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On-demand mobile application to support medication access and delivery

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Dissertation presented as partial requirement for obtaining
the master's degree in Information management,
specialization in Information systems and technologies

NOVA Information Management School
Instituto Superior de Estatística e Gestão de Informação
Universidade Nova de Lisboa

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ACCESS AND DELIVERY**

by

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Master Thesis presented as partial requirement for obtaining the Master's degree in Information Management, with a specialization in Information Systems and Technologies Management.

Supervisor: PhD Vítor Duarte dos Santos

November 2022

STATEMENT OF INTEGRITY

I hereby declare having conducted this academic work with integrity. I confirm that I have not used plagiarism or any form of undue use of information or falsification of results along the process leading to its elaboration. I further declare that I have fully acknowledge the Rules of Conduct and Code of Honor from the NOVA Information Management School.

Diogo Semedo

Lisbon, 9 of November 2022

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ABSTRACT

The pharmaceutical sector is pivotal in our society. They provide medication and different services that contribute for populations well-being.

Multiple sectors have found their way to the digitalization era, by creating their own digital platform or integrating existing ones, allowing them to survive and reinvent. The pharmaceutical has found some constraints on their way to this new era due to its severe regulations, lack of availability and trustworthiness of current online pharmacies.

During this project, interviews were made to health professionals that confirmed from their point of view, the usefulness of such an application and service. Convenience was the main attribute associated with online pharmacies feature that is inherent of almost all on-demand services. Regardless, concerns on the user-friendliness when using these kinds of services especially when leading with older demographics.

This project aims to design the information system architecture of an on-demand mobile application providing patients with a more efficient and available service that would deliver prescribed medication anywhere, anytime. This project is aimed for the Portuguese pharmaceutical sector, for that same reason, a deep understanding of local environment was conducted but also, current limitations of already established online pharmacies that currently operate outside the Portuguese territory were considered and their current limitations to design a more reliable and efficient application.

KEYWORDS

Medication; Mobile application; Information System architecture; Online pharmacy

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LIST OF ABBREVIATIONS AND ACRONYMS

ANF	Associação Nacional das Farmácias
API	Application programming interface
B2B	Business-to-business
B2C	Business-to-consumer
BPMN	Business Process Model and Notation
C2C	Consumer-to-consumer
DSR	Design Science Research
IS	Information System
LDM	Logical Data Model
PEM	Prescrição Eletrónica de Medicamentos
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
SWOT	Strengths, Weaknesses, Opportunities, and Threats
UML	Unified Modeling Language
USD	User Centered Design

1. INTRODUCTION

1.1. BACKGROUND AND PROBLEM IDENTIFICATION

In today's world we use our smartphones, digital platforms, and technology to perform almost every kind of activity: from working, socializing, paying bills or buying groceries. The COVID-19 crisis demonstrated exactly how powerful platform are, and that they became even clearer winners in terms of adoption and value capture (Kenney & Zysman, 2020). In face of lockdowns, digital platforms became social intermediaries. Those online platforms have been a vital part of the response to the pandemic, and their importance has grown with constant shutdowns and ongoing necessity for social distancing. Specialist defend the global pandemic triggered society to acknowledge the benefits of technology and, for the same reason, a new normal will emerge, with different global patterns of consumer activity and habits (Kenney & Zysman, 2020).

As mentioned before, triggered by the global pandemic, multiple sectors saw room for developing into the online world, not just for their own benefits but also for necessity. Healthcare was not an exception.

The rapid development in information technology and the increasing number of internet users opened new doors to numerous sectors including healthcare (eHealth) and online pharmacy (ePharmacy) fields that are expected to create massive demands soon.

Online pharmacies are internet-based sellers of prescribed and non-prescribed meds. Selling medicine over the internet started in the late 90's in the United States of America (Orizio et al., 2011). From then, it's growth and popularity has been rising with expectations to continue.

In 2018, the global ePharmacy market had a market value of approximately 42 billion dollars and it's expected to increase towards around 108 billion by 2025, corresponding to an annual growth of 14.26% (Sabbir et al., 2020).

This increase procurement for online pharmacies services it's related to multiple advantages that they offer for both parties: patients and pharmacies. The ability of online pharmacies to practice lower prices due to lower transaction costs is one of the advantages (Desai, 2016). For instance, is estimated that 50 million of Americans between the ages of 18 to 64 did not fill a prescription in 2012 due to high costs practiced by local pharmacies (Levitt, 2015).

For that same reason, online pharmacy could be seen as a viable solution for those with less purchasing power allowing general access for medication across all population.

Although there are other reasons, besides costs, why patients go online to buy medication. For other patients with mobility limitations or those who live in rural locations, ordering and receiving their medication can be very helpful. Others may prefer, during to its medical conditions, to order their medication privately online. These are some of the reasons that trigger the increased popularity of online pharmacies (Sabbir et al., 2020).

Although the undoubtable advantages of the online pharmacy sector, there are also some subjects of concern. This sector is heavily affected by laws and regulations, varying from country to country. Specialists defend that is necessary to focus on policies for regulating the phenomenon at an international level, as multiple studies have showed the existence of multiple smuggled online pharmacies that sold contraband drugs (Orizio et al., 2011). These are some issues that need to be addressed to build a transparent, accessible, safe, and reliable healthcare environment to make the most of the multitude of opportunities and advantages offered by medicine 2.0.

During the pandemic, and with such a gap on this sector, patients had to go physically to pharmacies or count on goodwill of relatives and friends to have access to their prescribed medication. The objective would be to dynamize the sector, providing a solution who would benefit patients and pharmacies when exploring the potentialities of the internet.

Allowing pharmacies to enter the e-commerce world could be considered complex because this sector is affected by multiple regulations regarding privacy, commercialization of medication and patient's data (Arruñada, 2004). Such concerns must be considered, but unless aren't well balanced, could limit the adoption of many IT applications that are critical to address health care quality concerns (Arruñada, 2004). Currently, and according to researchers and health specialist, the online pharmacy practice needs proper and clear regulations to respond to the procurement increase of online pharmacies across Europe (Mäkinen et al., 2005).

