient satisfaction. Furthermore, more attention should be given to the evaluation of the effectiveness and scalability of various and different logistics models, particularly in terms of long-term sustainability and their ability to manage high patient volumes.

From the literature analysis concerning the influencing factors characterizing the customer opinion on home delivery of pharmaceutical products, rather than the pharmacy pick-up, it is possible to outline some future research developments which mainly concern the study of customer decision factors investigating the reasons behind the choice between home delivery and in-person pharmacy pick-up. Thus, the need for empirical analysis into consumers' perspectives on the factors that encourage or discourage home delivery arises.

Research should investigate the reasons why patients decide which model to use, taking into account a number of factors. It would be useful to investigate, for example, the psychological and behavioural aspects, maybe through the use of questionnaires, surveys, interviews or focus group, which could give rise to emotional variables, social preferences or an idea about the service perception helping to recognize the current need of customers. In addition, it could be appropriate exploring other aspects

which may influence the management and accuracy of orders, the integration of the service with innovative technological systems, the reliability of deliveries taking into account factors such as delivery times and flexibility, analysis of socio-demographic and/or geographical factors segmenting population in different groups to distinguish characteristics and differences in the choice, and, finally, also IT security regarding personal data privacy.

In summary, to better understand the customer's assessment of potential use of home delivery service rather than pharmacy pick-up, future research directions should explore several factors such as social-demographics and geographics factors, customer psychology side, technology impact and other elements that could contribute to the research with an exhaustive landscape about decisional factors between the two types of service.

2.8 Aspects of customer satisfaction in e-commerce

As a result, an additional second list of keywords was developed on four levels, supporting the second section of the work, helpful to collect several customer satisfaction aspects about e-commerce, as a starting point to be refined for the last two questions of the subsequent questionnaire. **Table 7** summarizes this list of keywords.

Table 7. *Keywords II*

Keyword 1	Keyword 2	Keyword 3	Keyword 4
E-commerce	Delivery		
Home		Customer satisfaction	
E-grocery		Satisfaction	Factor
		Impact	
		Driver	
		Benefit	
		Limitation	
		Community perception	

Customer satisfaction in e-commerce is a complex and multidimensional construct, crucial for the survival and growth of online businesses. Delivery logistics plays a primary role in determining customer satisfaction. Fast and reliable delivery times, transparent and reasonable shipping costs, and an efficient and flexible delivery service are essential elements. The quality of the delivery service is reflected through various aspects, including punctuality in meeting expected delivery times, availability of simple and convenient return options, accuracy in order fulfillment, and in the management of shipping documentation (Gajewska and Zimon, 2018). Several studies highlight how the quality of "last mile delivery," the final leg of the delivery process to the end customer, is often the most critical factor influencing overall satisfaction in e-commerce (Vasić *et al.*, 2023). A positive experience in this phase, including effective package tracking, smooth and hassle-free receipt, and the perception of convenience, significantly contributes to generating satisfied customers.

However, customer satisfaction is not limited to purely logistical aspects. The entire online shopping experience plays a key role (Felix and Rembulan, 2023). This includes the quality and usability of the e-commerce website or app, clarity of product information, security of payment transactions, and the effectiveness of customer service in providing pre- and post-sales assistance. Factors such as the

availability of discounts and promotions, the offering of high-quality products, ease of navigation, and access to information, along with responsive and knowledgeable customer support, all contribute to creating a positive experience that leads to higher satisfaction (Gajewska and Zimon, 2018; Felix and Rembulan, 2023). Furthermore, satisfaction may vary based on contextual factors, such as the customer's residential area (rural or urban) and the category of product purchased, as highlighted in a study conducted in Sri Lanka (Damruwan *et al.*, 2023). Trust in e-commerce and the online seller, the perception of the value offered, and the quality of the service provided by the home delivery staff are also important antecedents of customer satisfaction. In the specific context of online grocery delivery (e-grocery), additional relevant aspects for satisfaction emerge. For example, in South Korea, customers seem to place greater importance on packaging type than on delivery time when choosing a service. Specific preferences also emerge regarding delivery options, with a preference for early morning delivery and the use of reusable packaging with temperature-maintaining functions (Park, 2023).

In summary, to ensure high levels of customer satisfaction in e-commerce, companies must adopt a holistic approach that considers not only the efficiency and reliability of delivery logistics but also the quality of the entire online shopping experience, building trust, and understanding the needs and preferences of different customer segments. Special attention to the "last mile" phase and innovation in delivery options, as in the case of e-grocery, can represent an important differentiating factor and a key element for customer loyalty (Damruwan *et al.*, 2023).

Chapter 3. Questionnaire design and administration

This chapter is dedicated to the development of a questionnaire to capture the opinions of consumers regarding home delivery services for products sold by pharmacies, exploring their perceptions and expectations.
The aim of the questionnaire is to better understand consumer preferences and the factors influencing their choice regarding the home delivery of products sold by pharmacies, leveraging both descriptive and inferential statistics.

3.1 Definition of the objective

As previously said, the objective of the questionnaire arises from the desire to understand the customer relationship with pharmacies and home delivery. So, understanding the interest in the home delivery of products sold by pharmacies, rather than collecting them in a physical pharmacy, can help to assess the service, giving the research a better comprehension about the critical factors that lead to one choice or the other. Consequently, the questionnaire can provide valuable information to help the research to assess the feasibility, impact and widespread adoption of the home delivery service, customizing it according to the patient's needs and optimizing the service's organization.

3.2 Designing the questionnaire

Questionnaire is one of the most widely used research tools to collect data. A questionnaire enables quantitative data to be collected in a standardized way so that the data are internally consistent and coherent for analysis (Taherdoost,2020). The questionnaire is structured starting with general and simple questions, gradually progressing to more detailed ones, mentally helping participants feel more comfortable while answering them.

The questionnaire in the present study starts asking personal information about age and occupational status, followed by questions on having a nearby pharmacy and satisfaction about relative opening hours. In the same section of the questionnaire, having a trusted person to collect pharmaceutical products on its behalf and if it has ever happened to do it (or it is currently done) on behalf of someone else is asked. Lastly, the individual frequency of the use of e-commerce is questioned. The second section starts detailing if customer needs to regularly purchase medications for chronic diseases (Nsamzinshutia *et al.*,2017; Brey *et al.*,2020; Jirjees *et al.*,2024), if there is a trusting relationship with a specific pharmacy (Kavanagh *et al.*,2022; Jirjees *et al.*,2024) and what type of products sold by pharmacies a customer would it to be delivered at home (Nsamzinshutia *et al.*,2017; Hammour *et al.*,2022; Jirjees *et al.*,2024). Then, the questionnaire points to understand the influencing factors between home delivery and pick-up at stores of products usually sold by pharmacies in customer's opinion, listing a series of aspects for both services to be rated by respondents, which can be included in different topics such as convenience and accessibility(e.g. time-saving, costs, access in remote areas, flexibility of delivery) (Nsamzinshutia *et al.*,2017; Jirjees *et al.*,2024), health, safety and privacy (e.g. avoiding crowded places, sensitive conditions privacy, access for those with special needs) (Nsamzinshutia *et al.*,2017; Saiyed and Patel, 2021; Jirjees *et al.*,2024), simplified prescription and order management(e.g. electronic prescriptions, automatic order management) (Nsamzinshutia *et al.*,2017; Saiyed and Patel, 2021; Srinon *et al.*,2022), technology and digital integration(e.g. health app synchronization, telemedicine support) (Saiyed and Patel, 2021; Hammour *et al.*,2022; Srinon *et al.*,2022), logistical efficiency and environmental considerations(e.g. delivery logistics,

environmental impact) (Kritchanchai *et al.*,2024; Jirjees *et al.*,2024). These aspects were identified by additional research on customer satisfaction aspects for individuals using e-commerce, following the list of keywords indicated in section 2.8 within. For instance, patients with chronic diseases, who lead to more demand for drugs refill to guarantee the continuity of the therapy (Jirjees *et al.*,2024), could be a potential user of the home delivery service as it could ensure a better program of automatic delivery based on recurrent orders. In addition, the location of the pharmacy can impact the related access, as the distance from the pharmacy, transportation difficulties, high costs and lack of time could be specific barriers preventing patients from accessing medications and pharmaceuticals (Kavanagh *et al.*,2022). Moreover, investigating the relationship with a pharmacist is a relevant aspect because the home delivery could limit the communication with pharmacists, an important concern for several patients (Jirjees *et al.*,2024).

To gather useful and relevant information it is essential that careful consideration is given to the design of a questionnaire. Questionnaire appears to be just a simple list of questions to the naive. However, the language of the questions, the type of questions used, the order in which they are arranged and many other details, all impact the results of the survey. Arrangement of the questions in a logical and structured sequence, with general questions preceding the specific, is recommended to get better responses (Yaddanapudi, 2019).

The questionnaire designed in this research, titled "Home Delivery Services for Products Sold by Pharmacies: What Do Consumers Think?" aims to collect opinions from consumers regarding home delivery services for products typically available from pharmacy shops.

It is structured in 12 questions, divided into 3 sections:

Section 1: Demographic profile and purchasing experiences

This section proposes 7 questions regarding the profile of respondents, particularly 2 questions about the age and the employment status, and 5 questions regarding the purchasing experiences of products sold by pharmacies, as well as regarding if there is a pharmacy nearby to customer home or workplace and relative working hours.

Section 2: Relationship with pharmacies and home deliveries

This section includes 3 questions about the relationship with pharmacies, in particular the need to regularly purchase drugs to treat chronic conditions, the customers' trust in a specific pharmacy shop, and questions related to which products sold by pharmacies customers would buy through home delivery.

Section 3: Drivers of preference between home delivery and pharmacy pickup

In the last section 2 questions are proposed, regarding the influencing factors which drive customers to choose between home delivery service and pharmacy pickup.

Each of these questions includes multiple-choice answers, which allows respondents to select more than 1 answer option, and answers based on a rating scale. These were evaluated using a Likert scale, a widely used psychometric scale measuring attitudes, opinions and perceptions towards a specific object of evaluation, in which is mandatory express a rating from 1 to 5 based on the relevance the respondent attribute to the element considered (Taherdoost, 2022). Likert scale is applied as one of

the most fundamental and frequently used psychometric tools in educational and social sciences research (Joshi *et al.*, 2015). Likert-scale is a summative scaling type that arranges the opinions in a specific range from extremely positive to extremely negative.

In this questionnaire, a rating scale of 5 different level (from 1 to 5) was defined. This helped to measure perceptions of customers. Within the home delivery service, it allows to translate different aspects (e.g. time, convenience, safety) in meaningful indicators, asking respondents to assess the importance of these concepts. Moreover, it reduces subjectivity and variability in data collection, providing objective responses, as the respondents must choose among a set of predefined options, which proposes an importance rating scale for each option. Each level in the Likert scale adopted in the present questionnaire corresponds to:

1= Not relevant at all;

2 = Not relevant;

3 = Neutral (neither relevant nor not relevant);

4 = Relevant;

5 = Very relevant.

The questionnaire completion process has been facilitated making all the questions mandatory. This was helpful to collect as much information as possible from the completion by each respondent. As a result, it has been avoided that the respondent did not complete some questions, thus not expressing their opinion on them.

The full text of the questionnaire and the associated cover letter can be found in the Appendix section.

3.3 Questionnaire validation

The validation of the questionnaire is a preliminary and necessary phase of a survey. A formal and scientifically reliable validation is the condition sine qua non for conducting an accurate, precise and well-executed study. Thus, once a questionnaire is developed, it needs to be validated by a panel of experts before it is administered (Yaddanapudi, 2019). As a result, once the design phase was completed, the questionnaire developed in this study underwent through a validation process by both academic and professional experts, with the aim of detecting possible criticalities related to the consistency, ambiguity, and redundancy of the questions. Particularly, the academic experts were represented by two university professors of supply chain management doing research in the field of healthcare logistics. The selected professional experts included two pharmacists, owing to their expertise with the studied topic.

At the end of this process, some few changes were made to the questionnaire. The version presented in the Appendix is the final one, already including such changes.

3.4 Identifying potential respondents

The sample of potential respondents has been created leveraging a network of personal and professional contacts, ensuring different experiences and perspectives. This group of people included relatives, students, work colleagues, university professors, and PhD students, each from different backgrounds, range of ages, educational levels, which allowed the diversification of the collected data. To improve the representativeness of the sample, word-of-mouth was also used, encouraging network members to involve others who might be interested in questionnaire participation, helping to enlarge the sample by reaching further respondents who otherwise would not have been included. As a result, keeping track of these further potential respondents has been crucial to have an exact number of total respondents, ensuring a more precise response rate. At the end of this process, a total of 190 potential respondents were identified.

3.5 Data Collection

Data collection is the process in which responses provided by the participants to the survey are collected, recorded and organized for following analysis. It is a crucial phase of the research, as the quality of the collected data directly impacts the reliability and validity of the results (Karunarathna *et al.*, 2024). The tool used for data collection of the questionnaire was Microsoft Forms. An invitation to participate in the questionnaire, thanks to a link generated from Microsoft Forms, was sent first by e-mail and WhatsApp, followed by a reminder to those people that had not yet completed the questionnaire about 14 days after the invitation, by the same means. The administration of the questionnaire covered 20 days starting on February 3rd, 2025, a period that allowed the collection of 121 valid responses, achieving a response rate of approximately 64%. Response rate is crucial to guarantee the representativeness of the population sample. A universal threshold to define "high" a response rate does not exist; however, generally, the higher the response rate the better, because it underscores an improved reliability of the questionnaire results (Dillman *et al.*,2014). Nevertheless, (Dillman, 2011) considers "acceptable" a response rate exceeding 30-40% for online questionnaire. Particularly, an high response rate decreases the risk of non-response errors, reduces bias balancing the representation of groups of respondents better reflecting the opinions and characteristics of sample, enhancing the accuracy of the estimation and quality of data, allowing for stronger conclusions and the reliability of subsequent analyses (Billiet *et al.*,2007) Collecting data through MS Forms has allowed to record responses into an Excel spreadsheet to support their subsequent quantitative analysis.

3.6 Processing of collected data

As mentioned in Section 4.1, after the questionnaire administration period ended, the collected data from MS Forms, was exported into an Excel file where it has been possible to ensure that all the responses were complete and accurately recorded. The data was then organized to facilitate descriptive and inferential statistical analysis. Relevant information was synthesized and presented in various and adequate types of graphs to provide a clear understanding of the results. Particularly, the application of different statistical tests, supporting both descriptive and inferential statistical analysis, will be presented in the following section, respectively through Cronbach and Kruskal-Wallis tests.

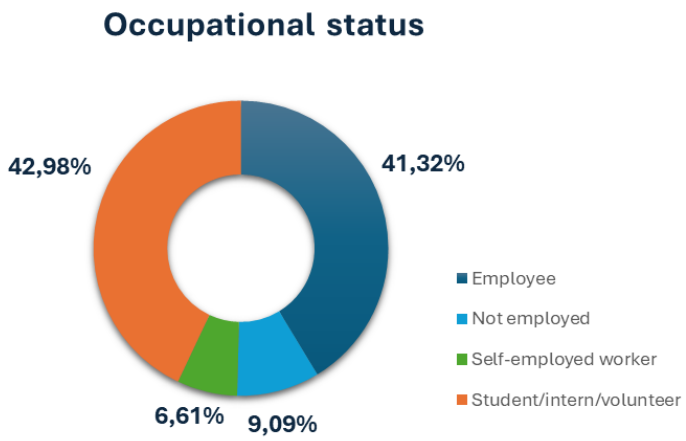
Chapter 4. Data Analysis

The present chapter aims to outline the results originating from the administration of the questionnaire by carring out descriptive and inferential statistics.

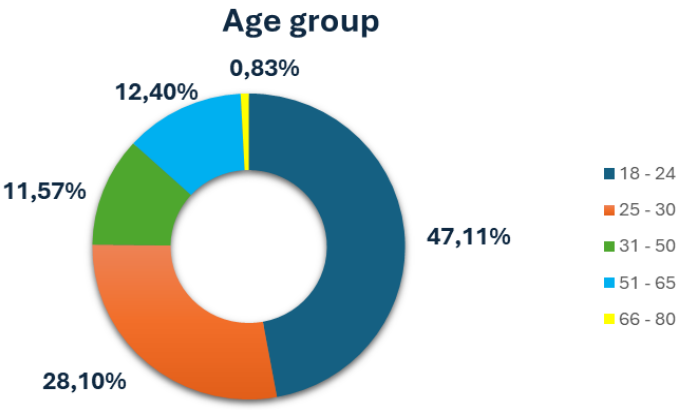
4.1 Descriptive statistics

Descriptive statistics involves collecting, summarizing, and analyzing variable data, synthesizing it to discover patterns, supported by different graphs, such as histograms and box plots, to present the results effectively (Case, 2007).

By considering their occupation, almost 85% of the respondents are represented by students, interns, volunteers or employees (Graph 13). The remaining ones are almost equally divided between self-employed workers and not employed. Most of them belong to the age group between 18 and 24 years old, representing the 47% of the total, followed by 28% of people between 25 and 30. Approximately 25% are distributed between the 31 and 50, 51 and 65, and 66-80 (Graph 14). Questionnaire proposed also an age range over 80 years old, but no responses were collected from it.

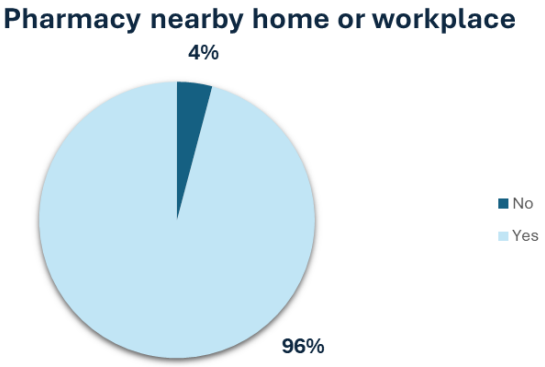


Graph 13. Respondents occupational status graph

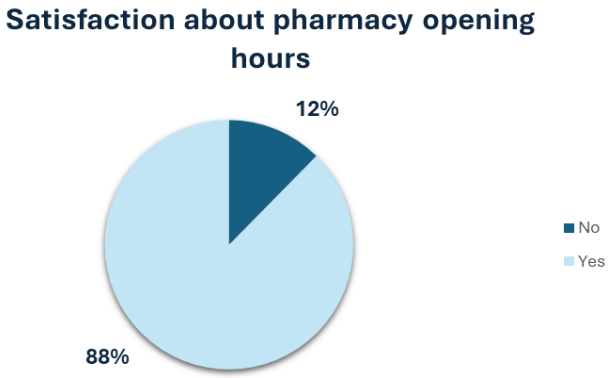


Graph 14. Age group graph

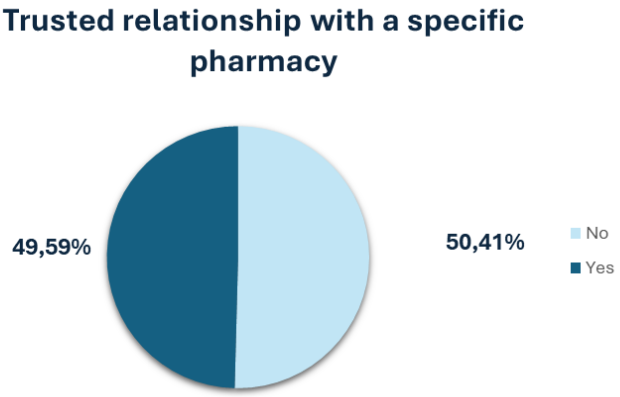
96% of respondents have a pharmacy 1 km away from their home or workplace. In addition, 88% are satisfied with the opening hours of the pharmacy they usually visit. Feedback about the trustworthiness of a specific pharmacy for patients are almost equally divided between negative and positive responses (Graph 15, 16, and 17).



Graph 15. Pharmacy nearby home graph

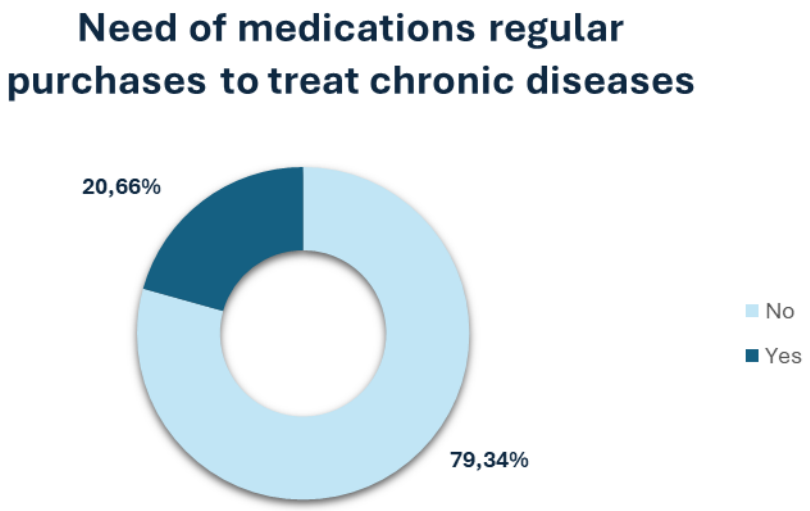


Graph 16. Satisfaction about pharmacy opening hours graph



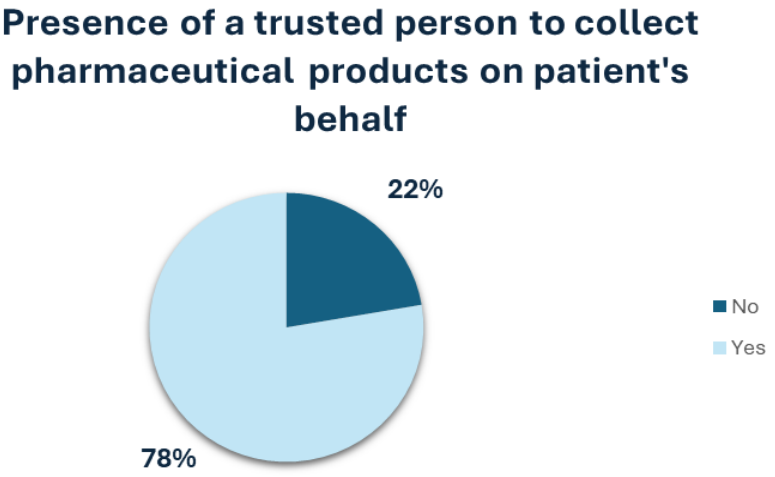
Graph 17. Trusted relationship with a specific pharmacy graph

Additionally, approximately 80% of respondents confirmed they regularly purchase medications to manage chronic conditions (Graph 18).

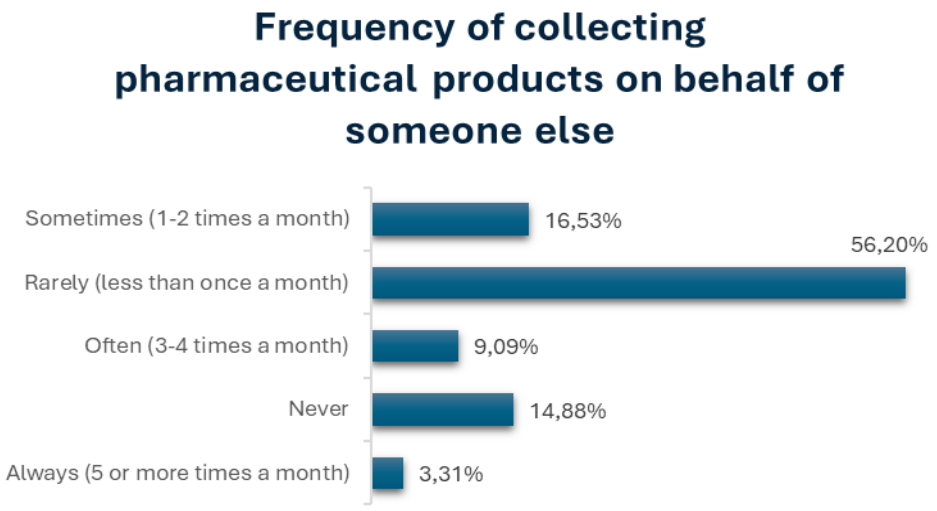


Graph 18. Need of medications regular purchases to treat chronic diseases

Furthermore, the distribution of responses regarding the presence of a trusted person who collects pharmaceutical products on their behalf (Graph 19) presents most people having someone else to collect pharmaceutical products (78%). In the chart below (Graph 20), it is also possible to observe the frequency of this task. Most common response was "rarely" which indicates approximately 57% of people that collects pharmaceutical products on behalf of someone else less than once a month, may it could be reserved to specific or unexpected situation. 17% responded sometimes, which is 1-2 times a month and 9% collect these products 3-4 times a month. These are moderate percentage, but with some regularity, like a commitment for someone such as friends or family members. Lastly, 15% of respondents never collected or currently collect for someone else. These could be people who prefer or are able to do everything on their own or who have never been involved in this activity, instead of the 3% of them who do it 5 or more times a month, which suggests it is not a common practice but typically reserved for specific situations.

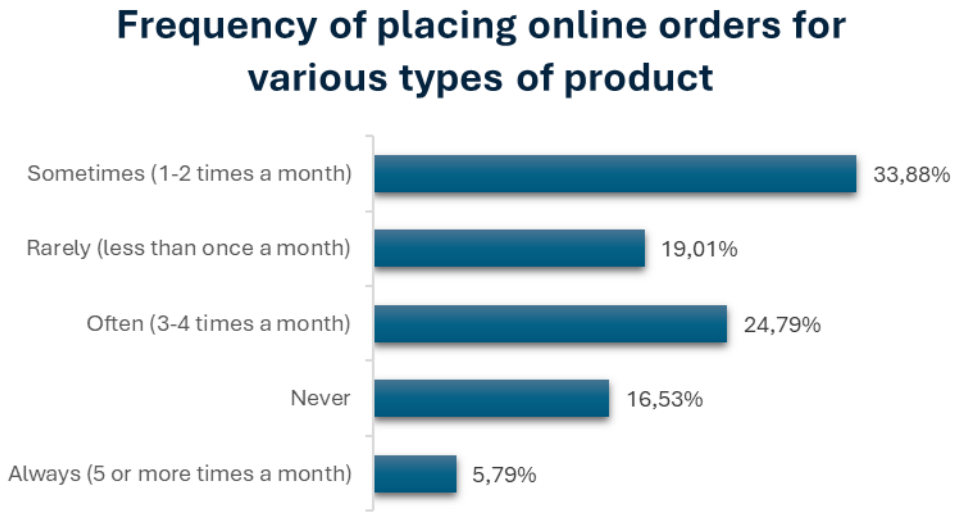


Graph 19. Presence of a trusted person to collect pharmaceutical products on patient's behalf graph



Graph 20. Frequency of collecting pharmaceutical products on behalf of someone else graph

Investigating the frequency of online orders for various types of products, it has been seen that most people shop online, but the frequency varies a lot (Graph 21). A low percentage (6%) makes online orders 5 or more times a month, which suggests that shopping online is a common practice, but not extremely frequent for most people. On the other hand, 17% of respondents never purchased online, maybe due to an individual preference for physical shopping or lack of trust in online platforms. However, a fairly percentage shop online 1-2 and 3-4 times a month, respectively 25% and 34%, which is the highest percentage, suggesting a common and almost constant practice. Lastly, 19% prefers to shop online in an occasional way, maybe for specific needs.



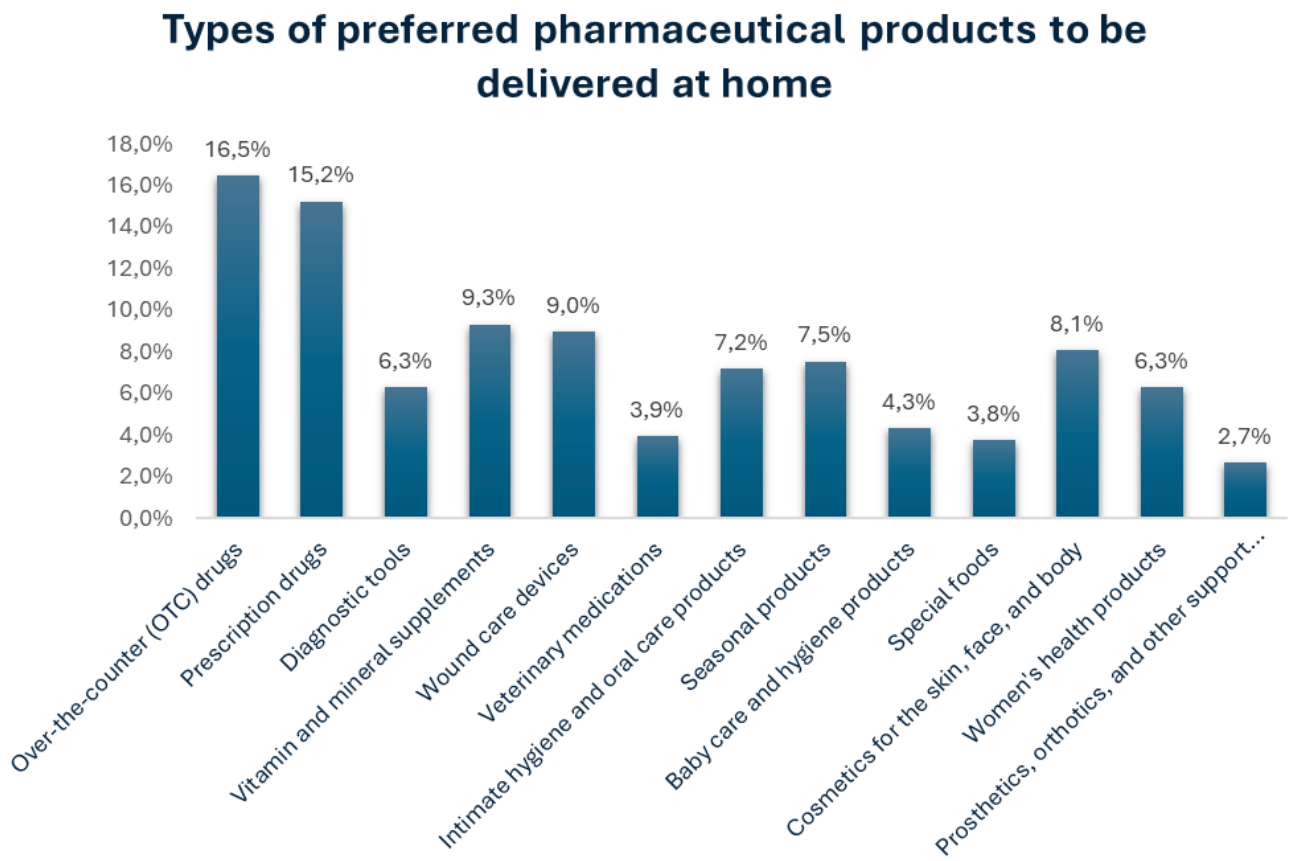
Graph 21. Frequency of placing online orders for various type of product graph

Moreover, respondents were asked to identify potential pharmaceutical products, sold by pharmacies, would like to be delivered at home through a home delivery service. Firstly, the histogram below highlights them in percentage values (Graph 22), then the **table 8** below summarizes the various product categories.

Table 8. *Pharmaceutical product categories*

Pharmaceutical products	Description
Over-The-Counter (OTC) drugs	Medications that can be sold without a prescription, such as pain relievers, anti-inflammatory drugs, and antihistamines
Prescription drugs	Medications that require a doctor's prescription
Diagnostic tools	Thermometers, blood pressure monitors, glucometers, etc.
Vitamin and mineral supplements	Multivitamins, joint supplements, immune system supplements, bone health supplements, heart supplements, memory supplements, etc.
Wound care devices	Bandages, gauze, adhesive plasters, disinfectants, etc.
Veterinary medications	Medicines intended for animal care
Intimate hygiene and oral care products	Soaps, toothpaste, mouthwashes, toothbrushes, etc.
Seasonal products	Eye drops and nasal sprays for colds, etc.
Baby care and hygiene products	Diapers, wipes, baby formula, etc.
Special foods	Foods for people with specific dietary needs, such as for celiac, diabetic, or vegan diets
Cosmetics for the skin, face, and body	Creams, lotions, shampoos, hair treatments, deodorants, sunscreens, products specifically for sensitive or acne-prone skin, etc.
Women's health products	Sanitary pads, tampons, skin creams, pregnancy products
Prosthetics, orthotics, and other support devices	Braces, bandages, orthopedic appliances, walking sticks, walkers, pressure relief mattresses, etc.

Particularly, the most common category people want to be delivered at their home is OTC drugs, such as pain relievers, anti-inflammatory drug and antihistamines, representing the 16.5%. Prescription drugs, which are the medicines requiring a mandatory and valid doctor's prescription, is the second most common response with 15,2%. This suggests many people would choose the home delivery service as it seems very helpful having these products easily accessible without spending effort and time to go to the pharmacy. Then, 9.3% of respondents wish to receive vitamin and mineral supplements at home. The ease of access to these products could help people to increase their consumption to have a better adherence to healthy routines.



Graph 22. Types of preferred pharmaceutical products to be delivered at home graph

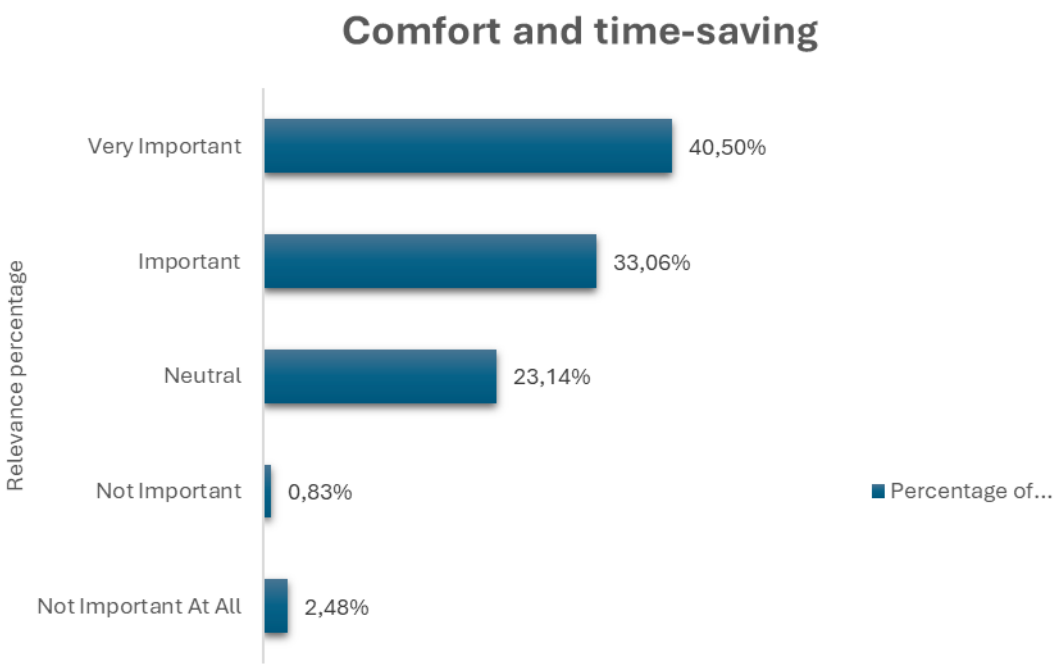
In addition, 9% is represented by wound care devices, as they may be crucial to manage chronic wounds that need regular changes of bandages and use of disinfectants. Cosmetics for the skin, face, and body (8,1%) and intimate hygiene and oral care products (7,2%) follow, as they are regular-use products for which the possibility to have them delivered at home could decrease the risk of not finding them at the pharmacy or to running out of them. The home delivery of seasonal products (7,5%) could allow people to avoid pharmacies when sick or product is urgently needed. An additional 12,6% of products are equally divided between diagnostic tools and women's health products. Some diagnostic tools may be expensive or difficult to find in pharmacies, so the door-to-door delivery service could make them more accessible; moreover, the Covid-19 pandemic, for instance the use of rapid tests, has grown the "self-care" practice, so people could prefer to monitor their health independently and at home. Instead, products such as sanitary pads or tampons are often purchased discreetly, so the home delivery could provide greater privacy. Baby care and hygiene products (4,3%) and veterinary medications (3,9%) follow. The home delivery of these products offers a solution to avoid frequent trip to the pharmacy and relative stress to go with the kids, as well as the animals, often considered family members and treat them with medications if needed. Lastly, prosthetics, orthotics, and other support devices represents a little portion (2,7%) of all the product categories people potentially wish to be delivered at home.

For the last two questions, Likert scale was used to evaluate respondents' perceptions of several factors. Influencing factors leading to the choice of home delivery rather than pharmacy pick-up and influencing factors leading to the choice of pharmacy pick-up rather than home delivery were

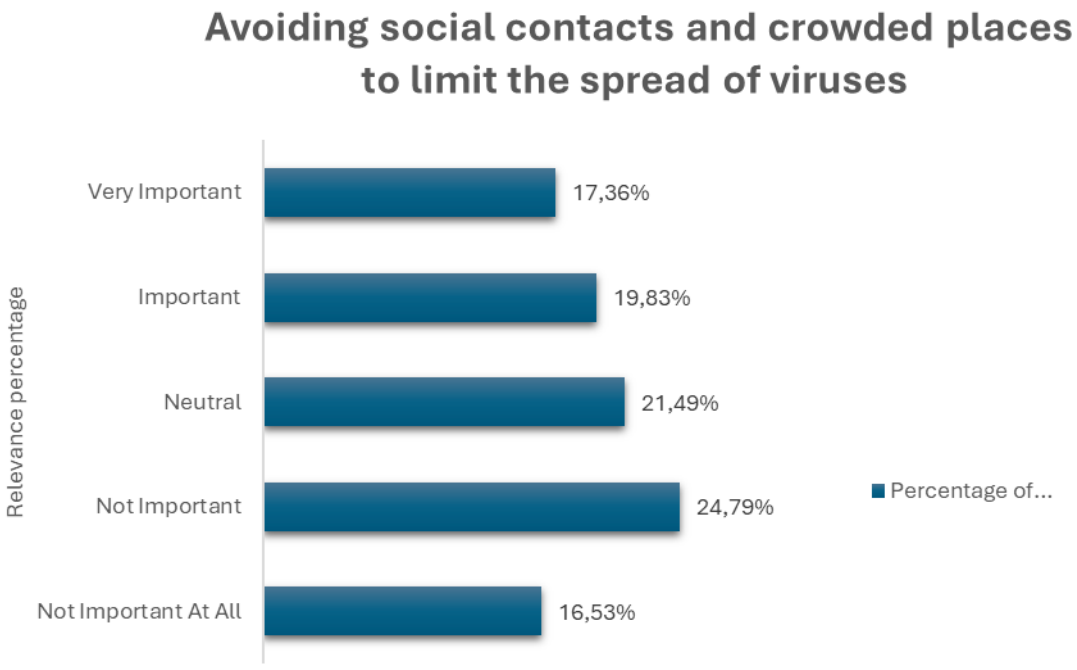
graphically summarized as follows. The first 12 aspects are related to the question number 11 of the questionnaire and the subsequent 14 ones to the question number 12. For each graph, relevance level and relative response percentage are respectively indicated on vertical and horizontal axis.

Comfort and time saving stands out as highly relevant factor in the decision to opt for home delivery, as almost the 74% of responses shows a high concentration of important and very important levels combined, which indicates that the practical benefit of receiving products at home, avoiding travel and waiting times, serves as a strong incentive for choosing home delivery (Graph.23). Concerning the flexibility of the delivery times, 75% of respondents considers important or very important this aspect, probably these are people with irregular working hours or shifts, which appreciate the possibility to receive products at better times of their daily routine, or those with mobility issues, such as the elderly or people with disabilities (Graph 28). Another key factor is the ease of access for vulnerable individuals, such as those with reduced mobility or the elderly, as represented by the 70% very important responses. This underscores the potential of home delivery in breaking down both physical and geographical barriers, a point emphasized in the introduction of the thesis and in Chapter 1. Simplified prescription management through e-prescriptions is seen as important or very important by respondents, indicating the will to reduce the risk of errors related to handwriting and the management of paper documents, eliminating the need for physical visits for every prescription, despite an approximately 25% of people considering it not important, not important at all or neutral, may due to a limited familiarity with new technologies (Graph 25). Aspects such as greater privacy when purchasing medication for sensitive conditions, ease of managing recurring orders, and reduced stress over product availability, are generally considered relevant, with a range of 60-70% of respondents considering them important or very important, but with a significant portion of responses falling in the intermediate levels of not important, not important at all, and neutral. This suggests that the importance of these factors may vary more among individuals, as some people not having specific privacy concerns or not managing medications on a continuous basis may not consider these aspects a priority, as well as the perception of "stress" or difficulty in managing product availability may be more pronounced for some people (such as those with chronic conditions), while for others, it may not be a relevant issue. (Graph 27,29, and 30). Moreover, Graph 24 highlights the highest percentage (25%) regarding the ability to avoid social contact and crowded places to limit the spread of viruses considers not important this aspect.