1.2. STUDY OBJECTIVES

The objective of this research is to create and design the architecture of an on-demand mobile application who would deliver prescribed medication to patients. It's also relevant to understand the whole incited context, by analysing the environment and the actual knowledge base applied to current online pharmacies.

To achieve the research goal, the following intermediate objectives were defined:

1. Study the Portuguese pharmaceutical sector
2. Study the different types of online pharmacies and their challenges
3. Understand Portuguese health professionals' perceptions on online pharmacies
4. Define functional and non-functional requirements
5. Design the application architecture
6. Evaluate and validate the proposed application design

1.3. STUDY RELEVANCE AND IMPORTANCE

The IOT aligned with eHealth, is expected to open the way to increase the development of the person and machine relationship communications for the benefit of society, in general. The expectation is that health industry will suffer a revolution with no precedents (Ray, 2017).

The growth of the IOT, big data is aligned with the increase of use of smartphones and the mass adoption of smart devices could represent a trigger for this evolution.

With the rise and growth of the internet, the e-commerce, digital health, direct-to-consumer offers started to multiply, as well as their demand.

Major pharmacies companies started to invest in online infrastructures to expand their business, leaving behind other small sized pharmacies, due to high entry cost related to technological infrastructures (MacKey & Nayyar, 2016).

As mentioned before, online pharmacies offer multiple advantages from the consumer point of view. The certainty is for an increasing number of people, given population ageing, rise of chronic illness and allied with the growth of familiarity with internet related devices usage, online pharmacies will likely become a more viable and favourable option (Wells L., 2015). Understanding and exploring the online pharmacy business means offering the society a more efficient pharmaceutical system, that would allow medication available to more people due to lower prices but also due to online pharmacies allied with delivery services could reach patients in less accessible areas.

This study has the objective of creating an online pharmacy application adapted to the Portuguese pharmaceutical sector to respond current community pharmacies limitations.

This study would also be conducted, with the objective of understanding the Portuguese pharmaceutical sector and prescription process to create an efficient application that would meet society needs but also addressing law regimentation imposition that could limit service adoption.

1.4. DOCUMENT STRUCTURE

This document is divided in 5 main chapters:

- **Introduction** where the background and problem identification, objectives, and study relevance of this study. A general overview of the study will be addressing the whole environmental research and it's purposes.
- **Methodology** where the chosen methodology will be explained. The Design Science research method was selected to be adapted for this research and a brief explanation will be executed regarding the different steps and integration with Hevner (2007) framework adaptation.
- A **Literature Review** is performed where an overview of the whole Portuguese pharmaceutical sector and online pharmacies. Then a systematic literature review is

conducted to better understand user perception utility of online pharmacies and the regulation needs.

- Then based with the collected information, the artifact will be designed.
- The final chapter encompasses the artifact evaluation.

2. RESEARCH METHODOLOGY

The desired output of this study is to build an innovative artifact, more specifically a design for a mobile application adapted for delivery of prescribed medication in Portugal, something, that as of today, does not exist. To achieve the research proposal goal, a vast and rigorous research on the actual knowledge base and existing ideas will be conducted, steps that must be taken to achieve a successful project following design-based research.

Since the objective of this research is to build a something innovative, creativity will take an important role an inherent characteristic into the design and construction of artifacts that have utility in application environments communal in Design Science research projects (Peppers et al., 2007) .

As so, Design Science Research (DSR) methodology seemed the right choice to achieve desired outcome.

2.1. DESIGN SCIENCE RESEARCH (DSR)

The Design Science Research (DSR) is defined as a research model where researchers try to answer questions to relevant human problems by creating innovating artifacts. The term artifact is used to describe something that is constructed by humans, that is artificial and so, nothing that occurs naturally (Simon, 1996) . The outcome is the improvement of an existing solution or something new that would provide a solution for an existing problem (Hevner et al., 2004).

This research method is utilized under Information System projects and research which require a deep understanding of two complementary but distinct paradigm: the behavioural and design science (March & Smith, 1995). The behavioural science paradigm it's based on natural science research methods that attempt to develop and justify theories that may have an impact on the human adoption of information systems. This information could represent a valuable insight for this research, to understand possible synergies between the adoption of technology and people, in order to achieve the purpose artifact goals (Hevner et al., 2004). The features acquired on the behavioural will constitute an important asset for the design phase that will be leveraged by a problem-solving paradigm, as mentioned before.

2.2. RESEARCH STRATEGY

In the current research, the mobile application information system would constitute our artifact, as a possible solution, to an already existing problem: the access to medication by patients. Although, the ability to sell medication online is already a reality, there still missing a digital platform that would allow patients to receive their medication within a few minutes, and permit pharmacies to integrate the ecommerce easily.

This research will follow a slightly adaptation of the developments made by *Peppers* (2007) in 5 different phases: problem identification; objectives for a solution; design and development; evaluation; communication.

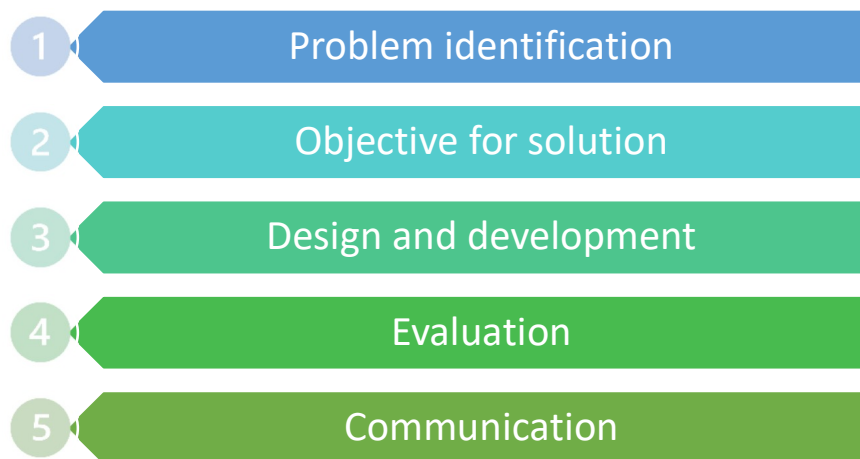


Figure 1 - DSR Method Adapted from (Peppers et al., 2007).

Problem Identification

After identified the gap and the correlated issue, the problem will be further studied more precisely, the Portuguese pharmaceutical sector as an environment, as well as their sector regulations and health professionals' traits. A special attention will be given to ePharmacy sector, more precisely, to current online pharmacies procedures, business models and challenges.

Objective Definition

Once the problem is properly identified, its solutions need to be defined among what is feasible (Hevner et al., 2004). The main requirements will be defined for the development of the artifact.

Design and development

In this stage, the artifact is designed. A clear understanding of the solutions outcomes is needed for better decision making concerning the artifact functions (Peppers et al., 2007).

Evaluation

An analysis will be executed, to see how the artifact supports the solution of the problem, as well as, comparing the objectives to the results observed from given feedback (Hevner et al., 2004). To test the artifact functionality, an objective-based approach will be adopted. This approach seeks to determine if a resource meets its designer objectives (Friedman & Wyatt, 1997).

Communication

A presentation to a technical audience will be performed, to understand the artifact utility and novelty as a solution for the research problem.

A complementary design framework developed by Hevner (2007) will also be adapted to this research.

The DSR methodology stood multiple adaptation that extend the research ideas established at the 2004 MISQ paper (Peppers et al., 2007). From the various examples, the Hevner (2007) will be the one followed in this project.

The *Hevner (2007)* DSR adaption fortifies the significance that can be gained by identifying three design science research cycles instead of following a detailed process to accomplish the desired results in a design science research project: relevance cycle, rigor cycle and design cycle.

The relevance cycle will initiate the design science research with an applicational context that provides the requirement for the research and could provide a conclusive criterion for evaluating the artifact utility (Peppers et al., 2007). In this first step, in concordance with the problem identification phase, an environment analysis will be performed where the whole Portuguese pharmaceutical will be analysed highlighting the main features, regulation applicable, interviews with health professionals (doctor and pharmaceuticals) to understand their importance perception regarding the

research project and collect quality attributes that could influence the success of the proposed artifact. The last step will be the definition of problems and opportunities.

The rigor cycle will constitute the second phase of this research. On this step, allied with the objective definition phase, previous knowledge will be collected to ensure the proposed artifact innovation (Peppers et al., 2007). A detailed analysis of current national and international online pharmacies will be staged intended to understand their difficulties, e-prescribing phenomenon and how it could benefit the online pharmacy adoption and the current perception of patients regarding the use of online pharmacies. The current existing artifacts, theories and opportunities/problems will constitute a key insight for creative design activity (Livari et al., 2007).

The design cycle constitutes the heart of any design science research project and it's last phase.

During this cycle, multiple design alternatives will be tested and therefore, evaluated taking into consideration the requirements defined on the previous research cycles for attaining the adequate artifact design (Simon, 1996). The evaluation must be settled in rigorous methods since it will test the viability of the final solution.

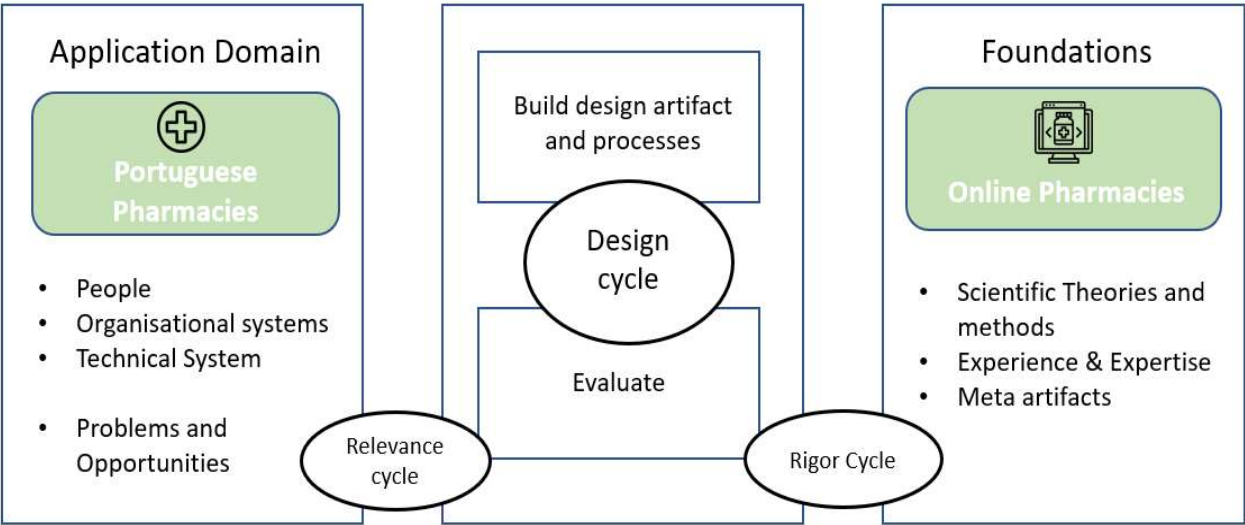


Figure 2 - Information Systems research adaptation from (Hevner et al., 2007).

3. LITERATURE REVIEW

3.1. CONTEXT

Humans have been using and taking advantage of practices and remedies to cure injuries and diseases.

Remedies were developed from natural products and nowadays, due evolution, science developments, access to technology, vast data, and knowledge, are produced and created with access to ultimate technology and techniques.

The history of pharmacy and drugs could be considered as old as the mankind history.

Pharmacy, as an occupation in which individuals, made a living from the sale and supply of the medicines, is amongst the oldest of professions. The practitioners of healing combined the roles of priest, pharmacist, and physician (Burke, 2014).

European pharmacy shops began to appear around the eleventh century, but the professionalization of pharmacy only started in 1841 in Great Britain (Anderson, 2007) .

Community pharmacies started to proliferate and became an important organ of public health and support. They covered the production, prescription, dispensing, counseling and at in times of yore, stomatology that at some point was the most profitable part of the business (Burke, 2014). There was a need of transformation since population demanded for new services and pharmacies desired for new ways of bringing more profits.