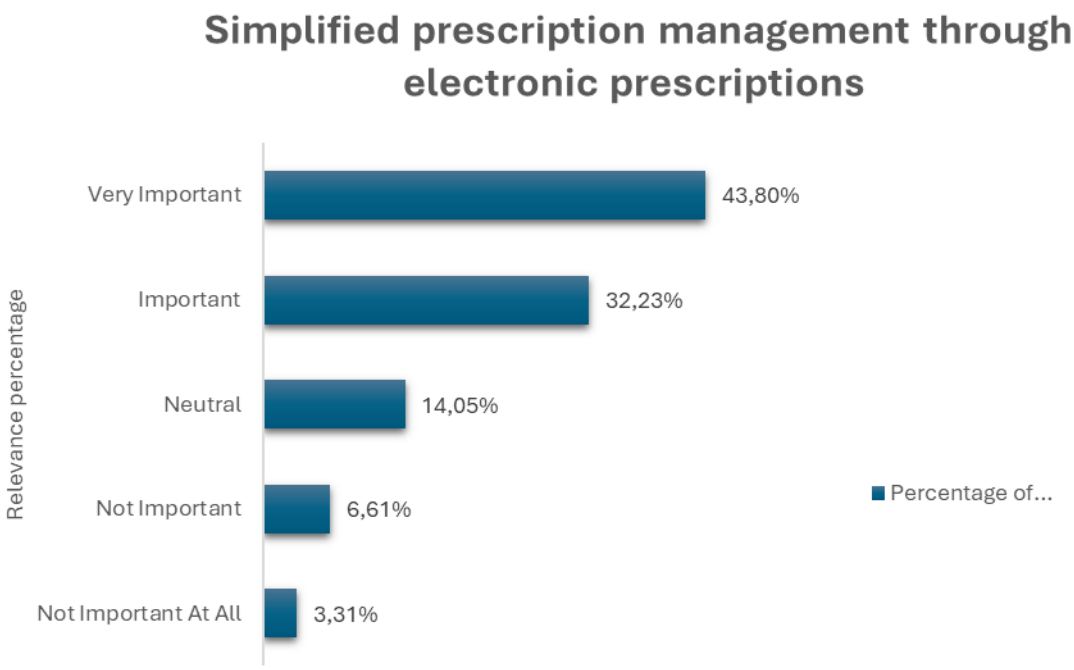
Access to pharmaceutical products in remote areas received 43% of very important ratings, a very large percentage which confirms the aforementioned potential of home delivery in overcoming geographical disparities. Lastly, aspects like additional telemedicine services, synchronization with health management apps, and integration with health insurance services seem to have a smaller impact on the decision to choose home delivery, as most of the responses were concentrated in the middle of the Likert scale, with approximately 30% on the neutral rating, suggesting that these services could be useful, but not determinant in the choice between the two delivery options.



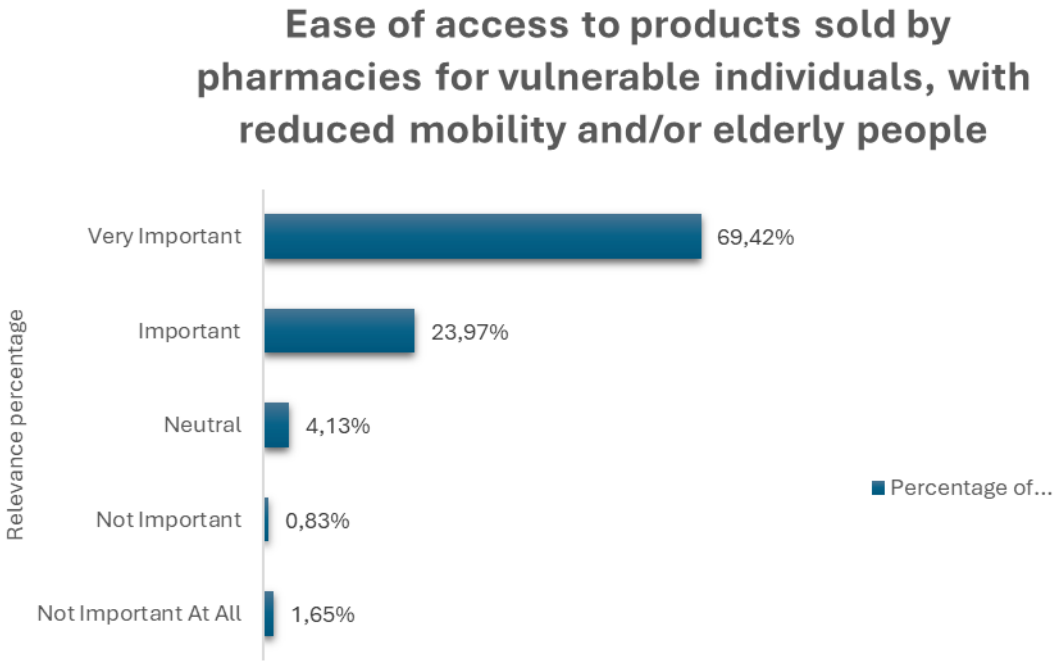
Graph 23. Comfort and time saving factor graph



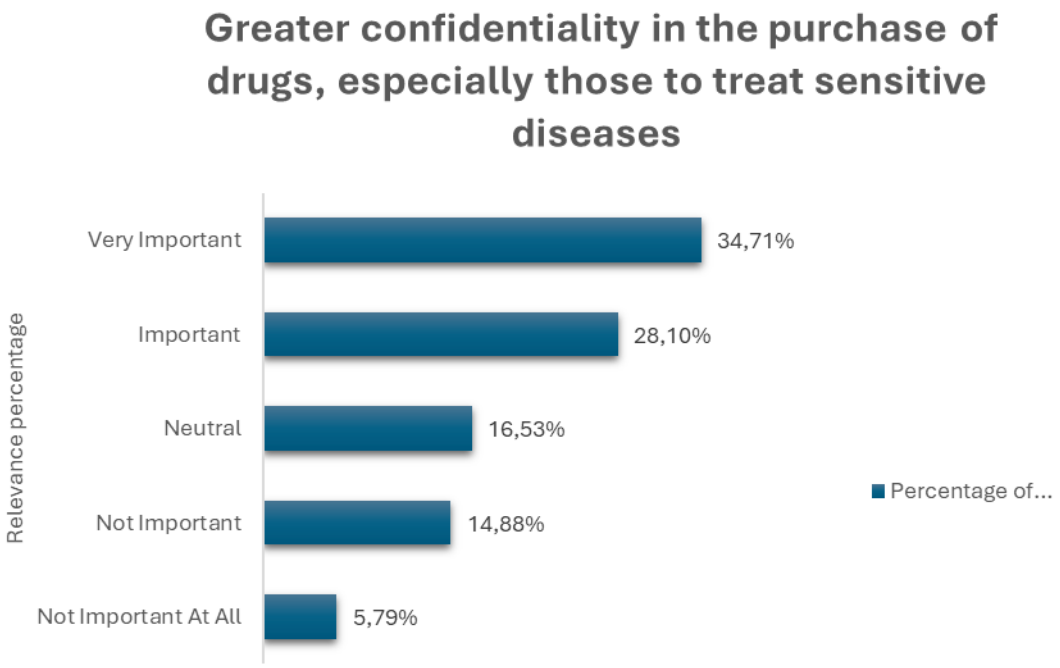
Graph 24. Avoiding social contacts and crowded places to limit the spread of viruses factor graph



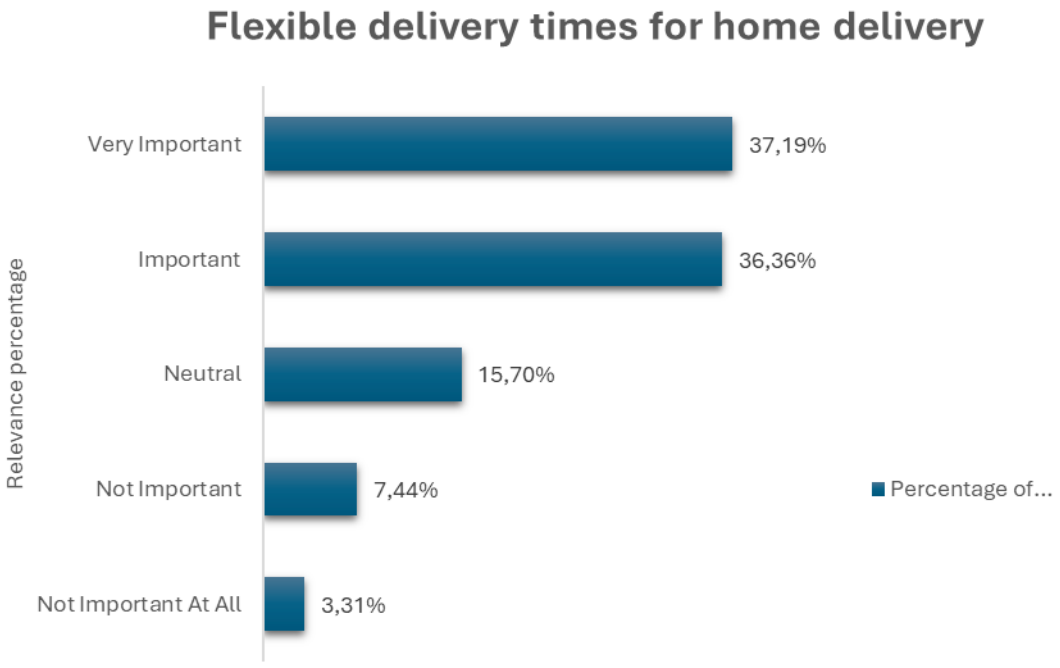
Graph 25. Simplified prescription management through electronic prescriptions factor graph



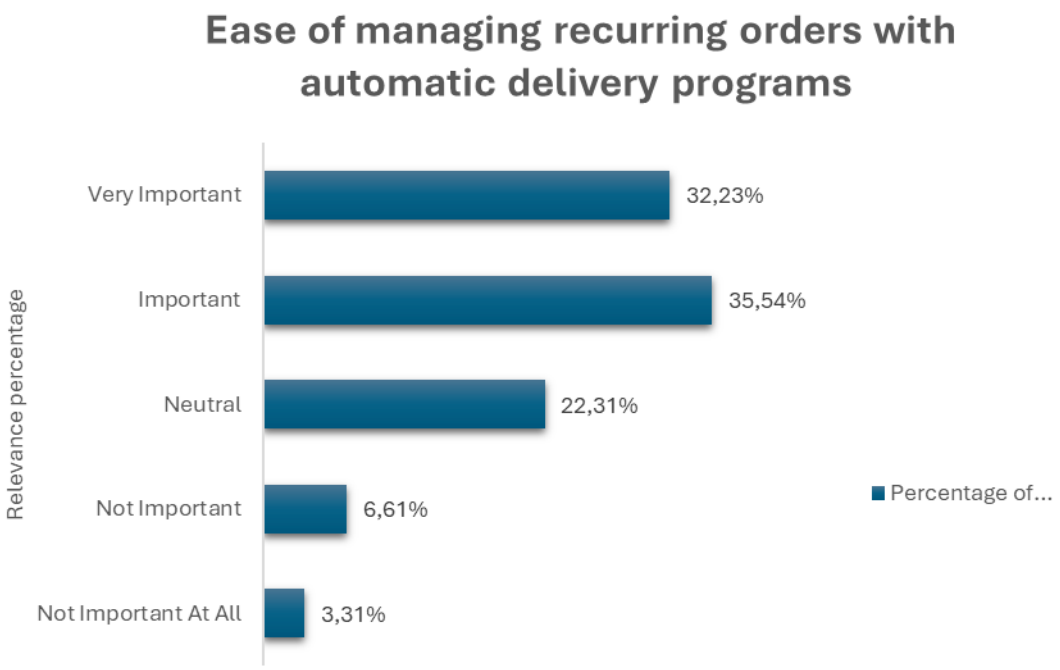
Graph 26. Ease of access to products sold by pharmacies for vulnerable individuals, with reduced mobility and/or elderly people factor graph



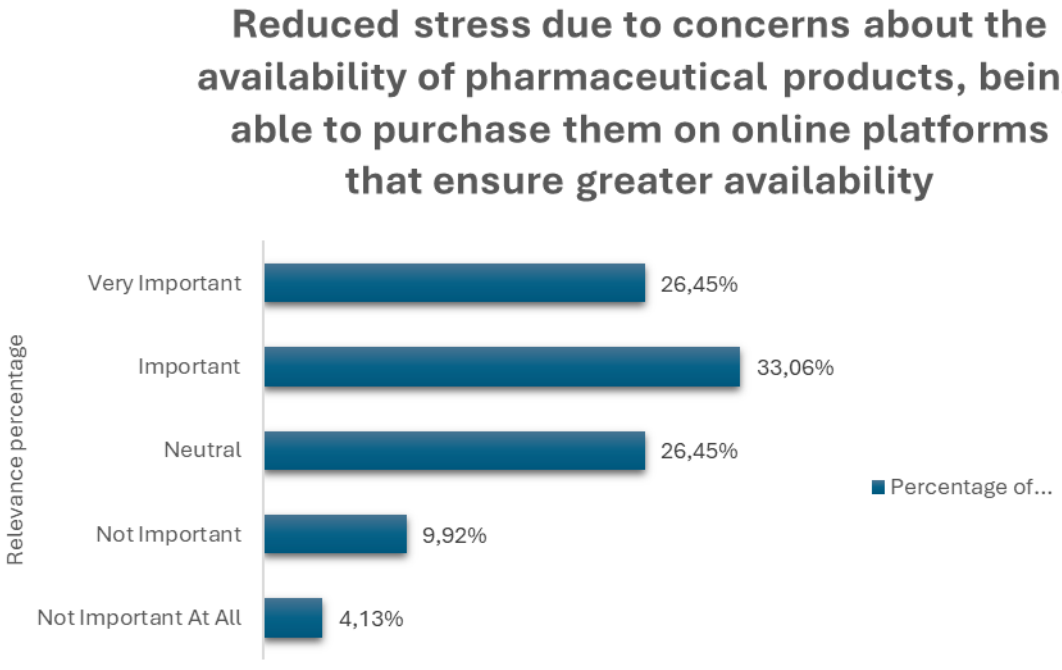
Graph 27. Greater confidentiality in the purchase of drugs, especially those to treat sensitive diseases factor graph



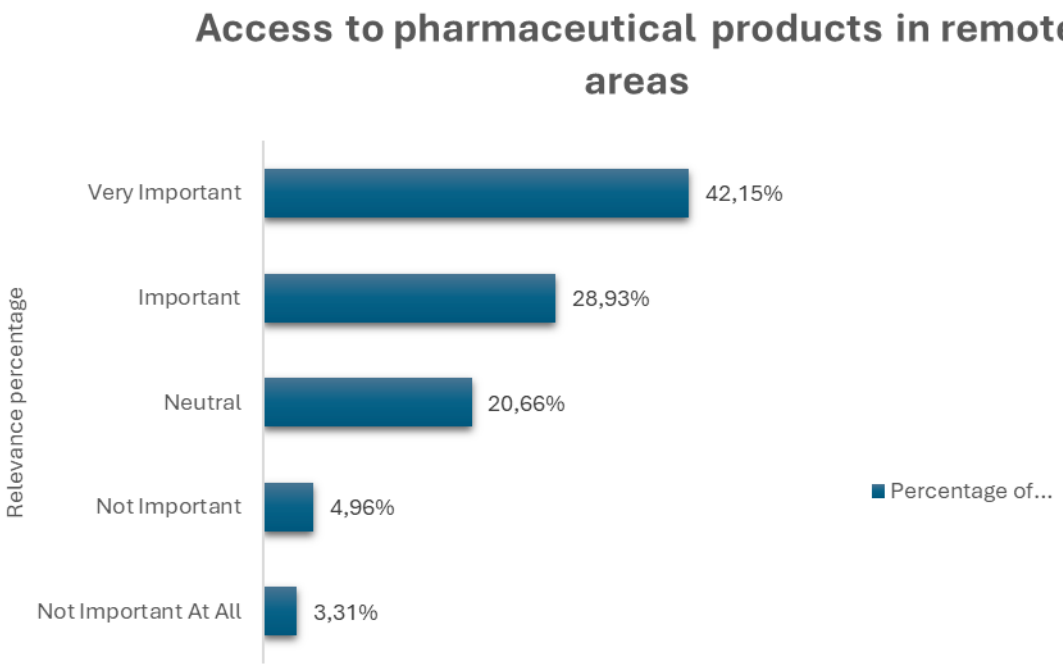
Graph 28. Flexible delivery times for home delivery factor graph



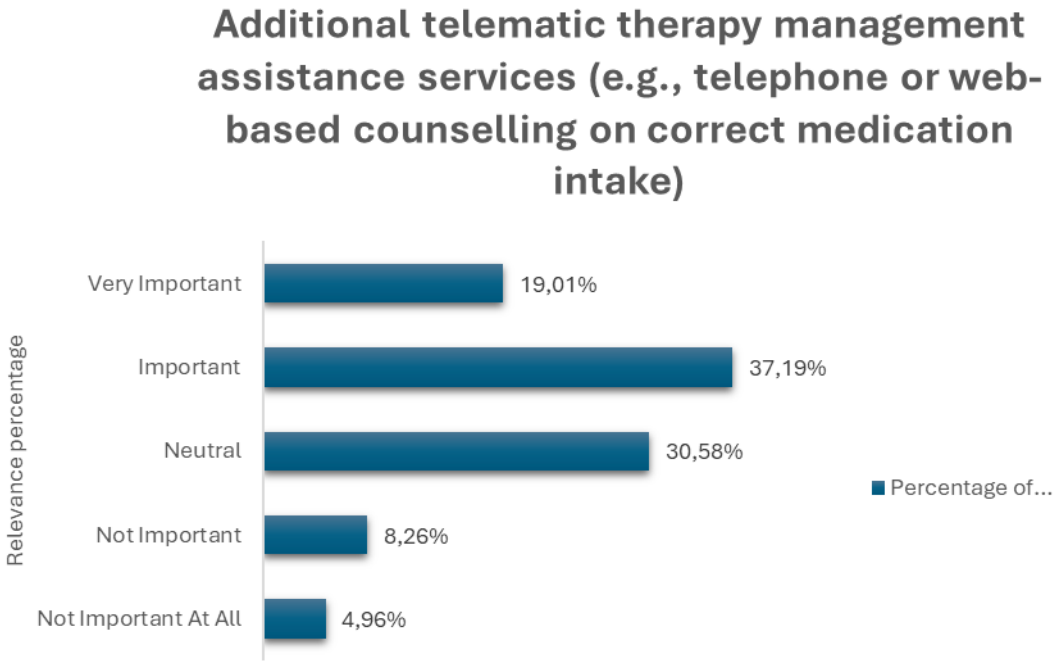
Graph 29. Ease of managing recurring orders with automatic delivery programs factor graph



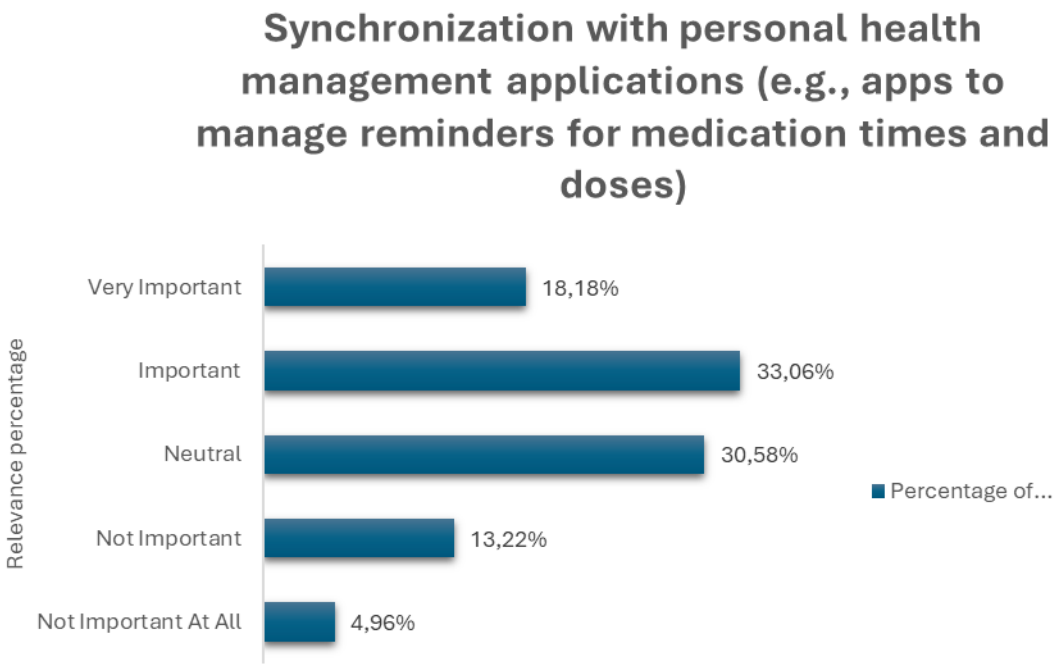
Graph 30. Reduced stress due to concerns about the availability of pharmaceutical products, being able to purchase them on online platforms that ensure greater availability factor graph



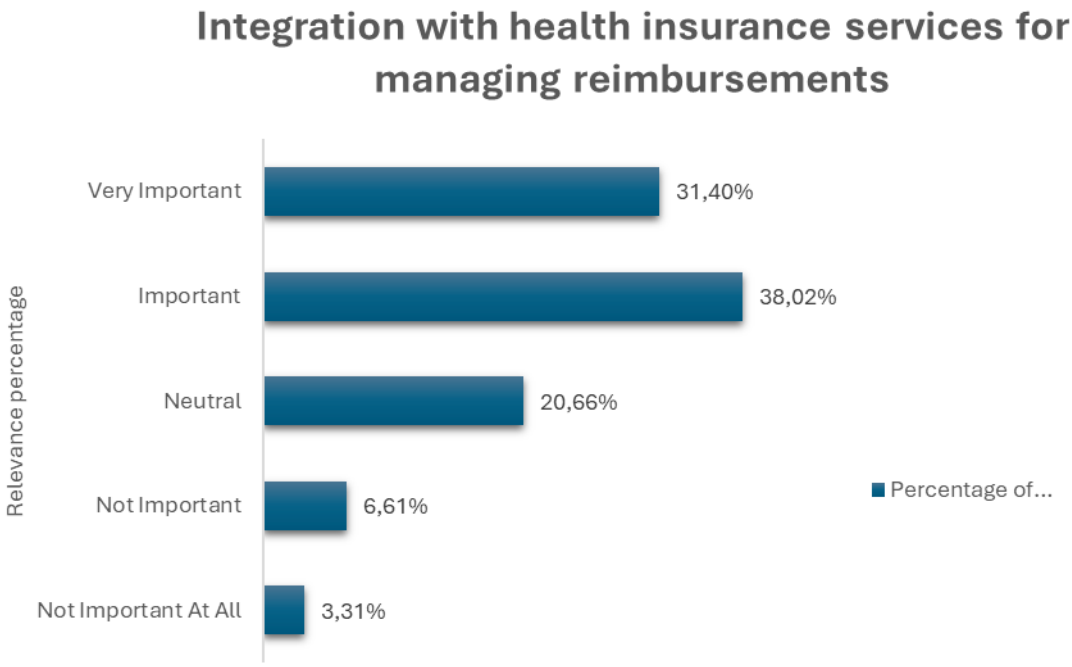
Graph 31. Access to pharmaceutical products in remote areas factor graph



Graph 32. Additional telematic therapy management assistance services (e.g., telephone or web-based counselling on correct medication intake) factor graph



Graph 33. Synchronization with personal health management applications (e.g., apps to manage reminders for medication times and doses) factor graph

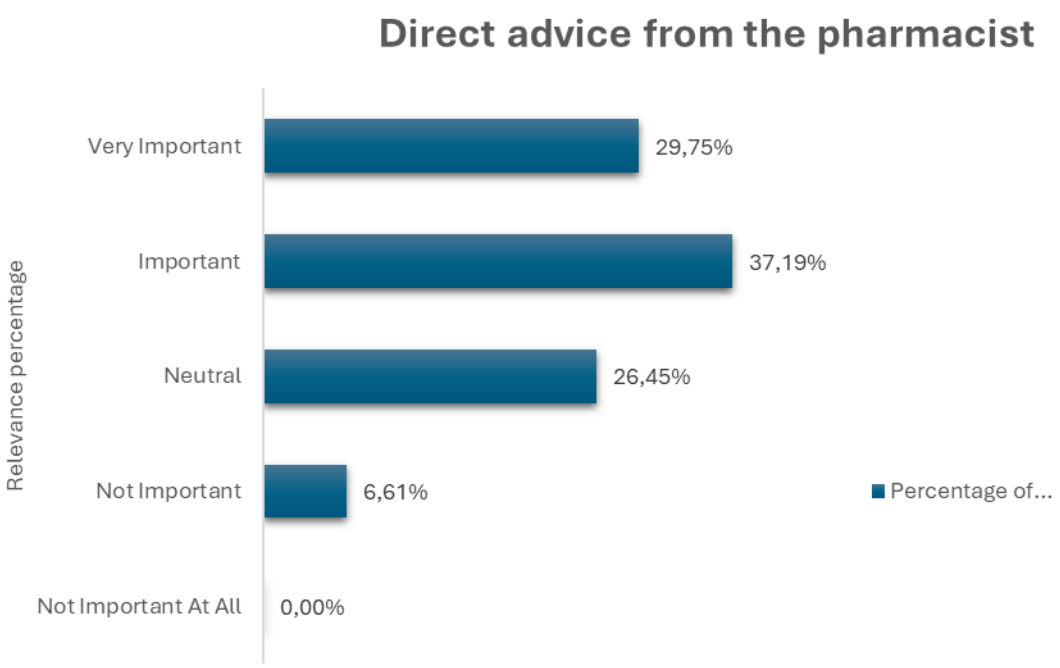


Graph 34. Integration with health insurance services for managing reimbursements factor graph

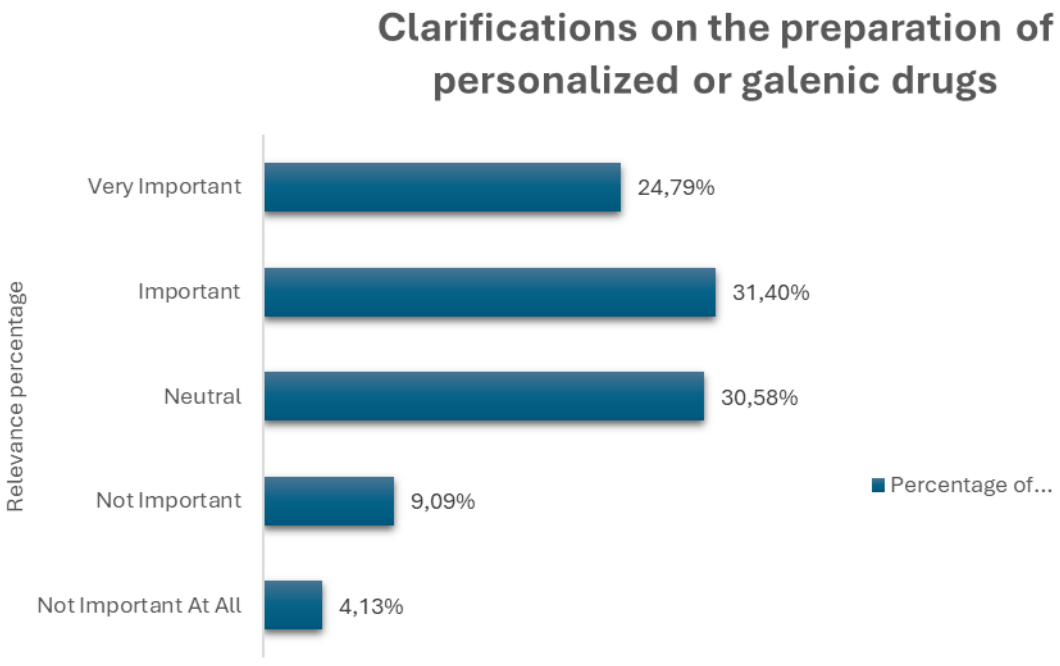
The speed of direct pick-up compared to home delivery times is highly relevant factor. In fact, 36% of recorded responses were on important level (Graph 38). Obtaining medication immediately is seen as a significant advantage of physically going to the pharmacy, instead of waiting for delivery times. Thus, avoiding delivery costs is another crucial factor, but with a response distribution that includes lower levels as well, with 61% considering it important or very important and 39% not important at

all, not important or neutral (Graph 39). This underscores that cost is certainly a consideration, but not so decisive. 31% of responses about trust and familiarity with the pharmacist are rated important, suggesting that personal relationship with pharmacist plays a moderate role in choosing the pharmacy as a place of purchase (Graph 41). The experience of social contact in a publicly accessible retail store such as a pharmacy receives lower importance ratings with a 39% of them neutral (Graph 40). Social aspect of visiting the pharmacy does not seem an influencing element in people decision, even if the lack of social interaction may be a disadvantage of home delivery for certain type of individuals like the elderly. Confidentiality of the delivery address for drugs related to sensitive diseases is not rated too important as it could be imagined. It seems respondents are not so concerned about personal data privacy, as 29% of them are neutral to the theme (Graph 42).

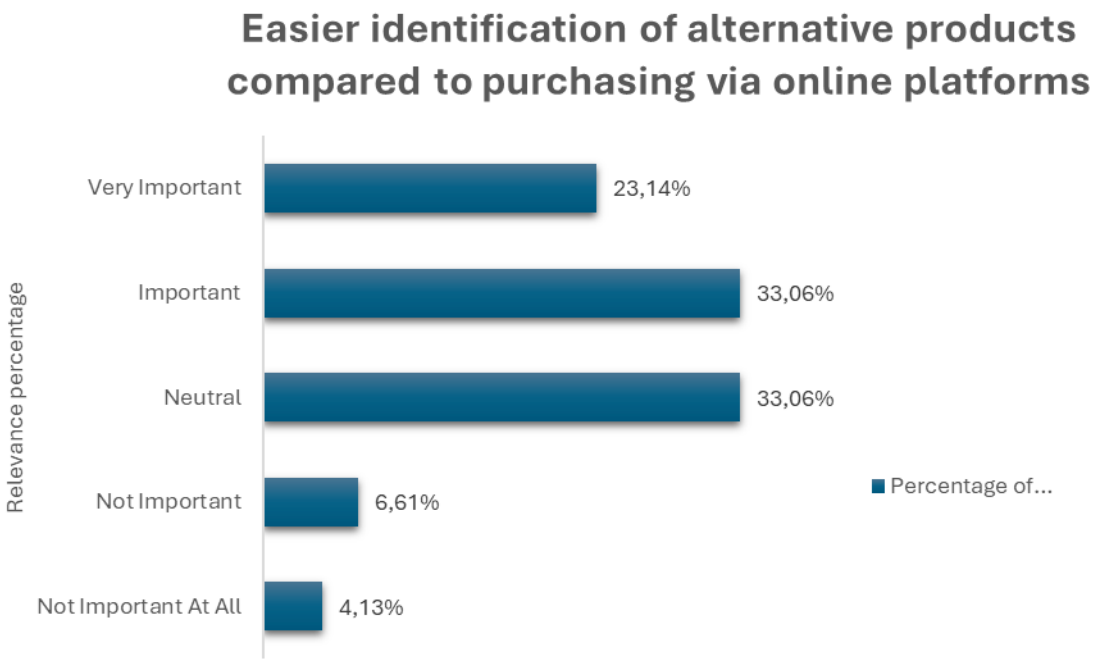
46% of ratings on real-time control over the quality of the received medication and direct management with the pharmacist for any issues was important, reflecting a preference for immediate verification and the ability to resolve any problems directly with the pharmacist (Graph 43). Access to other health services (e.g., blood pressure measurement, blood sugar testing, etc.) is rated as neutral or of low importance for many respondents, indicating they are not the primary driver for preferring pharmacy pick-up (Graph 44). Respecting the delivery time indicated during the ordering process is considered important as influencing factor, emphasizing a concern for the reliability of home delivery services. Nevertheless, 34% of respondents rated neutral this aspect, suggesting a certain willingness to wait and no worries about late delivery, going against the pharmacy pick-up (Graph 45). The technological barrier due to inexperience or incompetence in placing online orders is rated as neutral or of low importance by most respondents, suggesting this may still represent a barrier for certain individuals (Graph 46). Proper management of medication during the last-mile delivery represents a key factor, as 33% of respondents rated it as important (Graph 47). This reflects concerns about the quality and integrity of medication during transportation. Finally, respondents are neutral (28%) to the potential environmental impact of home deliveries, suggesting that environmental sustainability is not yet a primary factor in individual decision-making between the two options (Graph 48).



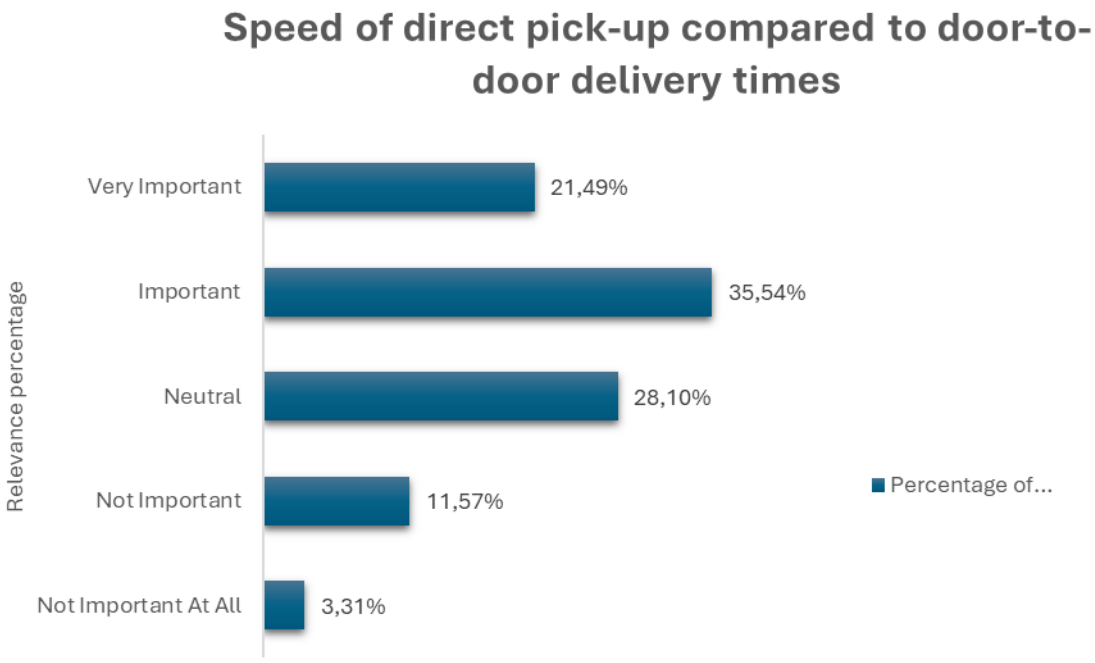
Graph 35. Direct advice from the pharmacist factor graph



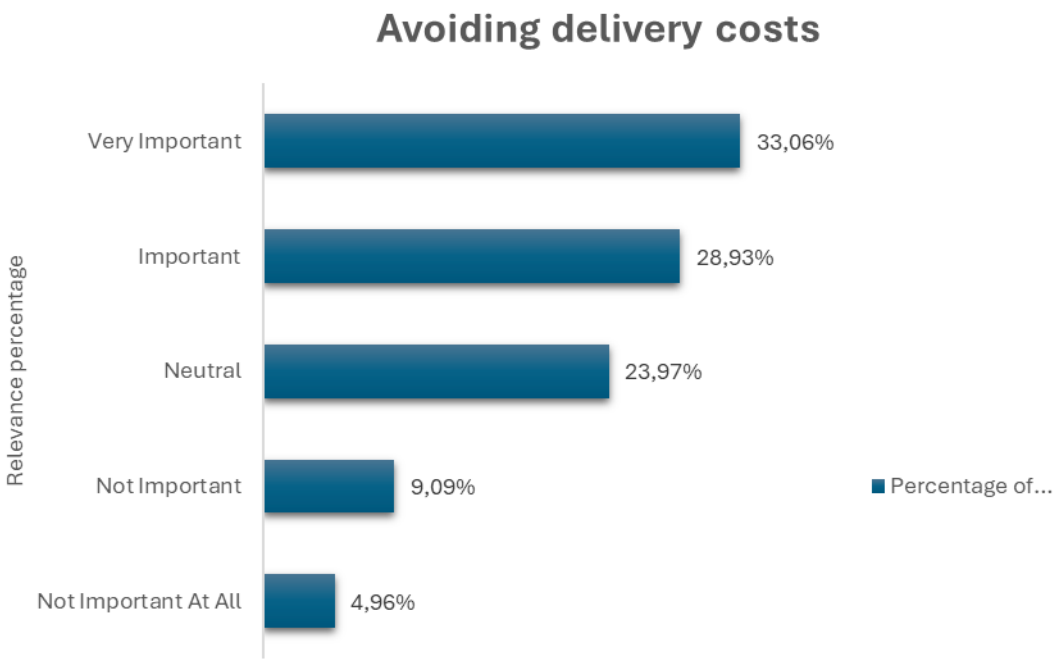
Graph 36. Clarifications on the preparation of personalized or galenic drugs factor graph



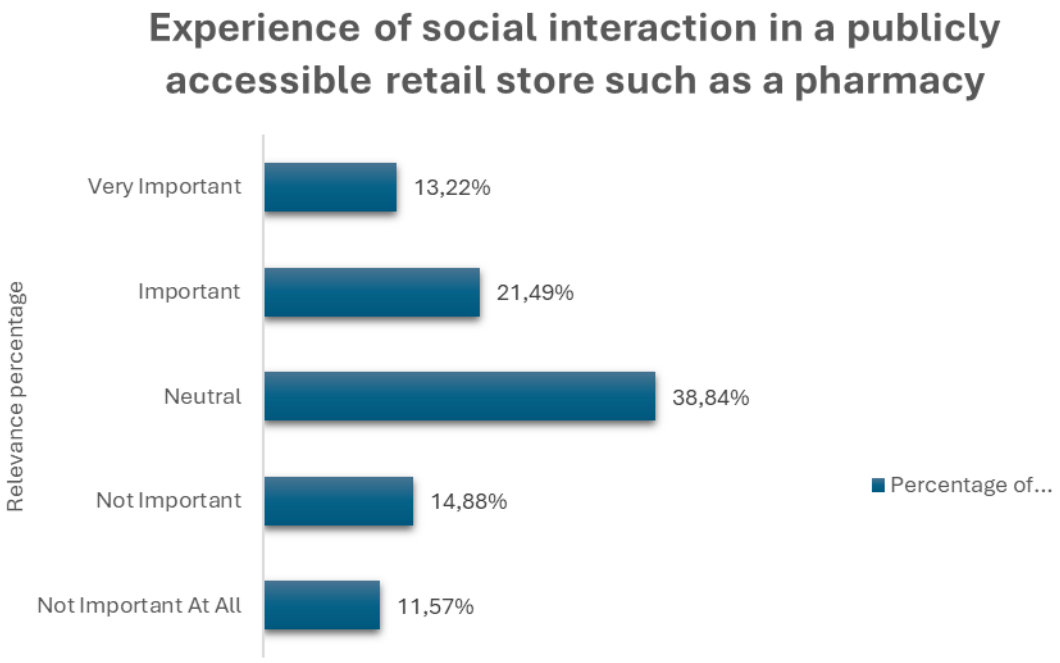
Graph 37. Easier identification of alternative products compared to purchasing via online platforms factor graph