The appearance of health insurance had a massive impact on the fortunes of community pharmacists around the nineteenth century (Burke, 2014). Prescriptions started to multiply as insurances covered the costs of visiting the doctor and medicines. Pharmacists' traditional business started to decline, and their activity focused mainly on dispensing prescriptions. Pharmacies became more commercial and started being paid for the products they sell, and not for the advice they gave (Burke, 2014) .

From then, there has been a widespread of uncertainty regarding the future of pharmacy, more specifically, community pharmacies. Pharmacies needed to re-invent itself. These major changes of operationalization occurred across the history of pharmaceutical practice and will continue to, during to different kind of demands and needs from patients and other important stakeholders.

Community Pharmacies is the most common type of pharmacy and a required part of the health workforce and reliable and indispensable to many people (Ekenga et al., 2018). They are considered the most accessible health professionals, as they sell medication and health advice to the public (Parkhurst et al., 2020).

Corona Virus (COVID-19), an infectious disease that took over the world by surprise leverage some infirmities of multiple health services across the world. Due to large number of cases, country leaders started to prevent health services from becoming swamped.

Hospitals became pressured by COVID-19 patients, some others with chronic illnesses and surgeries were left behind. For that reason, community pharmacies and their staff became the only available health care professionals available to respond to their needs. Allied with supply problems, these professionals were faced with multiple pressures: from patients with chronic illnesses that relied on their medication started to flood pharmacies with their prescription's requests, others were stacking up for medication that they haven't needed for years or even for over-the-counter medicines as paracetamol (Parkhurst et al., 2020) .

Community pharmacies were a vital part of the efforts to control and help patients during these unusual times all over the world and highlighted their importance not just for the population but also, for the health sector stability.

3.2. SECTOR CHARACTERISTICS - PORTUGAL

The Portuguese pharmaceutical sector is composed by 4 108 institutions that employ 43 562 professionals with an annual 13 497 million trade volume (BDP, 2021).

The sector is divided in 3 big areas: pharmaceutical industry, responsible for the development and production of medicines, wholesalers responsible for the distribution of medicines to pharmacies and other customers, as hospitals or physician offices and community pharmacies that are responsible for retailing commercialization of pharmaceutical products that as the name indicates, sell medicines to the public. The retail commercialization is responsible for 68% of the total number of sector enterprises but only represent 25% of total sector turnover that is dominated by the wholesalers (61,82%). Regarding the number of employed professionals, the retail commercialization of medicines is responsible for almost 50% of total sector professionals (BDP, 2021).

Pharmacist as an occupation has been evidenced an increased in popularity in Portugal. Between 2012 and 2020, was verified a 21,4% increase of pharmacy professionals' passing from 12 816 to 15 565 reason why, 41% of current active pharmacists are aged below the age of 35 and 68% below 45 years old (Ordem dos farmacêuticos, 2020).

Regarding their geographical distribution, around 49% are based on south and autonomous (Madeira and Azores) regions, 33% in the north and 18% in the center. Concerning the gender, there is an evident supremacy of the feminine gender representing around 80% of professionals (Ordem dos farmacêuticos, 2020).

In Portugal, the number of active community pharmacies has been increasing at a slow pace from 2 503 active pharmacies in 1990 to 2 922 in 2020, a 17% percent increase in 30 years. This moderate development is explained by financial crisis that decelerated investments in almost all activity sectors and triggered by the global pandemic crisis that led to financial pressures that some could not tolerate (Lima, 2021) .

3.3. REGULATION

Health regulation can be considered as challenging when compared to other sectors since is applied in multiple components, from ethical to social and as their output is multidimensional contrary to other areas where the output can be seen as an outcome or consequence.

Each country has its own local institution responsible for regulating their health system. INFARMED is the institution responsible in Portugal.

INFARMED, the acronym for National Authority of Medicines and Health products is the competent authority according to the Portuguese Health Minister for the authorization, inspection, control of production, distribution, commercialization, and utilization of human used medicines.

Through a judicious testing and evaluation of medicines before entering the market, licensing and inspection of establishments responsible for manufacture, distribution and selling of medicines, surveillance of medicines adverse reactions, actualized information provided by consumers and health professionals and also monitorization and quality control medicines through periodic analysis allow INFARMED to verify and authenticate the efficiency and safety of medicines in the Portuguese market protecting public health matters.

In Portugal, the establishment of a community pharmacy must follow some specific criteria defined by the regulated authority to protect the population access to medication allowing them to offer a quality service that responds to population needs. Some of the applied criterions are (Ministério da Saúde, 2016):

- 3 500 habitants of minimum capitation for each pharmacy in a specific county unless it's situated more than 2 kilometers away from other pharmacy.
- A minimum 350 meters between pharmacies, counted in straight line from the outer limits.
- A minimum of 100 meters between the pharmacy and other health units besides in localities with less than 4 000 habitants.

The submission of the request for a community pharmacy could be concluded via INFARMED's website where all regulations and protocols are available for consultation.

After the verification and validation of all different requirements, an action of inspection is conducted intending to guarantee all required conformities for practicing and establish activity.

Regarding the transportation of medicines, some rules are applied to distribution wholesalers the only entities with permissions by the Portuguese regulated authority to transport prescribed medication. Among many other responsibilities according to Deliberation n.o 77-A/CD/2021, from 6 of august 2021 approved by INFARMED, the distribution wholesalers are responsible to assure that the transported goods aren't object of rupture, adulteration, burglary and maintained inside the acceptable temperatures. These agents must possess specific formation, previously, during and continuously about the required competences and experience before initiating their affairs. All formations must be documented and must be periodically evaluated.

3.4. ACTORS

As mentioned before, the pharmaceutical sector is composed by multiple activities, from manufacturing, stocking, and delivering to consumers. Along the supply chain, activities are performed by different actors, making them a very complex environment. All actors across the supply chain contribute to organizational, operational, and value-adding elements until reaching the final consumer (Mendoza, 2021).

The key stakeholders in the drug supply chain are pharmaceutical companies also known as drug manufactures, drug wholesaler/distributers, pharmacies, consumers, governments and regulatory institutions, doctor's and insurers.

Pharmaceutical companies are the responsible for creation, manufacturing, and development of medicines. Normally, they are also responsible for the medication pricing and marketing based on expected demand and marketing costs (Mendoza, 2021).