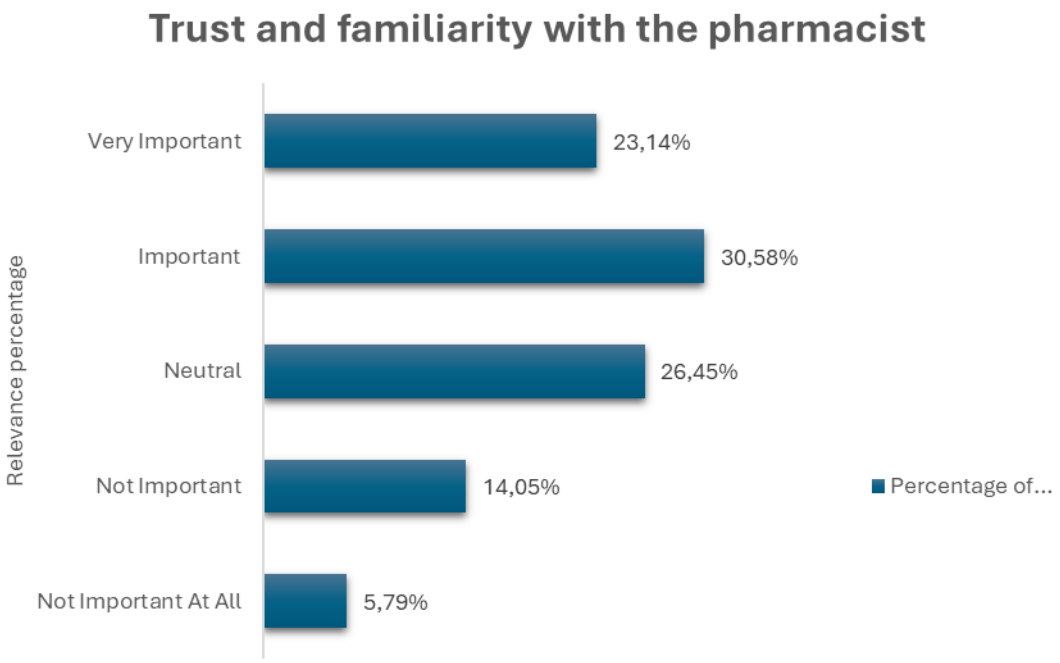
Graph 38. Speed of direct pick-up compared to door-to-door delivery times factor graph



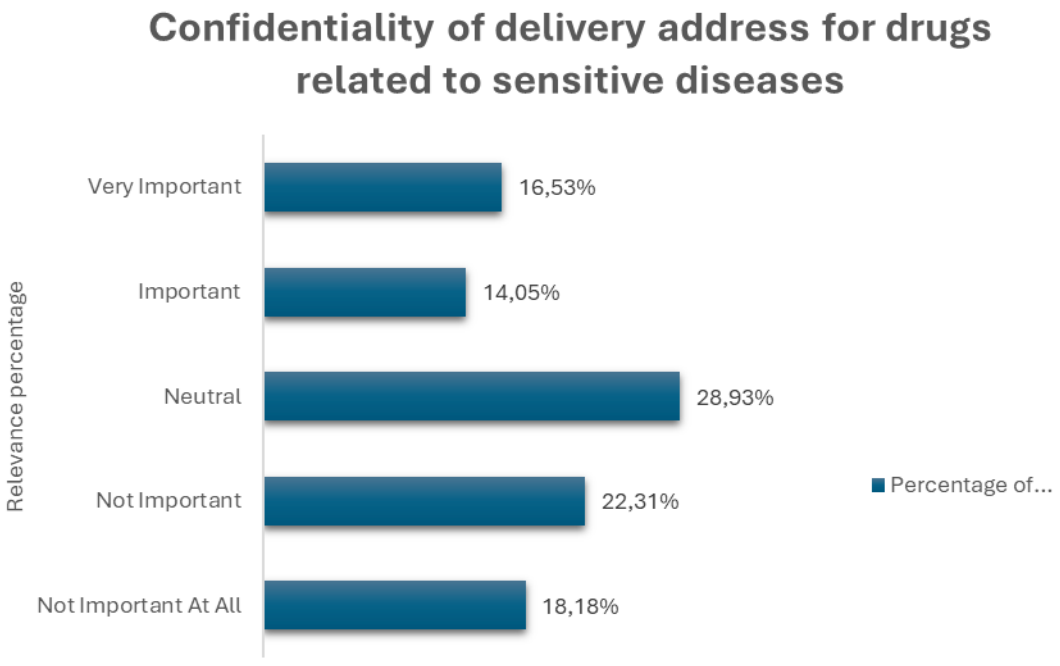
Graph 39. Avoiding delivery costs factor graph



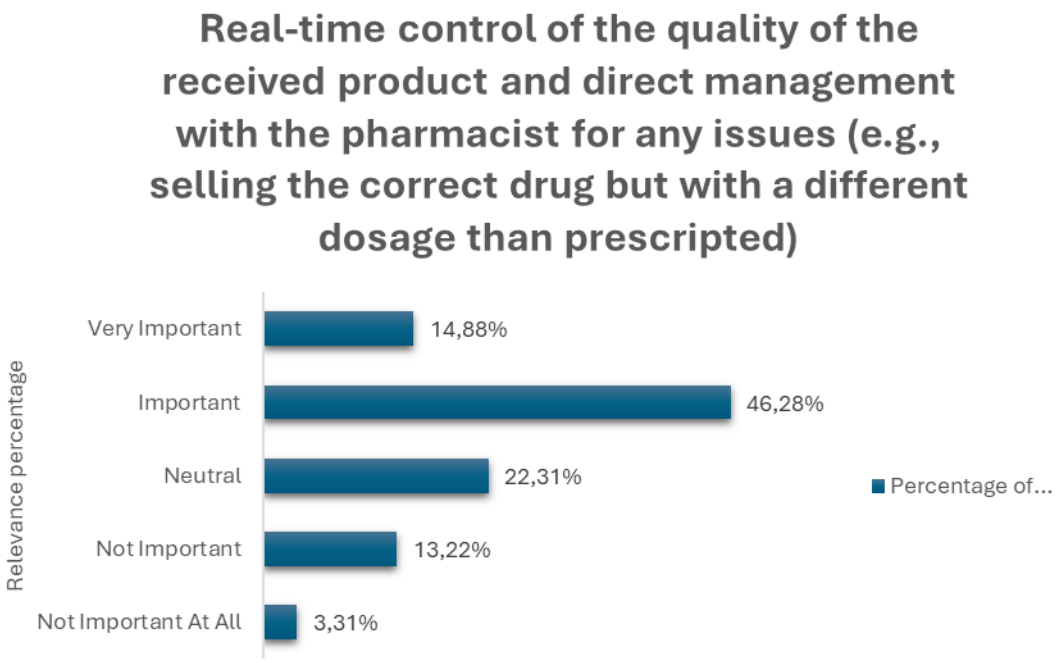
Graph 40. Experience of social interaction in a publicly accessible retail store such as a pharmacy factor graph



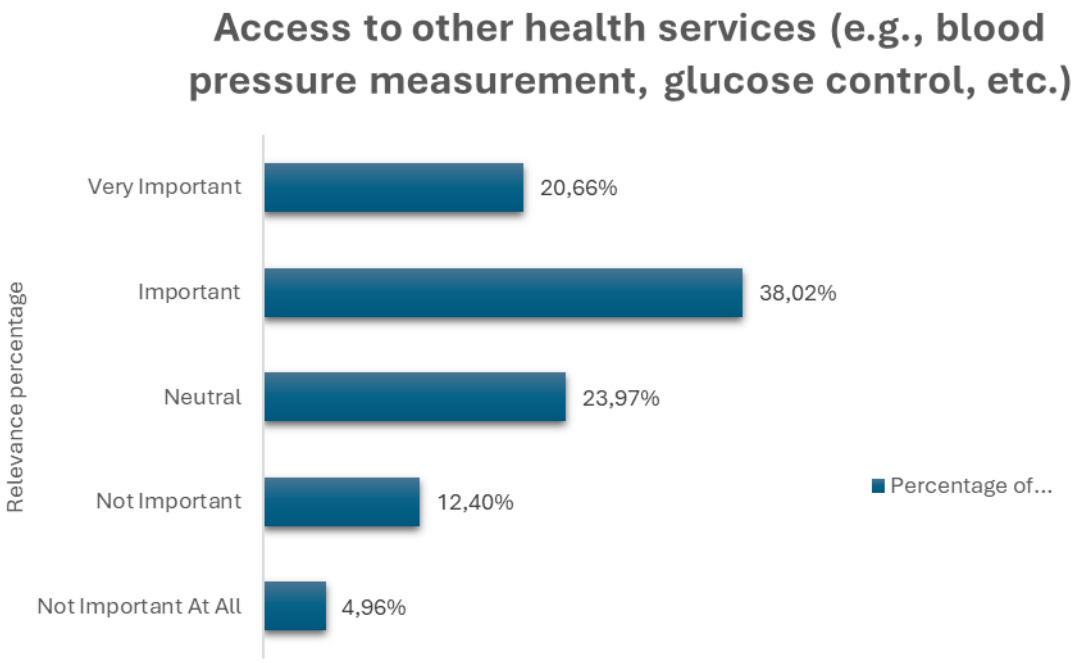
Graph 41. Trust and familiarity with the pharmacist factor graph



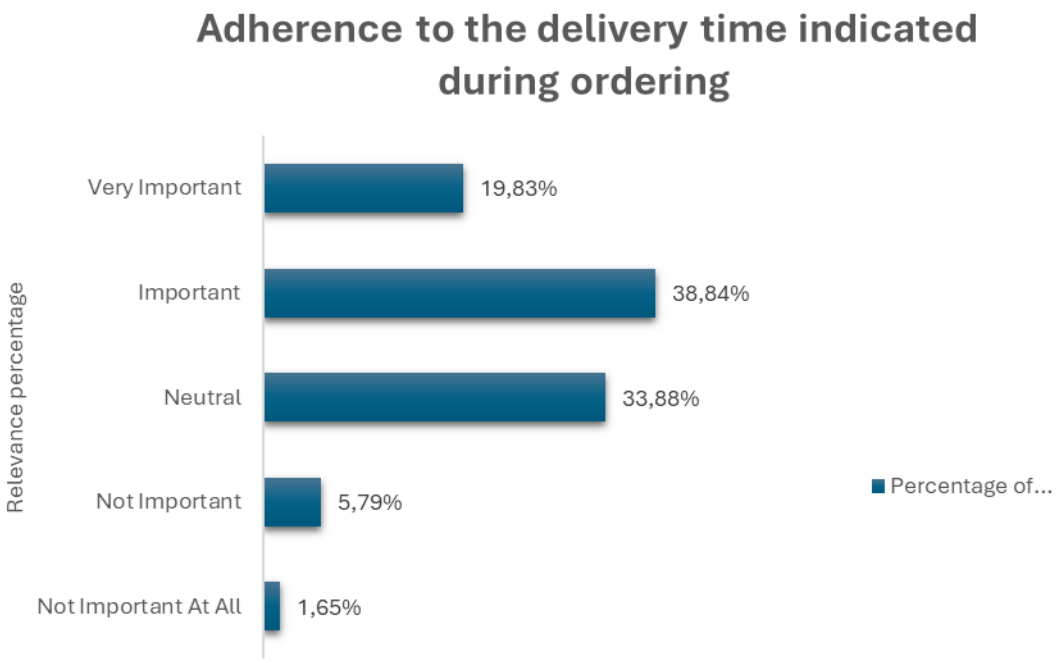
Graph 42. Confidentiality of delivery address for drugs related to sensitive diseases factor graph



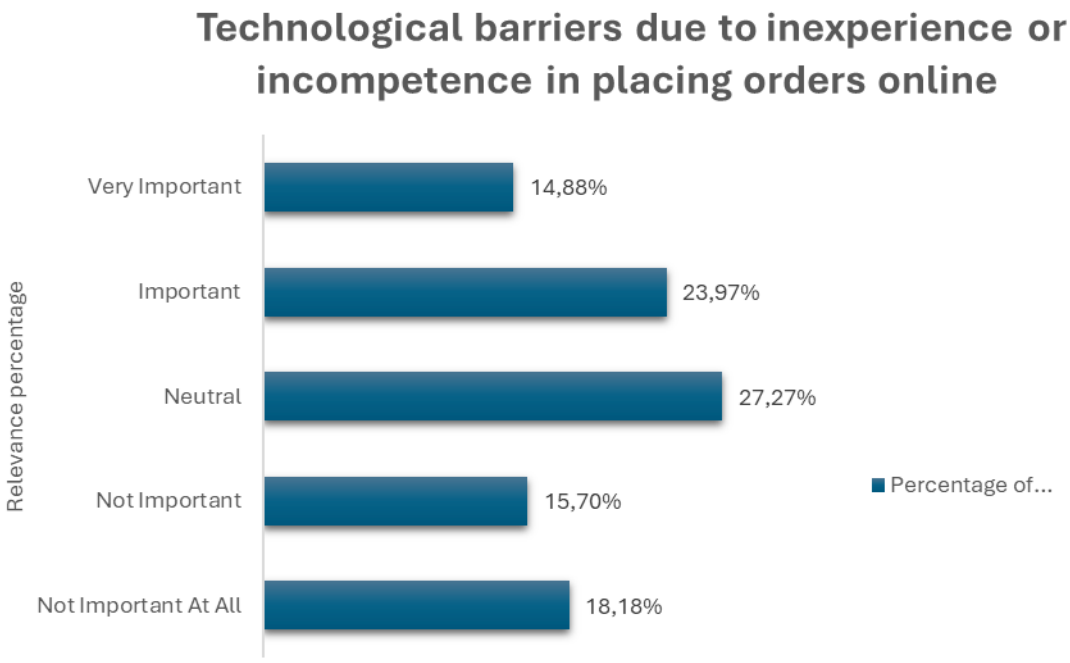
Graph 43. Real-time control of the quality of the received product and direct management with the pharmacist for any issues (e.g., selling the correct drug but with a different dosage than prescripted) factor graph



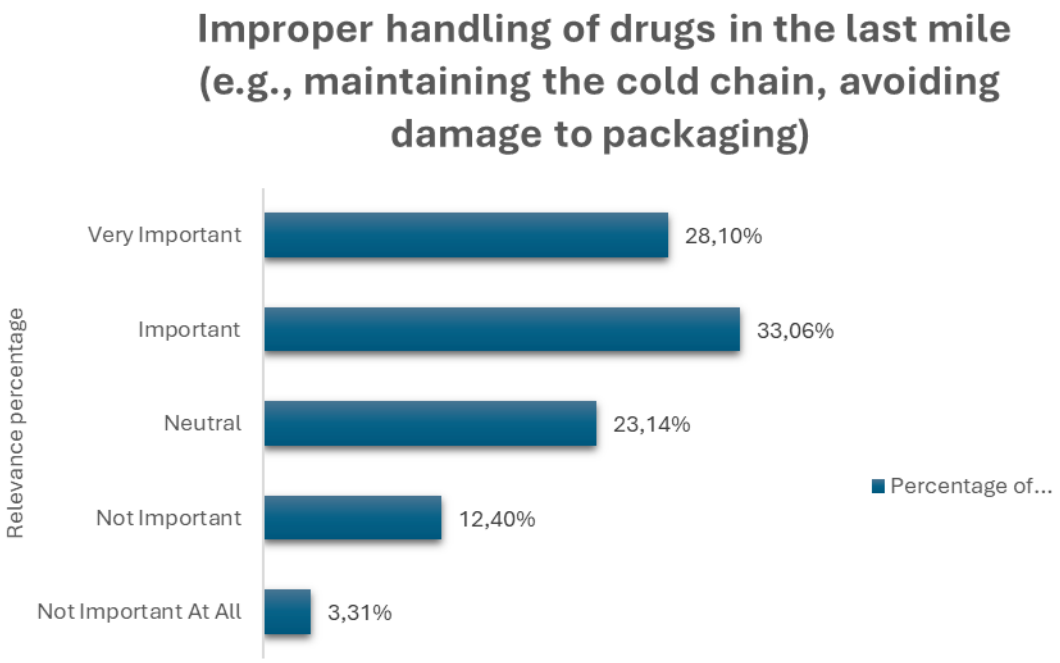
Graph 44. Access to other health services (e.g., blood pressure measurement, glucose control, etc.) factor graph



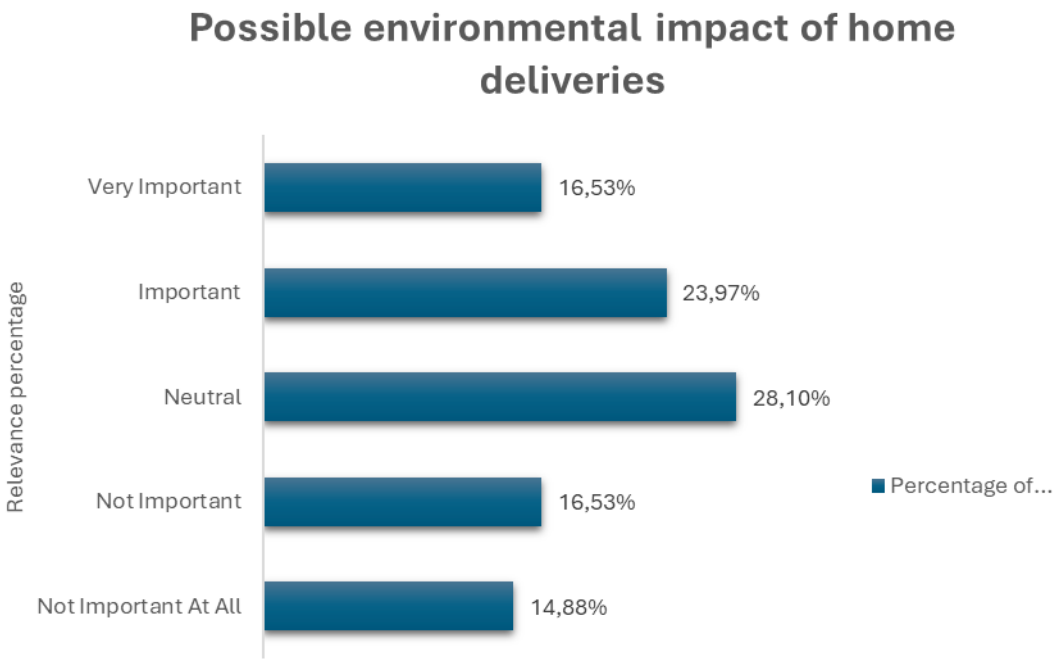
Graph 45. Adherence to the delivery time indicated during ordering factor graph



Graph 46. Technological barriers due to inexperience or incompetence in placing orders online factor graph



Graph 47. Improper handling of drugs in the last mile (e.g., maintaining the cold chain, avoiding damage to packaging) factor graph



Graph 48. Possible environmental impact of home deliveries factor graph

In conclusion, the choice between home delivery and pharmacy pick-up is influenced by a balance of factors, the analysis of which could give valuable insights for the development and improvement of home delivery services in the HSC. As a result, the following section will attempt to relate, through the use of inferential statistics, and specifically through the Kruskal-Wallis test, these categorical variables describing the sample of respondents with the aspects just analyzed.

4.2 Inferential statistics: the Kruskal-Wallis test

As (Vicario and Levi, 2011) said, the term "inferential statistics" refers to the study of a representative sample from an entire population, random and composed by independent elements as they represent the realization of casual variables with the same population distribution, in order to make hypotheses and predictions about the population itself, as studying the entire population is costly both in terms of resources and time.

Before starting with the inferential statistics, the Cronbach's Alpha test was performed for question 11 and 12 of the questionnaire to check the validity of the analysis. Cronbach's Alpha is a measure of internal consistency among different items, measurements, or evaluations, thus estimating the reliability of the questionnaire responses (Bujang et al., 2018). This coefficient is a measure of internal consistency that assesses how reliable surveys are designed. It ranges between 0 and 1, with higher values indicating greater consistency. Values greater than 0.7 can be considered sufficient to confirm the internal consistency and reliability of the scale (Mangano et al., 2023). The results of the Cronbach's Alpha test are reported in **Table 9** and **Table 10**.