The drug wholesalers are responsible for distributing drugs from the manufacturers to pharmacies and other customers, as hospitals and physician offices.

Pharmacies, local or online, purchase medication directly to manufactures or indirectly through wholesalers and provide them to the population.

The supply and demand follow a different perspective in health sector when compared to the general economy since health cannot be seen as a good susceptible of consumption but, a desire of well-being. Doctors could be seen as triggers of demand in the view of the fact that they are responsible for the medicine prescription (Daya et al., 2001; Settele et al., 2021) .

Consumers or patients, purchase medication on pharmacies by delivering the prescription issued by their doctor.

Insurers play an important role too. If a patient is covered by an issuer plan, they can receive allowances for purchased medication.

Governments, have different roles varying from country to country. In Portugal, the limit drug prices of different drugs and in some medication, for example insulin for diabetics, they com participate the totality of the cost and the patient is exempt of paying for the medication and creating and applying norms and regulations to control the overall sector.

3.5. IDENTIFICATION OF APPLICATIONS NEEDS AND UTILITY

Preceding the sector identification and its stakeholders', interviews were conducted to collect helpful insights as well as, their perspective about internet pharmacies and key features that could be implemented on the artifact.

Research interviews are defined as a qualitative method that provides researchers a clear understanding of participants perceptions and experiences regarding a specific manner. Structured Interviews could be considered as verbally administered questionnaire where a list of previous established questions is asked to the interviewee (Gill et al., 2008).

As so, the data collection approach was structured interviews where a set of equal questions sorted by the same sequence were made to all 10 professionals (5 Doctors and 5 pharmaceuticals). In this approach, the questions are fixed, and responses depend exclusively on the interviewee.

Before starting the interview, a brief and synthetic project explanation and objectives performed.

The 3 questions asked to each interviewee were:

1. Have you tried any home deliver medication app? If yes, how was your experience?
2. Would you find useful the creation of a medication delivery app who would deliver prescribed medicines at home? Why?
3. What are the main requirements that you would find important to include in the application?

The answers provided by all interviewees were grouped by question and transcribed bellow:

Interview with Dr. Tiago Abreu (Doctor)

Question 1: Have you tried any home deliver medication app? If yes, how was your experience?

Answer: No.

Question 2: Would you find useful the creation of a medication delivery app who would deliver prescribed medicines at home? Why?

Answer: Yes, very useful. We are faced with dozens of aged patients who are dependent of other people due to their physical condition. In my opinion, it would be a good evolution and a necessary one.

Question 3: What are the main requirements that you would find important to include in the application?

Answer: Communication between health professionals and their patients is very important. I believe that it would be important to include a way of communication between these two parties. Also, a helpline could be important to help people not familiarized with technology.

Interview with Dr. Sara Alfarroba (Doctor)

Question 1: Have you tried any home deliver medication app? If yes, how was your experience?

Answer: I tried but I couldn't. The medicine that I wanted wasn't available and I couldn't buy it.

Question 2: Would you find useful the creation of a medication delivery app who would deliver prescribed medicines at home? Why?

Answer: Yes, especially for child's and aged people. Sometimes medicines urgencies happen and could be a need, especially for people in this age ranges.

Question 3: What are the main requirements that you would find important to include in the application?

Answer: The stock where you could see all the different variety of products available.

Interview with Dr. Renato Cabral Monteiro (Doctor)

Question 1: Have you tried any home deliver medication app? If yes, how was your experience?

Answer: Never.

Question 2: Would you find useful the creation of a medication delivery app who would deliver prescribed medicines at home? Why?

Answer: I have my doubts. Could facilitate mainly aged and ill patients or even persons that don't have any physical pharmacy nearby. My doubtfulness is regarding the patient's capacity to use the application. For the rest of the population, without any kind of illness or physical limitation, because I believe that it would make the medicines more expensive

Question 3: What are the main requirements that you would find important to include in the application?

Answer: Intuitive, easy to use, safe and capacity to adopt in other countries outside national territory.

Interview with Dr. Catarina Antunes (Doctor)

Question 1: Have you tried any home deliver medication app? If yes, how was your experience?

Answer: No.

Question 2: Would you find useful the creation of a medication delivery app who would deliver prescribed medicines at home? Why?

Answer: Yes, very useful specially for patients with chronic illnesses. More practical, without queues and without unsolicited publicity.

Question 3: What are the main requirements that you would find important to include in the application?

Answer: To see the medication availability and all the different brands and generics available and their respective price difference

Interview with Dr. Júlio Semedo (Doctor)

Question 1: Have you tried any home deliver medication app? If yes, how was your experience?

Answer: Never.

Question 2: Would you find useful the creation of a medication delivery app who would deliver prescribed medicines at home? Why?

Answer: Yes, it would make patients life easier: no need to go to the pharmacy (time management, convenience, people with mobility problems) and its importance in an emergency and at uncomfortable times where the patients must look for a pharmacy on duty.

Question 3: What are the main requirements that you would find important to include in the application?

Answer: Safe, easy to manipulate and that would indicate the adequate dosage for the order prescription.

Interview with Dr. Sónia Arruda (Pharmacist)

Question 1: Have you tried any home deliver medication app? If yes, how was your experience?

Answer: Yes, a few times. They only arrived once on time. I found the application a little bit confusing, and it could be hard for someone who isn't familiarized.

Question 2: Would you find useful the creation of a medication delivery app who would deliver prescribed medicines at home? Why?

Answer: Yes, especially in this pandemic situation where people could not be able to access their well needed medication.

Question 3: What are the main requirements that you would find important to include in the application?

Answer: Safe regarding payment methods, intuitive and clear regarding the practiced prices.

Interview with Dr. Cátia Ferreira (Pharmacist)

Question 1: Have you tried any home deliver medication app? If yes, how was your experience?

Answer: No.

Question 2: Would you find useful the creation of a medication delivery app who would deliver prescribed medicines at home? Why?

Answer: Yes, very useful because it could allow more accessibility to medicines when diseases don't allow their dislocation.

Question 3: What are the main requirements that you would find important to include in the application?

Answer: Information about the prescription and medicines prescribed (therapeutics actions and dosage), price comparison between different generics and medicines, drug interaction indicator and contradictions where the user could create their profile and share chronic illnesses for more adequate therapies and package follow-up.

Interview with Dr. Filipa Matos (Pharmacist)

Question 1: Have you tried any home deliver medication app? If yes, how was your experience?

Answer: No.

Question 2: Would you find useful the creation of a medication delivery app who would deliver prescribed medicines at home? Why?

Answer: Yes, convenient for someone who cannot leave the house and has no help.

Question 3: What are the main requirements that you would find important to include in the application?

Answer: Data privacy.

Interview with Dr. Berto Cabral (Pharmacist)

Question 1: Have you tried any home deliver medication app? If yes, how was your experience?

Answer: No.

Question 2: Would you find useful the creation of a medication delivery app who would deliver prescribed medicines at home? Why?

Answer: No, I don't find it useful

Interview with Dr. Patricia Noronha (Pharmacist)

Question 1: Have you tried any home deliver medication app? If yes, how was your experience?

Answer: No

Question 2: Would you find useful the creation of a medication delivery app who would deliver prescribed medicines at home? Why?

Answer: Yes, because it would help current community pharmacies to deliver medication at patients' home in a more efficient and quick way

Question 3: What are the main requirements that you would find important to include in the application?

Answer: Easy access and quick delivery

3.5.1. Data analysis

Thought the analysis of the collected data, we can conclude that almost all interviewees, except for one, agreed with the creation and usefulness of the proposed artifact.

From respondents, only one (Dr^a Sónia Arruda) had previously ordered medication online. As mentioned, the medication normally arrived late and the application was hard to use, reason why some individuals who aren't really familiarized with technology, could have some trouble filling their requests.

One of the interviewed (Dr. Berto Cabral) mentioned that he never used such an application and that the proposed service would not return any valuable outcome.

Most of the interviewees highlighted the importance that this service would have for patients with chronic illnesses, mobility problems or lack of support on their day-to-day activities. They believed that with this service, patients in those conditions could receive their well needed meds at their homes facilitating the process and avoiding any excessive efforts but would also be favorable for general population by virtue of being more convenient and less time consuming.

Regarding the third question, there was a broad diversity of suggestions. A wide-ranging majority suggested that the application should be intuitive, user-friendly, and easy to use taking into consideration the large age range target audience that would go from teenagers generally have more knowledge and facility using technology and third aged patients who could have more difficulties when leading to this kind of utilities. This concern was raised by Dr. Renato Cabral Monteiro that had some doubts respecting the capacity of older people to use the application.

Security and data privacy was also subject matter raised. Security is an important topic when we address the usability but also the threats associated with the Internet, a virtually free-entry world where millions of people interact and share information. Information systems security could be seen as a social and technical problem that needs to be addressed from developers but also internet users (Strous et al., 2021).

Pharmacist – Patient communication is crucial. As mentioned before, pharmacists have an important role regarding public health as they are the easier health professional to be reached. For that reason, a communication channel between the pharmacist and the patient is pivotal for medication advice and control.

Stock availability and price comparison between different types of medicines, including generics, that would give the user more faculty to decide the most appropriate solution for their needs. Price has been considered has an important factor when acquiring medication online (Orizio et al., 2011). E-commerce allowed easier price by comparing multiple websites on the web helping the customer to make their decisions based on personal criteria's (Fittler et al., 2018).

Online pharmacies and physical pharmacies are sometimes seen as competitors but could also play a complementary role by offering services that the other, during to its nature, aren't available on to provide.

3.6. CHALLENGES AND OPPORTUNITIES

The analysis of the interview's outcome allied with the literature review allowed to build the following SWOT matrix.

When addressing a change, the environment must be studied and understood.

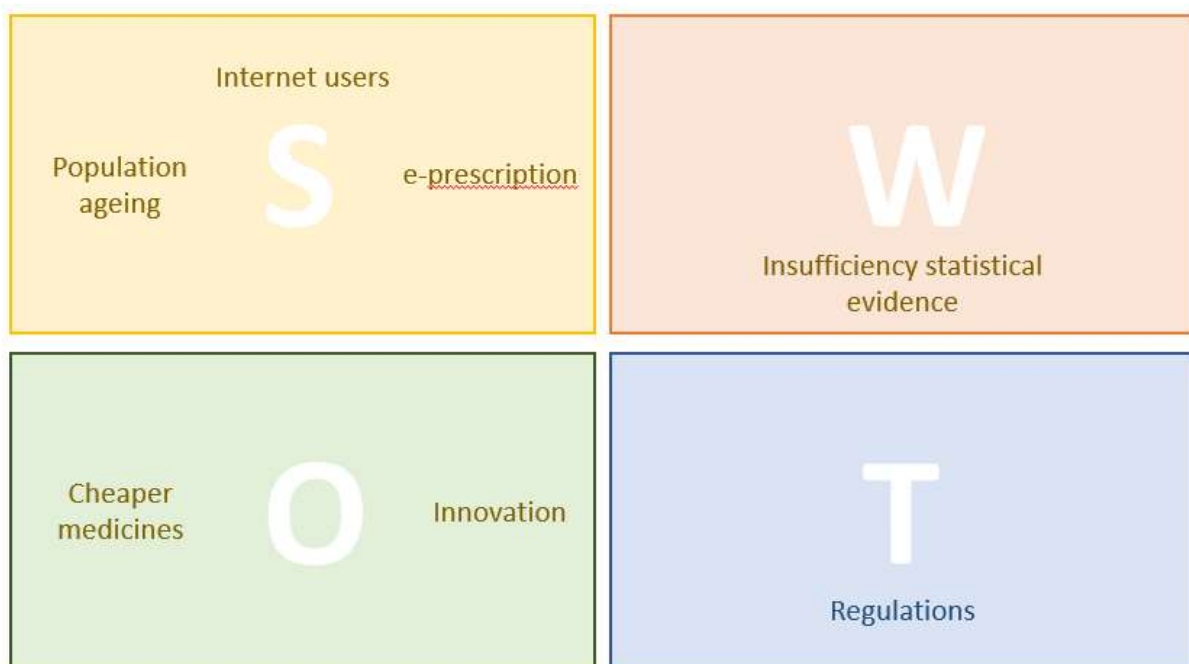


Figure 3 - SWOT Analysis from online pharmacies adoption in Portugal

Adopting innovation can be an opportunity but also a challenge especially in health's sector.