Table 9. *Cronbach's Alpha results – question 11*

Cronbach's Alpha

Alpha
0,8453

Omitted Item Statistics

Omitted Variable	Adj.Total Mean	Adj. Total Standard Deviation	Item-Adj Total Correlation	Squared Multiple Correlation	Cronbach's Alpha
Comfort_saving	41,769	7,548	0,2761	0,4101	0,8486
Avoiding_crowded_places	42,884	7,129	0,4476	0,3107	0,8381
Simplified_prescription	41,785	7,321	0,4506	0,3664	0,8380
Ease_of_access_for_vulnerables	41,264	7,531	0,3948	0,2462	0,8413
Drugs_purchase_confidentiality	42,140	7,076	0,5765	0,4463	0,8285
Flexible_delivery_times	41,884	7,283	0,4931	0,3652	0,8349
Automatic_recurring_orders	41,983	7,161	0,6280	0,5089	0,8251
Reduced_stress_for_availability	42,174	7,206	0,5489	0,4299	0,8307

Access_in_remote_areas	41,835	7,279	0,4961	0,2793	0,8347
Additional_telematic_services	42,281	7,134	0,6576	0,5533	0,8229
Apps_for_health_management	42,388	7,121	0,6402	0,5817	0,8238
Health_insurance_services	41,975	7,281	0,5115	0,4201	0,8336

Table 10. *Cronbach's Alpha results – question 12*

Cronbach's Alpha

$Alpha$
0,8593

Omitted Item Statistics

Omitted Variable	Adj.Total Mean	Adj. Total Standard Deviation	Item-Adj Total Correlation	Squared Multiple Correlation	Cronbach's Alpha
Direct_pharmacist_advice	44,793	9,041	0,2941	0,3347	0,8602
Clarifications_on_personalized_drugs	45,058	8,770	0,4905	0,4473	0,8511
Identifications_alternative_products	45,050	8,824	0,4597	0,2625	0,8527
Pick-up_speed_vs_home_delivery	45,091	8,899	0,3775	0,3984	0,8570
Avoiding_delivery_costs	44,934	8,804	0,4197	0,4408	0,8552
Social_interaction_experience	45,595	8,606	0,5968	0,5331	0,849
Trust_pharmacist	45,182	8,676	0,5334	0,5213	0,8486
Delivery_address_confidentiality	45,810	8,556	0,5483	0,4219	0,8480
Real-time_product-control	45,132	8,689	0,6107	0,4783	0,8445
Other_health_services_access	45,124	8,626	0,6186	0,5252	0,8439
Delivery_time_adherence	45,000	8,873	0,4883	0,3895	0,8518
Technological_barriers	45,678	8,580	0,5324	0,4429	0,8490
Improper_last-mile_handling	44,992	8,613	0,6267	0,5284	0,8434
Environmental_impact	45,587	8,603	0,5275	0,4153	0,8492

As illustrated in the tables, the Cronbach's Alpha test yielded convincing results, as a value between 0.8 and 0.9 indicates a satisfactory level of internal reliability of the questionnaire.

This allowed to proceed with the statistical analysis, conducting the Kruskal-Wallis test. Then, since the collected data are not normally distributed and the Likert scales used to rate the questionnaire responses are ordinal in nature, the Kruskal–Wallis nonparametric test was chosen to assess whether the medians of the associated populations were equal (Mangano et al., 2023). The null hypothesis (H_0) was tested, which stated that all the medians of the different variables could be considered equal, against the alternative hypothesis (H_1) that at least one median could be different. The p-value threshold below which the null hypothesis could be rejected is 5%, which means that the relationship between one categorical variable and different response options is statistically significant. The categorical variables are those represented by the questions from 1 to 9 of the questionnaire, with their categories represented by the corresponding response options of question 11 and question 12 of the questionnaire.

In particular, the process of the statistical test was developed in two steps:

1. Verifying which categorical variables have a more or less homogeneous distribution among the respondents because the Kruskal-Wallis test conducted on an unbalanced sample does not lead to reliable results.
2. Selecting only the categorical variables with a homogeneous distribution of respondents

To conduct both tests, Minitab Statistical Software was used, a tool that allows for various types of statistical analysis. The results of the Kruskal-Wallis test are reported in Table 11 – 19, and in Appendix 3.

4.3 Analysis of Results

In this section the results of the K-W test will be presented, supported by many tables as illustrated below, indicating variable categories and the corresponding response options categories, medians of the groups analyzed, and p-values for the singular relationship.

Starting with the analysis of the age group category (**Table 11** and **table 12**), the relationship between age groups and the different variables analyzed through the Kruskal-Wallis (K-W) test shows p-values higher than 5%, thus not statistically significant. In this regard, it cannot be stated that the medians of the two groups are different.

Firstly, regarding the evaluation of the importance of using electronic prescriptions, this could be due to low variability in the data, with most respondents considering the use of electronic prescriptions either important or, conversely, of little relevance, thus increasing variability. Furthermore, there may be factors not considered in the test, such as education level, access to technology, or familiarity with it, which could have a greater impact on the result, potentially masking a relationship between the two categories. Regarding the use of health management apps, the non-significant p-value suggests that age is not a determining factor. The use of apps may instead depend on individual motivations: older people might find them necessary, especially if they are easy to use and accessible, while younger people may not consider such use indispensable, unless in specific situations. Similarly, in the case of avoiding crowded places, the lack of statistical significance could stem from a general shared opinion, related to the pandemic situation during Covid-19, when the population generally

avoided crowded places to limit the spread of the virus. Moreover, both young people, who might prefer a quieter lifestyle, and older individuals, who might be motivated by the need to avoid stressful or health-risking situations, appear to have similar motivations despite age differences, thus not generating differences between the medians of the two groups. The lack of statistical significance regarding access to pharmaceutical products for vulnerable individuals could be explained by the fact that access needs depend more on reduced mobility rather than age, as both elderly individuals and younger people with disabilities face similar challenges in accessing medications and benefit from the same solutions. This is why the difference between the medians of the groups does not emerge. Modern inclusivity and accessibility policies aim to meet the needs of all vulnerable individuals, reducing age-related differences. The relationship between technological barriers and age, on the other hand, is not significant, likely because difficulties in using technology do not depend solely on age but also on factors such as technological training and individual motivation. The availability of tutorials, phone support, and user-friendly interfaces has reduced barriers for everyone, regardless of age. Finally, the lack of statistical significance in the relationship between the social interaction experience in pharmacies and age could be linked to factors such as personal preferences, healthcare needs, and familiarity with the environment. Both older and younger individuals may seek social interactions but for different reasons: older people might value company and support, while younger people may prefer a faster and more targeted service. Pharmacies are often designed to meet a wide range of needs, and regardless of age, customers may prioritize the efficiency of service rather than prolonged social interaction. Therefore, differences in social interaction experience seem to be influenced more by practical needs than by age itself.

Table 11. *Kruskal-Wallis test output - Age group I*

	Groups	**Ease of access for vulnerables**	**p-value**	**Technological barriers**	**p-value**	**Social interaction experience**	**p-value**
Age group	18-24	5	0,107	3	0,141	3	0,648
	25-30	4		3		3	
	31-50	5		2		3	
	51-65	5		3		3	
	66-80	5		5		4	

Table 12. *Kruska-Wallis test output - Age group II*

	Groups	Simplified prescription	p-value	Apps for health management	p-value	Avoiding crowded places	p-value
Age group	18-24	4	0,444	4	0,344	3	0,510
	25-30	4		3		3	
	31-50	4,5		4		2	
	51-65	4		4		2	
	66-80	1		1		4	

The lack of statistical significance in the relationship between occupational status and flexible delivery times for home delivery can be explained by the fact that flexible delivery times are perceived as a necessity by different occupational groups based on their individual preferences, regardless of the type of job. While some people in certain occupations may have more rigid schedules, the increase in remote work, flexible working hours, and the availability of flexible delivery options have reduced the differences between various occupational groups, thus diminishing the likelihood that occupational status significantly influences preference for this option. Similarly, the relationship between access to pharmaceutical products in remote areas and occupational status is not statistically significant. This can be explained by the fact that access to medication in remote areas primarily depends on logistical, geographical, and infrastructural factors, rather than occupational status. While people in different occupations may have varying work schedules, the availability of medication in remote areas is more influenced by the presence of local pharmacies, home delivery services, and the availability of online healthcare solutions, which are equally relevant for everyone, regardless of occupation. In addition, the decision to avoid delivery costs is influenced more by economic and personal factors than by occupational status, which is why this relationship shows p-values above 0.05. Despite the variability in income levels, the preference to avoid delivery costs is often driven by common motivations, such as seeking more affordable solutions and the availability of alternatives, regardless of whether one has a higher or lower income. Furthermore, ensuring access to free delivery services can reduce the differences between various occupational groups, further decreasing the significance of this cost factor.

Another aspect related to occupational status is comfort and time-saving. It has been observed that this does not significantly influence the choice of home delivery. The need to simplify daily life and save time is present across all occupational categories, regardless of the amount of work time spent during the day. Moreover, the increasing availability of online platforms offering rapid delivery services that provide comfort and time-saving has made these options attractive to everyone, reducing the possibility that occupational status significantly influences the preference for these solutions. Similarly, the management of recurring orders with automatic delivery programs follows more or less the same pattern, as they are a potential solution to enhance comfort and time-saving for all occupational categories, thus reducing the differences between groups and making occupational status less relevant in influencing the adoption of such programs. Finally, the only statistically significant result related to occupational status concerns stress reduction due to concerns about the availability of pharmaceutical products online, suggesting that occupational groups react differently to the possibility of buying medications online. (Julianto *et al.*, 2024) suggest that employees are major users of online pharmacies due to convenience and better access to technology, as they allow to obtain medications without visiting a pharmacy. However, offline pharmacies still offer direct interaction with pharmacists and quality assurance, which remain important (Alghamdi *et al.*, 2023). Employees value personalized advice and immediate clarifications from pharmacists, relying on them for suggested alternatives in case of unavailability of a product. In some cases, physical pharmacies may be preferred for immediate access to medications, especially if urgent (Punakivi, 2019). Familiarity with a specific physical pharmacy can make concerns about product unavailability less important. Some employees, however, may be wary of e-commerce platforms and prefer physical pharmacies due to trust and safety concerns. On the other hand, the study examines accessibility as a factor influencing purchasing decisions. Although some physical pharmacies are considered easily accessible, for students with limited time due to studies and other activities, going to a pharmacy only to find that a product is unavailable represents a significant waste of time (Julianto *et al.*, 2024). Students, who may need specific products for study or health reasons, easily navigate the net to find a wide range of products, reducing the risk of not finding what they need (Punakivi, 2019). Those results are illustrated in **table 13** and **table 14**.

As it has been showed, there is no statistical significance in the relationships with the age group variable. This could means that, all the young people, regardless of the use of e-commerce, are used to both traditional (phsyical store) and home delivery models; adults maybe do not use e-commerce platforms as frequently as youngsters, but are aware of the existing online platforms and maybe are used to leverage, for instance, the food delivery service, instead of people over 65 years which may result hostile to this type of delivery service culture. Nevertheless, there are many non-significant relationships which, at the same time, present medians equal or quite similar. These are presented in the **table 20**, **table 21** and **table 22**.

Table 13. *Kruskal-Wallis test output - Occupational status I*

	Groups	Flexible delivery times	p-value	Access in remote ares	p-value	Avoiding delivery costs	p-value
Occupational status	Student	4	0,281	4	0,756	4	0,375
	Employee	4		4		4	
	Self-employee	4,5		4,5		4	
	Not employed	5		4		4	

Table 14. *Kruskal-Wallis test output - Occupational status II*

	Groups	Automatic recurring orders	p-value	Reduced stress for availability	p-value	Comfort saving	p-value
Occupational status	Student	4	0,114	4	**0,026**	4	0,060
	Employee	4		3		4	
	Self-employee	4,5		3,5		5	
	Not employed	4		4		4	

Analyzing the categorical variable related to the collection of pharmaceutical products on behalf of someone else (**Table 15**), only the relationship with social interaction in the pharmacy proves to be significant. The explanation why people who always collect products on behalf of someone else could be linked to family or social reasons, such as helping a relative, and during the pickup, opportunities may arise to ask for information or clarification, fostering interaction with staff or other customers, thus creating more chances for social interaction during the act of collection, as pharmacies are environments where people go for consultations and services, offering multiple opportunities for socialization, making this relationship statistically significant. For instance, (Francis *et al.*, 2002) highlights that community pharmacies are a key source of prescribed medications outside hospitals in the UK, making them important contact points for patients and caregivers. The study emphasizes the role of pharmacies providing opportunities for pharmacist-caregiver interactions, serving as places to socialize by providing information, advice, and support.

On the other hand, people who collect rarely or just few times a month consider it neutral, because it may be seen as a purely practical task, a mechanical gesture that doesn't involve significant emotional or relational engagement. In addition, if the collection of medications is seen more as a duty than a voluntary choice, perhaps for a family member or friend, the experience loses its social value, becoming something to do out of obligation rather than an occasion to establish a connection. For those who rarely pick up medications for others, the experience of social interaction with healthcare staff is likely to be perceived as a neutral and functional event, devoid of the caregiving responsibilities and the emotional involvement that characterize the experience of informal carers. The focus is on completing the task itself, without the social aspect of the interaction holding any particular positive or negative significance (Francis *et al.*, 2002).

Even the further relationships are not statistically significant. The lack of statistical significance in the relationship between collection on behalf of someone else and both flexible delivery times and technological barriers can be explained by the fact that these two behaviors are influenced by different factors related to social or logistical motivations, such as helping friends or family, and do not have a direct connection with the preference for flexible delivery times, which depends on factors such as availability of time or the need for fast delivery, nor with technological difficulties, which are related to individual familiarity with using online platforms. Although there could be a logic that might suggest that a person with difficulty using technology could delegate the pick-up to someone else, this connection is not universal and could be influenced by external variables, such as the availability of help from family or friends, or other solutions to overcome technological barriers, such as simply avoiding making online orders.

Table 15. *Kruskal-Wallis test output – Collection on behalf of someone else*

	Groups	Flexible delivery times	p-value	Technological barriers	p-value	Social interaction experience	p-value
Collection on behalf of someone else	Always	5	0,071	2,5	0,112	4,5	**0,040**
	Rarely	4		3		3	
	Sometimes	4		3		3	
	Often	4		3		3	
	Never	4		4		3	

Regarding the use of e-commerce (**Table 16** and **table 17**), home delivery speed could be an influencing factor as the pick-up speed, rather than delivery speed, recorded a p-value under 0.05, resulting in statistical significance. This means that the medians of the groups are different. In fact, while some people who frequently use e-commerce tend to prefer quick and convenient purchasing methods, there are others who hardly use it at all. In this context, the preference for a fast pick-up could stem from the desire to avoid the unpredictable waiting times associated with home delivery. On the other hand, those who never use it or use it only occasionally, because they typically do not need specific products and pick them up only in particular situations, might prefer the immediate availability of the product by going directly to the pharmacy to pick it up. In addition, it could be assumed that people using e-commerce 5 or more times a month develop a greater awareness of lead time of deliveries and the small variations in delivery times compared to those who use it less than 4 times a month, due to the direct experience with different services, gaining more and more higher expectations and better understanding more the shipping policies, making them more sensitive than people who shop online less. (Punakivi, 2019) highlights that some users may not perceive sufficient added value in home delivery to justify the need to plan for the arrival of the package. Especially for OTC drugs needed urgently, the immediate availability in the pharmacy (without waiting for delivery times and potential delayed deliveries) makes in-store pickup more beneficial in terms of speed and immediacy. In the absence of strong incentives (such as lower prices or fast, free delivery), users may not see a significant gain from opting for home delivery. Immediate access to medications, especially for urgent needs, remains crucial. On the other hand, the lack of statistical significance in the

relationship between e-commerce usage and flexible delivery times may be due to the variability in individual preferences. Although e-commerce is often associated with convenience, not all users attribute the same level of importance to flexibility in delivery times. Preferences vary depending on the type of product, the urgency of the purchase, or the delivery policies of different online stores. Many platforms, for example, offer flexible delivery options only for certain products or for high-value orders, reducing the consistency of the relationship and its statistical impact. Lastly, no statistical significance was recorded between the use of e-commerce and the avoidance of delivery costs, which can be explained by the variability in preferences and shopping habits. While the goal of many consumers using e-commerce is to avoid delivery costs, not all do so for economic reasons, but also for convenience or product availability. In fact, some online platforms offer free delivery above a certain price threshold, while others include the costs in the product price, reducing the perceived impact of additional delivery costs. Furthermore, the relationship between the use of e-commerce and the increased ease of identifying alternative products did not yield statistical significance, likely due to the variability in purchasing behaviors and consumer expectations. Although e-commerce allows users to compare products across a wide range of options, not all users perceive searching for alternatives as a priority during their purchase. Some consumers may focus on a specific product without seeking alternatives, while others might prefer shopping at physical stores, where interaction with staff helps uncover other options.

Instead, the statistically significant relationship between the use of e-commerce and the confidentiality of the delivery address for medications related to sensitive diseases can be explained by the fact that consumers who purchase medications online for sensitive conditions are particularly concerned with protecting their privacy. In particular, those who always use e-commerce are less likely to worry about providing their personal data, probably prioritizing the convenience of home delivery, especially for products that do not generate any social embarrassment. (Marchany and Tront, 2002) highlight that occasional e-commerce users tend to have concerns about privacy when providing their delivery address, due to their scarce familiarity with online platforms and a greater concern for the security and management of their personal data. In particular, these users may not trust online platforms and fear that their personal information, such as the delivery address, could be misused, sold to third parties for marketing purposes, or become vulnerable to theft or fraud. Even in absence of direct negative experiences, their awareness of risks related to online security, such as privacy breaches and cyberattacks, can fuel their concerns about protecting their data (Marchany and Tront, 2002). On the other hand, other individuals, such as those dealing with sensitive conditions, tend to prefer handling the purchase discreetly, avoiding visible or recognizable interactions. E-commerce, in fact, offers the possibility to choose discreet delivery options, reducing the risk of exposure to embarrassing situations or social stigma. As a result, the use of e-commerce in this context is strongly linked to concerns about privacy, justifying the significant relationship between the two factors. Similarly, a p-value less than 5% was recorded for the relationship between e-commerce usage and concern about the environmental impact of home deliveries. Frequent consumers who use e-commerce at least 5 times a month do not consider the environmental impact to be important, likely viewing home delivery as an essential part of their daily routine and not worrying about the contribution of frequent deliveries to pollution and increased CO2 emissions. Frequent e-commerce users may not prioritize the environmental impact of their purchases for several reasons. First of all, repeated online shopping can lead to a normalization of processes like packaging and shipping, becoming routine aspects of the experience (Sunita, 2023), maybe making users stop reflecting on

the resources consumed and emissions generated by each transaction. Moreover, they might perceive their individual actions having a low environmental impact within global e-commerce system. (Tiwari and Singh, 2011). In fact, trust in e-commerce companies also plays a role, as users may assume that large companies are already addressing their environmental footprint through practices like optimized delivery routes and sustainable packaging (Mangiaracina *et al.*, 2014). This belief can lead to a lack of personal responsibility for the issue. On the other hand, those who never use e-commerce consider the environmental impact to be critical and may prefer more sustainable delivery options or adopt behaviors that reduce their ecological footprint. Non-frequent e-commerce users may consider the environmental aspect more. They may not be familiar with the benefits of e-commerce, and may instead focus on its potential downsides, particularly the environmental costs like excessive shipping and packaging waste (Tiwari and Singh, 2011), viewing instead traditional shopping as less harmful to the environment, focusing on direct interaction with products, supporting local businesses, and reducing individual packaging. (Mangiaracina *et al.*, 2014).

Finally, another statistically significant relationship was found between the use of e-commerce and technological barriers due to inexperience or incompetence in making online orders. As one might easily imagine, those who regularly use e-commerce tend to be more experienced in using digital technologies, not encountering a specific barrier in technology, becoming an integrated aspect of the shopping process (Corbitt, 2002). Regular e-commerce users typically do not consider technological barriers important due to their familiarity and experience with online shopping, because having overcome initial challenges like website navigation and online payment processes, they now see these as routine aspects of the experience (Almousa, 2013). Trust in online platforms and their security systems, built through repeated positive interactions, also reduces the perception of technological barriers (Punakivi, 2019). In contrast, less experienced consumers fall into the group that is less likely to shop online and may therefore face difficulties in placing orders or navigating websites. Non-frequent users or those who never use e-commerce often view technological barriers as significant obstacles. They may lack the perceived skills needed for online shopping, find navigating unfamiliar websites or understanding payment processes daunting, and worry about privacy and data security (Punakivi, 2019), as well as negative personal experiences, which could potentially influence customer perception of not be able to complete the task of online order (Marchany and Tront, 2002).