Entrepreneurialism could be a significant lever to stimulate innovation by the definition of new processes, platforms, or products from the identification of a need and exploration of an opportunity (Saltman et al., 2002). At a sectorial perspective, innovation could increase efficiency, resulting in increased profits, better services, and satisfaction. In a social point of view, innovation could amplify the choice of products and services by consumers who can choose according to their necessities and conveniences (Rice et al., 1998).

In health sector, innovation must deliberately follow restricted regulation that constitute a challenge for any proposed transformations that could lead to unfortunate and undesirable outcomes that could result in public hazard or even deaths (Saltman et al., 2002). For that reason, regulations are indispensable in all activity sectors since they protect societies well-being across different activity sectors and any innovation must be supported by them. Cheaper prices can also be considered as an opportunity, since Portugal has one of the lowest purchasing powers in Europe reason why, lower prices practiced by online pharmacies can be an attractive factor (Eurostat, 2021).

E-prescription is the term utilized for the emission of electronic prescription through the utilization of electronic devices to submit information exchange between the patient, doctor responsible for emitting and the pharmacy (Aldughayfiq & Sampalli, 2021).

In 2016, e-prescriptions were launched in Portugal. This innovation only took a boost when in 2019 INFARMED, the responsible institution for the Portuguese health sector, launched a mobile application labeled PEM (*Prescrição Eletrónica Médica*), that facilitated the act of prescribing. This tool dispensed doctor's and patient from being physically present to emit and consequently receive their prescription, making the process more flexible, agile, less bureaucratic, and safer. E-prescriptions allowed a reduction in 80% of prescription falsification. The prescription code as well as, the option that contains alternatives generics for the prescribed medication and waiver code is generated and sent to the patient via SMS. When dispensing, the pharmacist introduces the codes contained on the prescription and the process is finalized. Recently, SNS launched the possibility for referenced chronic patients to ask for their prescription without additional action of their doctor (SPMS, 2016).

PEM allowed a cost reduction, a resources optimization and minimize ambiental impact by replacing previous paper-based prescriptions.

In 2021, approximately 267 million e-prescriptions were emitted constituting 98% of total issued prescriptions (SNS, 2021). This type of technology could determine a favorable environment for online growth (Saraswat et al., 2020).

The Portuguese demographics can also be considered a strength associated with online pharmacy adoption. The Portuguese life expectancy average is situated at 80,6 years old, indicator that remains above the European Union average (Eurostat, 2021). Another important indicator is the ageing index situated at 165,1% which means that for each 100 individuals below the age of 15 corresponds 165 with 65 years or above (PORDATA, 2020). Additionally, access to the internet is a fundamental for online pharmacies practice. In 2020, 82,3% of the population had access to computer and the internet (PORDATA, 2021).

Previously mentioned indicators are favorable for online pharmacy adoption since, internet users are more likely to use online pharmacies and older people are more common to take medicines (Arruñada, 2004).

Regarding the weaknesses, there is a lack of statistical evidence on the effects and perceptions of Portuguese patients and pharmacies regarding online pharmacies.

4. ONLINE PHARMACY

4.1. CONCEPTS

This section presents more relevant concept on online pharmacy.

4.1.1. Electronic Commerce

Electronic commerce or ecommerce could be defined as digital enabled commercial transactions between organizations and individuals. This business practice is supported by technological infrastructure such as, the internet, world wide web and mobile platforms. There are some unique characteristics that influenced the explorational growth, such as:

- **Ubiquity** – available anywhere, anytime.
- **Global reach** – ability to have customers in different parts of the world.
- **Technological universal standards** – set of technological stands.
- **Information richness** – multiple communication channels.
- **Interactivity** – two-way communication channel between buyers and sellers.
- **Personalization** – personalized online content adapted to consumer behaviors.
- **Social technology** – user generated content, as for example reviews.

E-commerce allows disintermediation, which means that business processes and intermediaries are eliminated, as a result final costs are lower for the consumer since there's needless to increase the final price to distribute to different supply chain participants.

There are 3 main electronic commerce types when characterized by the nature of participants:

Business-to-consumer (B2C), Business-to-business (B2B) and Consumer-to-Consumer (C2C).

Business-to-consumer involves the exchange of a service or product between a retailer and the consumer as for example, online pharmacies; Business-to-business (B2B) includes the trade of goods and services between companies; Consumer-to-consumer (C2C) involves direct trade between consumer such as eBay (Sodeman, 2007).

4.1.2. Online pharmacies

During the past years, or decades, the internet became an accepted way to purchase products, services and to perform almost every kind of daily activity. Buying medication online is not an exception.

Online pharmacies are internet-based sellers of prescribed and non-prescribed meds. Selling medicine over the internet started in the late 90s in the United States of America (Orizio et al., 2011). From then, its growth and popularity has been rising with expectations to continue. The rising penetration of the internet across the globe and improving digitalization of healthcare services are important factors that could leverage their adoption and market growth boost on the next following years.

They provide patients an appealing alternative to local pharmacies and offer some benefits that properly balanced with safety, legal and ethical would allow population to have a more accessible and better access to medication (Fung et al., 2004).

These services offer advantages for the patients, such as, convenience, lower prices, privacy, and accessibility (Ndem et al., 2019). Although there are associated risks when buying medication online.

The rapid growth and adoption of online pharmacies contributed for the appearance of illicit pharmacies that presented serious risks for the population and demand for regulations and legislations (MacKey & Nayyar, 2016).

There are 3 types of online pharmacies business models that constitute differences in their way of practising business: Inventory-based model, marketplace-based and generic ecommerce marketplace.

Inventory-based ePharmacy, that involves the ownership of their own warehouses where all medicines are stored in different localities. Through a website or mobile application, the order is received and analysed by a pharmacist. The prescription is validated, and the package is sent through a third-party courier.