Table 16. *Kruskal-Wallis test output - Use of e-commerce I*

	Groups	Pick-up speed vs home delivery speed	p-value	Flexible delivery times	p-value	Avoiding delivery costs	p-value
Use of e-commerce	Always	4	**0,036**	5	0,690	4	0,057
	Rarely	4		4		4	
	Sometimes	4		4		3	
	Often	3		4		4	
	Never	4		4		5	

Table 17. *Kruskal-Wallis test output - Use of e-commerce II*

	Groups	Identification alternative products online	p-value	Delivery address confidentiality	p-value	Environmental impact	p-value	Technological barriers	p-value
Use of e-commerce	Always	4	0,269	1	**0,019**	1	**0,008**	1	**0,036**
	Rarely	4		3		3		4	
	Sometimes	4		3		3		3	
	Often	3		3		3		3	
	Never	4		4		4		3	

Moreover, **table 18** shows there is no significance in the relationship between trust in the pharmacy and clarifications regarding personalized medications. Many people may seek clarifications through alternative channels, such as the prescribing doctor or online sources.

Lastly, **table 19** summarizes all the statistically significant relationships recorded by the Kruskal-Wallis test mentioned before.

Table 18. *Kruskal-Wallis test output - Trusted relationship with pharmacy I*

	Groups	Clarifications on personalized drugs	p-value
Trusted relationship with pharmacy	Yes	4	0,207
	No	4	

Table 19. *Summarizing table - K-W test statistically significant results (p-value < 5%)*

p-value	Delivery address confiden-tiality	Environmental impact	Technological barriers	Pick-up speed vs home delivery speed	Social interaction experience	Reduced stress for availability
Use of e-commerce	0,019	0,008	0,036	0,036		
Collection on behalf of someone else					0,040	
Occupational status						0,026

Table 20. *Values of medians of non-significant relationships I*

	Groups	Flexible delivery times	p-value	Comfort saving	p-value	Automatic recurring orders	p-value
Age group	18-24	4	0,789	4	0,523	4	0,187
	25-30	4		4		4	
	31-50	4		4,5		4	
	51-65	4		4		4	
	66-80	5		4		1	

Table 21. *Values of medians of non-significant relationships II*

	Groups	Delivery time adherence	p-value	Other health services acces	p-value	Identification alternative products	p-value
Age group	18-24	4	0,958	4	0,681	4	0,833
	25-30	4		4		4	
	31-50	4		3,5		4	
	51-65	4		4		4	
	66-80	4		4		4	

Table 22. *Values of medians of non-significant relationships III*

	Groups	Health insurance services	p-value	Access in remote areas	p-value	Reduced stress for availability	p-value
Age group	18-24	4	0,660	4	0,774	4	0,123
	25-30	4		4		3	
	31-50	4		4,5		4	
	51-65	4		4		4	
	66-80	3		4		4	

Chapter 5. Conclusions

Having reached the end of the work, which aimed to explore the scientific literature about the home delivery services of products sold by pharmacies, as well as investigating consumer preferences and the factors influencing their choice regarding the home delivery of such products, it is now possible to summarize the main conclusions that emerged from the conducted research.

5.1 Contribution of the research to the state of the art

This thesis tried to give a significant contribution to the scientific literature on the state of art of home delivery service for products sold by pharmacies. Through a SLR about pharmaceuticals home delivery and an empirical analysis about the potential users' perspectives on the service, this study offers new insights into the field of home delivery of pharmaceutical products sold by pharmacies.
Firstly, the analysis carried out provided a general overview of existing trends and gaps in the literature regarding the models of home delivery service for pharmaceutical products, also identifying the main drivers, benefits and limitations. Therefore, although the research provides in-depth indications within the initial sections of the project, it also highlights a gap in understanding the reasons driving the customer to prefer this type of service rather than pharmacy pick-up, leaving room for further developments and insights. To address this gap, the thesis proposed a structured questionnaire aimed to exploring these influencing factors. Descriptive statistics highlighted the characteristics of the sample, considering different variables such as occupational status, age group, and other aspects related to the purchase experience of pharmaceutical products, as well as general products using e-commerce or the collection on behalf of someone else, and information about the main pharmaceutical products sold by pharmacy that people would be most interest in receiving at home, supported by many graphs. Inferential statistics, at the same time, gave a significative contribution to the literature about aforementioned factors. In particular, it analyzed the respondents' perceptions regarding multiple factors influencing the choice between home delivery and pharmacy pick-up, identifying and highlighting both statistically significant and non-significant relationship between these factors, trying to explain the obtained results supported by literature references.

5.2 Academic and practical implications

The academic implications of this research lie in the contribution it offers to the existing literature, particularly regarding the exploration of the healthcare home delivery. The SLR presented in Chapter 2 offers an overview of key trends and existing gaps in the literature of home delivery of pharmaceutical products, identifying driving factors, benefits, limitations, and logistical models of this service, also pointing to a lack of insight into customer preference between home delivery over pharmacy pick-up. This opens the door for future academic research aimed at exploring these aspects. The design and administration of the questionnaire described in Chapter 3 represent a methodological contribution to future empirical studies aimed at investigating consumer opinions and preferences regarding home delivery of pharmaceutical products. The outcomes of the application of descriptive statistics to the data collected through the questionnaire in Chapter 4 provides new insights into the sample characteristics and purchase experience of generic and pharmaceutical products both physically and online, particularly the main ones that customer would receive at home, followed by the Kruskal-Wallis test used for contributing to the research with suggestions about how and in which size people are influenced by several factors identified in the questionnaire, and insights about the

relationship between categorical groups and the identified influencing factors, providing some explanations to the statistically significant ones. Both the SLR and the empirical analysis could stimulate further studies in the future towards the innovative dynamics of the home delivery within the healthcare sector, going deeper into the impact of specific factors on service adoption, better analyzing the perceived benefits and limitations, and examining the logistical models also in non-emergency contexts, as well as better investigating the variables and motivations behind choices on the two types of service, using the evidence of customers' preferences resulting from this work as a starting point.

Turning to the practical implications, the research highlights the potential of home delivery to improve convenience and accessibility to pharmaceutical products for different patients. This information could be valuable for many stakeholders within the healthcare sector, such as pharmacies and logistics providers, interested in developing or enhancing their home delivery services, optimizing existing operational models, improving service quality, and implementing more sustainable and efficient solutions. In fact, identifying the driving factors, benefits, and limitations of home delivery of medications and understanding the factors influencing the choice between home delivery and pharmacy pick-up, could be a support for the strategic decisions of these players, as well as insights into consumer preferences for different categories of pharmaceutical products could help these actors to tailor their service based on customer needs. Furthermore, the analysis of logistical models presented in the Chapter 2 offers practical lessons for creating resilient and adaptable home delivery systems, which could be enhanced in order to be used both in emergency situations and in regular contexts.

Finally, research provides insights for both academic community and industry professionals involved in the healthcare industry interested in the implementation and innovation of home delivery for pharmaceutical products sold by pharmacy, needing an integrated approach considering aspects such as social, logistical, technological challenges, and continuous improvement of existing operational models.

5.3 Limitations and recommendations for future research

This research, while providing valuable insights, has some limitations that should be taken into account. Firstly, despite the completeness of the SLR, the analyzed topic is quite recent. There are still few papers discussing it, which lead to say results cannot be generalized. In fact, while providing a structured overview, the SLR is based on a corpus of 13 articles selected through specific criteria. Although this number is the result of a systematic and comprehensive process, it may not comprehensively cover the entire body of literature on the subject. Furthermore, the methodology of the studies included in the review reflects the emerging nature of the topic, with a predominance of empirical analyses and literature reviews over mathematical models or in-depth case studies. In addition, the lack of detailed information on the number and type of nodes within the logistics network for home delivery has been identified as a gap in the existing literature. Moreover, the analysis did not explore all potential variables that could affect the success of home delivery services. In fact, aspects such as specific technological barriers or deeper socio-economic factors that may influence the adoption and success of such services have not yet been explored in detail. On the other hand, despite the empirical analysis provides valuable insights as mentioned in the section before, a limitation could be faced. Even if the questionnaire was administered to 121 respondents equally

distributed on different levels, they are all people under 65 years, whit only 1 respondent having more than this age representing the elderly category.

As for future research, there are multiple directions research could explore starting from the findings of this study. Firstly, examining the structure of the SC network for home delivery of pharmaceutical products is a key area for future research. Particularly, research should focus on the number, type, and optimal location of nodes in the supply chain, as these factors could impact delivery efficiency and service quality. Furthermore, studies evaluating the sustainability and scalability of different logistical models for home delivery may be needed, especially in non-crisis contexts. Additionally, another important area for further exploration is the impact of technological innovations, such as artificial intelligence (AI), drones, and autonomous vehicles, on the efficiency and effectiveness of pharmaceutical home delivery systems. These technologies could potentially have a significant impact to enhance this type of service.

These recommendations, derived from the limitations and gaps identified in the current research, point to several promising directions for future studies in the field of pharmaceutical home delivery services. By addressing these areas, future research could contribute to the continuous improvement of home delivery systems, benefiting both consumers and service providers.

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Appendix 1: Full text of the questionnaire

SERVIZI DI CONSEGNA A DOMICILIO DI PRODOTTI FARMACEUTICI: COSA NE PENSANO I CONSUMATORI?

SEZIONE 1: PROFILO DEMOGRAFICO ED ESPERIENZE DI ACQUISTO

1. A quale fascia di età appartieni?

- 18 – 24
- 25 - 30
- 31 - 50
- 51 - 65
- 66 - 80
- > 80

2. Quale delle seguenti opzioni descrive meglio la tua situazione occupazionale?

- Lavoratrice/ore autonoma/o
- Lavoratrice/ore dipendente
- Studentessa/e, stagista, volontaria/o
- Non occupata/o

3. È presente una farmacia nelle vicinanze (entro un raggio di 1 km) della tua abitazione o luogo di lavoro?

- Sì
- No

4. Sei soddisfatta/o dell'attuale orario di apertura della/e farmacia/e alla/e quale/i ti rivolgi abitualmente?

- Sì
- No

5. In caso di necessità, hai una persona di fiducia alla quale affidare il ritiro di prodotti farmaceutici al posto tuo?

- Sì
- No

6. Ti è mai capitato (o ti capita) di ritirare prodotti farmaceutici per conto di un'altra persona?

- Mai
- Raramente (meno di una volta al mese)
- A volte (1-2 volte al mese)
- Spesso (3-4 volte al mese)
- Sempre (5 o più volte al mese)

7. Con quale frequenza utilizzi canali di e-commerce per effettuare ordini online di prodotti di vario tipo?

- Mai
- Raramente (meno di una volta al mese)
- A volte (1-2 volte al mese)
- Spesso (3-4 volte al mese)
- Sempre (5 o più volte al mese)

SEZIONE 2: RELAZIONE CON LE FARMACIE E CONSEGNE A DOMICILIO

8. Acquisti regolarmente farmaci per curare patologie croniche?

- Sì
- No

9. Hai un rapporto di fiducia con una specifica farmacia?

- Sì
- No

10. Quali tipi di prodotto venduti in farmacia vorresti poter ricevere tramite un servizio di consegna a domicilio? *Seleziona una o più opzioni di risposta*.

- Farmaci da prescrizione: medicinali che richiedono una ricetta medica

- Farmaci da banco (Over-the-counter, OTC): medicinali che possono essere venduti senza prescrizione, come ad esempio antidolorifici, antinfiammatori, e antistaminici
- Farmaci veterinari: medicinali destinati alla cura degli animali
- Strumenti diagnostici: termometri, misuratori di pressione sanguigna, glucometri, ecc.
- Dispositivi per la cura delle ferite: bende, garze, cerotti, disinfettanti, ecc.
- Protesi, ortesi e altri dispositivi di supporto: tutori, bendaggi, apparecchi ortopedici, bastoni, deambulatori, materassi antidecubito, ecc.
- Cosmetici per la pelle, il viso e il corpo: creme, lozioni, shampoo, trattamenti per capelli, deodoranti, prodotti solari, prodotti specifici per pelle sensibile o acneica, ecc.
- Igiene intima e prodotti per la cura orale: saponi, dentifrici, collutori, spazzolini, ecc.
- Integratori vitaminici e minerali: multivitaminici, integratori per le articolazioni, per il sistema immunitario, integratori per la salute delle ossa, per il cuore, per la memoria, ecc.
- Alimenti speciali: alimenti per persone con particolari esigenze dietetiche, come ad esempio per celiaci, diabetici, o vegani
- Prodotti per l'igiene e la cura dei bambini: pannolini, salviettine, latte artificiale, ecc.
- Prodotti per la salute femminile: assorbenti, tamponi, creme per la pelle, prodotti per la gravidanza
- Prodotti stagionali: colliri e spray nasali per i raffreddori, ecc.

SEZIONE 3: FATTORI DI PREFERENZA TRA CONSEGNA A DOMICILIO E RITIRO IN FARMACIA

11. Quanto ritieni importanti i seguenti aspetti nel far **preferire** a un consumatore un **servizio di consegna a domicilio** dei prodotti farmaceutici rispetto al loro ritiro diretto in farmacia?

Considera una scala di punteggi da 1 a 5, dove: 1 = Decisamente non importante; 2 = Non importante; 3 = Neutrale (né importante né non importante); 4 = Importante; 5 = Molto importante

	1	**2**	**3**	**4**	**5**
Comodità e risparmio di tempo	○	○	○	○	○
Evitare contatti sociali e luoghi affollati per	○	○	○	○	○

limitare circolazione di virus					
Gestione semplificata delle prescrizioni tramite ricetta elettronica	○	○	○	○	○
Facilità di accesso ai farmaci per persone fragili, con mobilità ridotta e/o anziani	○	○	○	○	○
Maggiore riservatezza nell'acquisto di farmaci, specialmente quelli per curare patologie sensibili	○	○	○	○	○
Flessibilità oraria della consegna a domicilio	○	○	○	○	○
Facilità di gestione degli ordini ricorrenti con programmi di consegna automatica	○	○	○	○	○
Riduzione dello stress dovuto alla preoccupazione sulla	○	○	○	○	○

disponibilità dei prodotti farmaceutici, potendo usufruire di un loro acquisto su piattaforme online che garantiscono una maggiore disponibilità					
Accesso ai prodotti farmaceutici in aree remote	○	○	○	○	○
Servizi aggiuntivi di assistenza telematica alla gestione delle terapie (*es.*, consulenza telefonica, o tramite web, sulla corretta assunzione dei farmaci)	○	○	○	○	○
Sincronizzazione con applicazioni per la gestione della salute personale (*es.*, app per gestire i promemoria personali degli orari e delle dosi dei medicinali da assumere)	○	○	○	○	○
Integrazione con i servizi di assicurazione	○	○	○	○	○

sanitaria per la gestione dei rimborsi					

12. Quanto ritieni importanti i seguenti aspetti nel far **preferire** a un consumatore un **ritiro diretto in farmacia** dei prodotti rispetto alla loro consegna a domicilio?

Considera una scala di punteggi da 1 a 5, dove: 1 = Decisamente non importante; 2 = Non importante; 3 = Neutrale (né importante né non importante); 4 = Importante; 5 = Molto importante

	1	**2**	**3**	**4**	**5**
Consulenza diretta del farmacista	○	○	○	○	○
Chiarimenti sulla preparazione di farmaci personalizzati o galenici	○	○	○	○	○
Maggiore facilità nell'individuazione di prodotti alternativi rispetto all'acquisto tramite piattaforme online	○	○	○	○	○
Rapidità del ritiro diretto rispetto ai tempi di consegna porta a porta	○	○	○	○	○
Evitare costi di consegna	○	○	○	○	○
Esperienza di contatto sociale in un punto vendita accessibile al	○	○	○	○	○

pubblico, come la farmacia					
Fiducia e familiarità con il farmacista	○	○	○	○	○
Riservatezza sull'indirizzo di consegna per farmaci legati a patologie sensibili	○	○	○	○	○
Controllo in tempo reale della qualità del farmaco ricevuto e gestione diretta con il farmacista di eventuali problematiche (*es.*, vendita del farmaco corretto, ma con un dosaggio differente da quello prescritto)	○	○	○	○	○
Accesso ad altri servizi sanitari (*es.*, misurazione della pressione, controllo glicemico, ecc.)	○	○	○	○	○
Rispetto dei tempi di consegna indicati in fase di ordinazione.	○	○	○	○	○
Barriera tecnologica dovuta all'inesperienza o incompetenza	○	○	○	○	○

nell'effettuare ordini online					
Gestione idonea del farmaco nell'ultimo miglio (*es.*, mantenimento della catena del freddo, evitare danneggiamenti agli imballi)	○	○	○	○	○
Possibile impatto sull'ambiente delle consegne a domicilio	○	○	○	○	○

Appendix 2: Questionnaire cover letter

SERVIZI DI CONSEGNA A DOMICILIO DI PRODOTTI FARMACEUTICI: COSA NE PENSANO I CONSUMATORI?

Gentilissima/o,

sono Matteo Taverna, un laureando magistrale di Ingegneria Gestionale del Politecnico di Torino. Le sarei grato se volesse offrirmi la Sua preziosa collaborazione nella stesura del mio progetto di tesi, dedicato alla consegna a domicilio di prodotti farmaceutici e all'analisi delle opinioni dei consumatori finali in merito ai fattori che favoriscono o limitano lo sviluppo di questo servizio. Lo studio è svolto in collaborazione con la Prof.ssa Anna Cagliano e l'Ing. Simone Preziosa del Dipartimento di Ingegneria Gestionale e della Produzione.

In questo ambito, La invito a completare un breve questionario, accessibile al seguente link:

https://forms.office.com/Pages/ResponsePage.aspx?id=DQSIkWdsW0yxEjajBLZtrQAAAAAAAAAAAAO__QOkjLVUNzY5TVUxVlA3WkZHMDlBVVRUMFhNR1ZXUC4u

Il questionario si compone di 12 domande, suddivise in 3 sezioni, con risposta a scelta

multipla e la sua compilazione richiede all'incirca 5 minuti.

I dati raccolti dall'indagine saranno trattati con la massima riservatezza, nel totale anonimato e nel rispetto della normativa in materia di tutela del segreto statistico e di protezione dei dati personali.

Non esiti a contattarmi nel caso abbia domande sia sulla compilazione del questionario che sugli obiettivi dello studio.

Confido che le Sue risposte mi consentiranno di avere una visione più completa del servizio in questione, e proprio per questo colgo l'occasione per ringraziarLa in anticipo.

Se interessato, siamo disponibili nei prossimi mesi a condividere i risultati dello studio.

Cordialmente,

Matteo Taverna

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Appendix 3: Kruskal-Wallis test results

WORKSHEET 1

Kruskal-Wallis Test: simplified_prescription versus Age group

Descriptive Statistics

Age group	N	Median	Mean Rank	Z-Value
1	64	4,0	60,3	-0,24
2	27	4,0	60,7	-0,06
3	14	4,5	67,1	0,69
4	15	4,0	62,8	0,22
5	1	1,0	2,5	-1,67
Overall	121		61,0	

Test

Null hypothesis H_0: All medians are equal
Alternative hypothesis H_1: At least one median is different

Method	DF	H-Value	P-Value
Not adjusted for ties	4	3,28	0,513
Adjusted for ties	4	3,73	0,444

The chi-square approximation may not be accurate when some sample sizes are less than 5.

WORKSHEET 1

Kruskal-Wallis Test: apps_for_health_management versus Age group

Descriptive Statistics

Age group	N	Median	Mean Rank	Z-Value
1	64	4	64,1	1,03
2	27	3	55,0	-1,00
3	14	4	58,8	-0,25
4	15	4	64,4	0,40
5	1	1	3,5	-1,65
Overall	121		61,0	

Test

Null hypothesis H_0: All medians are equal
Alternative hypothesis H_1: At least one median is different

Method	DF	H-Value	P-Value
Not adjusted for ties	4	4,16	0,385
Adjusted for ties	4	4,49	0,344

The chi-square approximation may not be accurate when some sample sizes are less than 5.

WORKSHEET 1

Kruskal-Wallis Test: avoiding_crowded_places versus Age group

Descriptive Statistics

Age group	N	Median	Mean Rank	Z-Value
1	64	3	65,5	1,50
2	27	3	55,4	-0,94
3	14	2	54,3	-0,76
4	15	2	56,2	-0,56
5	1	4	88,5	0,79
Overall	121		61,0	

Test

Null hypothesis H_0: All medians are equal
Alternative hypothesis H_1: At least one median is different

Method	DF	H-Value	P-Value
Not adjusted for ties	4	3,15	0,533
Adjusted for ties	4	3,29	0,510

The chi-square approximation may not be accurate when some sample sizes are less than 5.

WORKSHEET 1

Kruskal-Wallis Test: ease_of_access_for_vulnerables versus Age group

Descriptive Statistics

Age group	N	Median	Mean Rank	Z-Value
1	64	5	64,6	1,19
2	27	4	48,0	-2,18
3	14	5	63,4	0,27
4	15	5	65,6	0,55
5	1	5	79,5	0,53
Overall	121		61,0	

Test

Null hypothesis H_0: All medians are equal
Alternative hypothesis H_1: At least one median is different

Method	DF	H-Value	P-Value
Not adjusted for ties	4	4,96	0,292
Adjusted for ties	4	7,61	0,107

The chi-square approximation may not be accurate when some sample sizes are less than 5.

WORKSHEET 1

Kruskal-Wallis Test: technological_barriers versus Age group

Descriptive Statistics

Age group	N	Median	Mean Rank	Z-Value
1	64	3	65,5	1,49
2	27	3	60,6	-0,07
3	14	2	45,6	-1,75
4	15	3	53,5	-0,88
5	1	5	112,5	1,47
Overall	121		61,0	

Test

Null hypothesis H_0: All medians are equal
Alternative hypothesis H_1: At least one median is different

Method	DF	H-Value	P-Value
Not adjusted for ties	4	6,58	0,160
Adjusted for ties	4	6,91	0,141

The chi-square approximation may not be accurate when some sample sizes are less than 5.

WORKSHEET 1

Kruskal-Wallis Test: social_interaction_experience versus Age group

Descriptive Statistics

Age group	N	Median	Mean Rank	Z-Value
1	64	3	59,3	-0,56
2	27	3	67,0	1,00
3	14	3	54,0	-0,79
4	15	3	61,8	0,10
5	1	4	92,5	0,90
Overall	121		61,0	

Test

Null hypothesis H_0: All medians are equal
Alternative hypothesis H_1: At least one median is different

Method	DF	H-Value	P-Value
Not adjusted for ties	4	2,29	0,682
Adjusted for ties	4	2,48	0,648

The chi-square approximation may not be accurate when some sample sizes are less than 5.

WORKSHEET 1

Kruskal-Wallis Test: flexible_delivery_times versus Occupational status

Descriptive Statistics

Occupational status	N	Median	Mean Rank	Z-Value
1	52	4,0	58,5	-0,68
2	50	4,0	58,4	-0,67
3	8	4,5	72,8	0,99
4	11	5,0	75,9	1,48
Overall	121		61,0	

Test

Null hypothesis H_0: All medians are equal
Alternative hypothesis H_1: At least one median is different

Method	DF	H-Value	P-Value
Not adjusted for ties	3	3,43	0,330
Adjusted for ties	3	3,82	0,281

WORKSHEET 1

Kruskal-Wallis Test: automatic_recurring_orders versus Occupational status

Descriptive Statistics

Occupational status	N	Median	Mean Rank	Z-Value
1	52	4,0	67,7	1,82
2	50	4,0	53,3	-2,02
3	8	4,5	72,8	0,98
4	11	4,0	55,7	-0,52
Overall	121		61,0	

Test

Null hypothesis H_0: All medians are equal
Alternative hypothesis H_1: At least one median is different

Method	DF	H-Value	P-Value
Not adjusted for ties	3	5,43	0,143
Adjusted for ties	3	5,96	0,114

WORKSHEET 1

Kruskal-Wallis Test: comfort_saving versus Occupational status

Descriptive Statistics

Occupational status	N	Median	Mean Rank	Z-Value
1	52	4	62,5	0,41
2	50	4	58,9	-0,54
3	8	5	85,9	2,08
4	11	4	45,1	-1,57
Overall	121		61,0	

Test

Null hypothesis H_0: All medians are equal

Alternative hypothesis H_1: At least one median is different

Method	DF	H-Value	P-Value
Not adjusted for ties	3	6,54	0,088
Adjusted for ties	3	7,39	0,060

WORKSHEET 1

Kruskal-Wallis Test: reduced_stress_for_availability versus Occupational status

Descriptive Statistics

Occupational status	N	Median	Mean Rank	Z-Value
1	52	4,0	68,5	2,03
2	50	3,0	50,0	-2,89
3	8	3,5	65,0	0,33
4	11	4,0	72,8	1,17
Overall	121		61,0	

Test

Null hypothesis H_0: All medians are equal

Alternative hypothesis H_1: At least one median is different

Method	DF	H-Value	P-Value
Not adjusted for ties	3	8,61	0,035
Adjusted for ties	3	9,29	0,026

WORKSHEET 1

Kruskal-Wallis Test: access_in_remote_areas versus Occupational status

Descriptive Statistics

Occupational status	N	Median	Mean Rank	Z-Value
1	52	4,0	62,9	0,51
2	50	4,0	57,3	-0,96
3	8	4,5	63,3	0,19
4	11	4,0	67,1	0,60
Overall	121		61,0	

Test

Null hypothesis H_0: All medians are equal

Alternative hypothesis H_1: At least one median is different

Method	DF	H-Value	P-Value
Not adjusted for ties	3	1,06	0,787
Adjusted for ties	3	1,19	0,756

WORKSHEET 1

Kruskal-Wallis Test: avoiding_delivery_costs versus Occupational status

Descriptive Statistics

Occupational status	N	Median	Mean Rank	Z-Value
1	52	4	54,9	-1,66
2	50	4	66,4	1,43
3	8	4	62,5	0,13
4	11	4	64,2	0,32
Overall	121		61,0	

Test

Null hypothesis H_0: All medians are equal

Alternative hypothesis H_1: At least one median is different

Method	DF	H-Value	P-Value
Not adjusted for ties	3	2,88	0,410
Adjusted for ties	3	3,11	0,375

WORKSHEET 1

Kruskal-Wallis Test: flexible_delivery_times versus How often do you use e-commerce

Descriptive Statistics

How often do you use e-commerce	N	Median	Mean Rank	Z-Value
1	7	5	68,0	0,54
2	23	4	56,0	-0,76
3	41	4	57,2	-0,85
4	30	4	65,5	0,80
5	20	4	65,3	0,61
Overall	121		61,0	

Test

Null hypothesis H_0: All medians are equal
Alternative hypothesis H_1: At least one median is different

Method	DF	H-Value	P-Value
Not adjusted for ties	4	2,02	0,732
Adjusted for ties	4	2,25	0,690

WORKSHEET 1

Kruskal-Wallis Test: avoiding_delivery_costs versus How often do you use e-commerce

Descriptive Statistics

How often do you use e-commerce	N	Median	Mean Rank	Z-Value
1	7	4	75,5	1,13
2	23	4	67,3	0,96
3	41	3	53,4	-1,70
4	30	4	53,6	-1,32
5	20	5	75,2	1,98
Overall	121		61,0	

Test

Null hypothesis H_0: All medians are equal
Alternative hypothesis H_1: At least one median is different

Method	DF	H-Value	P-Value
Not adjusted for ties	4	8,46	0,076
Adjusted for ties	4	9,15	0,057

WORKSHEET 1

Kruskal-Wallis Test: clarifications_on_personalized_ versus How often do you use e-commerce

Descriptive Statistics

How often do you use e-commerce	N	Median	Mean Rank	Z-Value
1	7	4	61,6	0,04
2	23	4	62,5	0,23
3	41	3	55,2	-1,29
4	30	4	58,3	-0,48
5	20	4	74,8	1,93
Overall	121		61,0	

Test

Null hypothesis H_0: All medians are equal
Alternative hypothesis H_1: At least one median is different

Method	DF	H-Value	P-Value
Not adjusted for ties	4	4,44	0,350
Adjusted for ties	4	4,80	0,308

WORKSHEET 1

Kruskal-Wallis Test: identification_alternative_prod versus How often do you use e-commerce

Descriptive Statistics

How often do you use e-commerce	N	Median	Mean Rank	Z-Value
1	7	4	66,1	0,39
2	23	4	64,9	0,59
3	41	4	59,4	-0,35
4	30	3	51,5	-1,71
5	20	4	72,2	1,56
Overall	121		61,0	

Test

Null hypothesis H_0: All medians are equal
Alternative hypothesis H_1: At least one median is different

Method	DF	H-Value	P-Value
Not adjusted for ties	4	4,74	0,315
Adjusted for ties	4	5,18	0,269

WORKSHEET 1

Kruskal-Wallis Test: pick-up_speed_vs_home_delivery versus How often do you use e-commerce

Descriptive Statistics

How often do you use e-commerce	N	Median	Mean Rank	Z-Value
1	7	4	67,4	0,49
2	23	4	73,7	1,93
3	41	4	54,4	-1,48
4	30	3	50,9	-1,82
5	20	4	72,9	1,66
Overall	121		61,0	

Test

Null hypothesis H_0: All medians are equal
Alternative hypothesis H_1: At least one median is different

Method	DF	H-Value	P-Value
Not adjusted for ties	4	9,48	0,050
Adjusted for ties	4	10,29	0,036

WORKSHEET 1

Kruskal-Wallis Test: technological_barriers versus How often do you use e-commerce

Descriptive Statistics

How often do you use e-commerce	N	Median	Mean Rank	Z-Value
1	7	1	39,9	-1,64
2	23	4	74,3	2,02
3	41	3	58,1	-0,64
4	30	3	52,5	-1,54
5	20	3	71,7	1,50
Overall	121		61,0	

Test

Null hypothesis H_0: All medians are equal
Alternative hypothesis H_1: At least one median is different

Method	DF	H-Value	P-Value
Not adjusted for ties	4	9,77	0,045
Adjusted for ties	4	10,25	0,036

WORKSHEET 1

Kruskal-Wallis Test: delivery_address_confidentialit versus How often do you use e-commerce

Descriptive Statistics

How often do you use e-commerce	N	Median	Mean Rank	Z-Value
1	7	1	41,6	-1,50
2	23	3	68,3	1,12
3	41	3	53,6	-1,66
4	30	3	57,3	-0,67
5	20	4	80,0	2,66
Overall	121		61,0	

Test

Null hypothesis H_0: All medians are equal
Alternative hypothesis H_1: At least one median is different

Method	DF	H-Value	P-Value
Not adjusted for ties	4	11,20	0,024
Adjusted for ties	4	11,77	0,019

WORKSHEET 1

Kruskal-Wallis Test: environmental_impact versus How often do you use e-commerce

Descriptive Statistics

How often do you use e-commerce	N	Median	Mean Rank	Z-Value
1	7	1	33,4	-2,15
2	23	3	67,4	0,97
3	41	3	55,9	-1,15
4	30	3	56,1	-0,89
5	20	4	81,2	2,82
Overall	121		61,0	

Test

Null hypothesis H_0: All medians are equal
Alternative hypothesis H_1: At least one median is different

Method	DF	H-Value	P-Value
Not adjusted for ties	4	13,20	0,010
Adjusted for ties	4	13,87	0,008

WORKSHEET 1

Kruskal-Wallis Test: flexible_delivery_times versus Collection on behalf of someone else

Descriptive Statistics

Have you (or do you) ever colle	N	Median	Mean Rank	Z-Value
1	4	5	87,9	1,56
2	68	4	64,0	1,06
3	20	4	61,5	0,06
4	11	4	61,8	0,08
5	18	4	42,8	-2,39
Overall	121		61,0	

Test

Null hypothesis H_0: All medians are equal
Alternative hypothesis H_1: At least one median is different

Method	DF	H-Value	P-Value
Not adjusted for ties	4	7,72	0,102
Adjusted for ties	4	8,62	0,071

The chi-square approximation may not be accurate when some sample sizes are less than 5.

WORKSHEET 1

Kruskal-Wallis Test: technological_barriers versus versus Collection on behalf of someone else

Descriptive Statistics

Have you (or do you) ever colle	N	Median	Mean Rank	Z-Value
1	4	2,5	39,9	-1,23
2	68	3,0	56,7	-1,53
3	20	3,0	60,2	-0,11
4	11	3,0	69,5	0,85
5	18	4,0	77,6	2,17
Overall	121		61,0	

Test

Null hypothesis H_0: All medians are equal
Alternative hypothesis H_1: At least one median is different

Method	DF	H-Value	P-Value
Not adjusted for ties	4	7,14	0,128
Adjusted for ties	4	7,50	0,112

The chi-square approximation may not be accurate when some sample sizes are less than 5.

WORKSHEET 1

Kruskal-Wallis Test: social_interaction_experience versus Collection on behalf of someone else

Descriptive Statistics

Have you (or do you) ever colle	N	Median	Mean Rank	Z-Value
1	4	4,5	93,9	1,91
2	68	3,0	53,4	-2,71
3	20	3,0	69,4	1,17
4	11	3,0	66,8	0,58
5	18	3,0	69,7	1,14
Overall	121		61,0	

Test

Null hypothesis H_0: All medians are equal
Alternative hypothesis H_1: At least one median is different

Method	DF	H-Value	P-Value
Not adjusted for ties	4	9,29	0,054
Adjusted for ties	4	10,05	0,040

The chi-square approximation may not be accurate when some sample sizes are less than 5.

WORKSHEET 1

Kruskal-Wallis Test: clarifications_on_personalized_ versus Trusted relationship with pharmacy

Descriptive Statistics

Do you have a trusted relations	N	Median	Mean Rank	Z-Value
1	60	4	64,9	1,21
2	61	4	57,2	-1,21
Overall	121		61,0	

Test

Null hypothesis H_0: All medians are equal
Alternative hypothesis H_1: At least one median is different

Method	DF	H-Value	P-Value
Not adjusted for ties	1	1,47	0,225
Adjusted for ties	1	1,59	0,207

WORKSHEET 1

Kruskal-Wallis Test: flexible_delivery_times versus Age group

Descriptive Statistics

Age group	N	Median	Mean Rank	Z-Value
1	64	4	59,5	-0,49
2	27	4	59,9	-0,19
3	14	4	63,4	0,27
4	15	4	64,6	0,42
5	1	5	99,0	1,09
Overall	121		61,0	

Test

Null hypothesis H_0: All medians are equal
Alternative hypothesis H_1: At least one median is different

Method	DF	H-Value	P-Value
Not adjusted for ties	4	1,53	0,821
Adjusted for ties	4	1,71	0,789

The chi-square approximation may not be accurate when some sample sizes are less than 5.

WORKSHEET 1

Kruskal-Wallis Test: comfort_saving versus Age group

Descriptive Statistics

Age group	N	Median	Mean Rank	Z-Value
1	64	4,0	62,7	0,56
2	27	4,0	51,6	-1,59
3	14	4,5	66,3	0,60
4	15	4,0	66,5	0,64
5	1	4,0	52,5	-0,24
Overall	121		61,0	

Test

Null hypothesis H_0: All medians are equal
Alternative hypothesis H_1: At least one median is different

Method	DF	H-Value	P-Value
Not adjusted for ties	4	2,85	0,584
Adjusted for ties	4	3,21	0,523

The chi-square approximation may not be accurate when some sample sizes are less than 5.

WORKSHEET 1

Kruskal-Wallis Test: automatic_recurring_orders versus Age group

Descriptive Statistics

Age group	N	Median	Mean Rank	Z-Value
1	64	4	66,0	1,66
2	27	4	55,9	-0,87
3	14	4	51,9	-1,04
4	15	4	61,4	0,05
5	1	1	2,5	-1,67
Overall	121		61,0	

Test

Null hypothesis H_0: All medians are equal
Alternative hypothesis H_1: At least one median is different

Method	DF	H-Value	P-Value
Not adjusted for ties	4	5,61	0,230
Adjusted for ties	4	6,16	0,187

The chi-square approximation may not be accurate when some sample sizes are less than 5.

WORKSHEET 1

Kruskal-Wallis Test: delivery_time_aderence versus Age group

Descriptive Statistics

Age group	N	Median	Mean Rank	Z-Value
1	64	4	60,5	-0,17
2	27	4	64,4	0,57
3	14	4	57,4	-0,41
4	15	4	59,5	-0,17
5	1	4	74,0	0,37
Overall	121		61,0	

Test

Null hypothesis H_0: All medians are equal
Alternative hypothesis H_1: At least one median is different

Method	DF	H-Value	P-Value
Not adjusted for ties	4	0,58	0,966
Adjusted for ties	4	0,64	0,958

The chi-square approximation may not be accurate when some sample sizes are less than 5.

WORKSHEET 1

Kruskal-Wallis Test: other_health_services_access versus Age group

Descriptive Statistics

Age group	N	Median	Mean Rank	Z-Value
1	64	4,0	60,4	-0,20
2	27	4,0	63,7	0,45
3	14	3,5	50,5	-1,20
4	15	4,0	67,7	0,79
5	1	4,0	73,5	0,36
Overall	121		61,0	

Test

Null hypothesis H_0: All medians are equal
Alternative hypothesis H_1: At least one median is different

Method	DF	H-Value	P-Value
Not adjusted for ties	4	2,12	0,714
Adjusted for ties	4	2,30	0,681

The chi-square approximation may not be accurate when some sample sizes are less than 5.

WORKSHEET 1

Kruskal-Wallis Test: identification_alternative_prod versus Age group

Descriptive Statistics

Age group	N	Median	Mean Rank	Z-Value
1	64	4	58,7	-0,76
2	27	4	63,1	0,35
3	14	4	58,0	-0,34
4	15	4	68,8	0,92
5	1	4	73,5	0,36
Overall	121		61,0	

Test

Null hypothesis H_0: All medians are equal
Alternative hypothesis H_1: At least one median is different

Method	DF	H-Value	P-Value
Not adjusted for ties	4	1,34	0,854
Adjusted for ties	4	1,47	0,833

The chi-square approximation may not be accurate when some sample sizes are less than 5.

WORKSHEET 1

Kruskal-Wallis Test: health_insurance_services versus Age group

Descriptive Statistics

Age group	N	Median	Mean Rank	Z-Value
1	64	4	64,1	1,02
2	27	4	60,5	-0,08
3	14	4	57,0	-0,45
4	15	4	54,9	-0,72
5	1	3	25,0	-1,03
Overall	121		61,0	

Test

Null hypothesis H_0: All medians are equal
Alternative hypothesis H_1: At least one median is different

Method	DF	H-Value	P-Value
Not adjusted for ties	4	2,19	0,701
Adjusted for ties	4	2,42	0,660

The chi-square approximation may not be accurate when some sample sizes are less than 5.

WORKSHEET 1

Kruskal-Wallis Test: access_in_remote_areas versus Age group

Descriptive Statistics

Age group	N	Median	Mean Rank	Z-Value
1	64	4,0	63,0	0,66
2	27	4,0	60,0	-0,16
3	14	4,5	64,8	0,43
4	15	4,0	51,3	-1,15
5	1	4,0	53,0	-0,23
Overall	121		61,0	

Test

Null hypothesis H_0: All medians are equal
Alternative hypothesis H_1: At least one median is different

Method	DF	H-Value	P-Value
Not adjusted for ties	4	1,60	0,809
Adjusted for ties	4	1,79	0,774

The chi-square approximation may not be accurate when some sample sizes are less than 5.

WORKSHEET 1

Kruskal-Wallis Test: reduced_stress_for_availability versus Age group

Descriptive Statistics

Age group	N	Median	Mean Rank	Z-Value
1	64	4	68,1	2,36
2	27	3	48,2	-2,16
3	14	4	55,5	-0,63
4	15	4	58,4	-0,30
5	1	4	69,5	0,24
Overall	121		61,0	

Test

Null hypothesis H_0: All medians are equal
Alternative hypothesis H_1: At least one median is different

Method	DF	H-Value	P-Value
Not adjusted for ties	4	6,72	0,151
Adjusted for ties	4	7,26	0,123

The chi-square approximation may not be accurate when some sample sizes are less than 5.