A **Marketplace model** consists of technologies that act as facilitators between seller and consumers. The application possesses all licensed pharmacies and available products. Consumers choose according to his necessities and the medication is sent by a courier.

Generic ecommerce marketplaces are electronic platforms that sell a variety of products online including medicines (Amazon) (Parikh., 2021).

In Portugal, there are two main on-demand applications that focus their activities on delivering products, food, and medication: Uber and Glovo. These actors have been attaining significant relevancy on the Portuguese market including on the medication delivery sector. Although, due to regulation, their services are narrowed to non-prescribed medicines due to forbiddance by the Portuguese law to deliver prescribed medication.

4.1.3. Specific Regulations

The exponential growth of online pharmacies triggered to the appearance of illegal online pharmacies that dispensed medication without prescription. This constituted a public health concern and stimulated the appearance of new regulations (Orizio et al., 2009).

Practising online pharmacy constitutes risks to consumers when associated with the inappropriate medicine supplying. Consumers have been consulting health information through the internet something that could be seen as menacing since there's a considerable amount of disinformation online although, the products and services obtained through this environment, constitute the main public threat. Despite multiple efforts, consumers remain uninformed about safety risks of inappropriate use of falsified medication (Gabriel & Swain, 2014).

Regulations have been slow to adapt to epharmacy. While this matter is seen as a priority, responsible entities haven't defined specific frameworks for this business practice (Miller et al., 2021).

Less developed countries have been taking as references, other countries that have been leading with this practise years from now, as the United Kingdom, United States of America, and Germany however, there is still no consensus (Hock et al., 2019). As an example, in South Korea is still illegal to sell medicines online. In Germany, online pharmacies serve the same regulatory frameworks applied to physical pharmacies and in India, despite the interdiction of medication online sales the prohibition is not legislated. There's so, an identified lack of consensus resulted from the lack of consistent national laws on this manner.

Whilst some processes associated with internet purchased medicine have clear applied legislation, such as the delivering process. There's established specialized legislation regarding this activity since, it must be relied in specialized trained professionals. However, some drawbacks were raised since traditional pharmaceutical regulators lack the skills to monitor and evaluate logistics and shipping processes (Miller et al., 2021; Parkhurst et al., 2020).

Although, some actions have been done to try to mitigate these risks.

MEDICRIME convention, was conducted by the European council with the objective of criminalizing counterfeit medicines. Online pharmacies and individuals associated with this practise would be prosecuted regardless of the country (European Council, 2015). Other measures were applied, as accreditation systems. These systems provide seals and website checkers that verify the legitimacy of the website, improving safety assurance for customers, however lack of standardized safety criteria had led to inadvertent accreditation (Hock et al., 2019).

Portugal shares the same problems has other countries. Even though, some regulatory and safety measures are registered at the INFARMED's website and available for public consultation, the interpretation could be considered arduous non laws connoisseurs.

Portuguese online pharmacies are applied by legislative regulation, such as updated records of unprescribed delivered medication, trained delivery couriers and certification website checkers. Albeit Portuguese online pharmacies are not allowed to sell prescribed medication narrowing the advantages of this kind of business practise.

4.2. TOOLS AND APPLICATIONS

Amazon, a big player in business-to-consumer retail, entered the online pharmaceutical market in 2020 when acquiring PillPack Inc., however they practice separately with different kind of epharmacy services (Stich et al., 2021).

To fill an order, Amazon customers can charge their prescriptions through the website, mobile application, or a telephone call. Adding to all these commodities, medication can also be ordered using *Alexa* a virtual assistant device that uses voice Artificial Intelligence permitting patients to order their meds through a simple dialogue. In these digital platforms, patients can also access their medication history where all the medication, orders and prescription details are registered. This permit patient to better control their previous medication dosage. When ordered, amazon's pharmacist review the prescribed medicine and provides information about any possible interaction issues that the patients could face when taking their medication. After confirmed the ordering and respective payment is finalized, the medication arrives within 4 days. Insurances are available to use, and consultation is 24/7 allowing the patient to clarify any doubts about the medication (*Amazon Pharmacy, 2022*).

With *Pillpack*, the medication order can be customized according to the patient. Each month, the medication is packed in easy to open packages according to the prescribed medication and sorted by date and hour. *Pillpack* works directly with doctors to resolve any issues and clarify question that may arise. A contact helpline is available through phone, email or chat and the delivery can take up to 2 weeks (*PillPack*, 2022).

Farmácias Portuguesas is a digital platform where all adherents' pharmacies can sell non-prescribed medication online. All pharmacies from ANF, the Portuguese national association of pharmacies can adhere to this service without any additional cost. The platform has some useful features such as: a 24h hour availability communication channel through phone call that provides patient support and counselling, a prescription storage option where client can store all prescriptions and a pharmacy locator service. As previously mentioned, clients only have the option to have their prescription delivered if it is a non-prescribed product although, this platform allows to reserve a specific product, prescribed or non-prescribed, and collect at a physical pharmacy. The delivery is done between 3 and 8 working days depending on the location (*Farmácias Portuguesas*, 2022).

These ecommerce pharmacy actors provide different personalized services characteristics an advantage inherent to electronic commerce.

However, Amazon pharmacy and online pharmacies such as *Farmácias Portuguesas* digital platform, may have negative impacts on economic, humanistic pharmacy experience and job market. Pharmacists recognize that lower medicine cost could improve adherence although there are some doubts regarding if it would generate better or less health control. There's also some a big uncertainty among professionals about the future of pharmacist as an occupation. Online pharmacies operate differently from common community pharmacies, relying on and requiring more technology use and knowledge but also, with new processes and ways of operationalization. These new ways of practicing pharmacy could also mean a readaptation of professional teaching and formation (Stich et al., 2021).

4.3. SYSTEMATIC LITERATURE REVIEW

The advantages provided by online pharmacies are irrefutable, as well as their threats. Considering previously searched concepts, is now relevant to understand the scientific relevancies that could support topic research importance.

To identify the most actual concerns, characteristics, and perceptions on online pharmacies usage abroad that should be taken in consideration on the artifact architecture a systematic literature review was performed.

This systematic literature review addressed important topics such as regulations and current online pharmacies obstacles and perceptions outside the national territory.

As so, a systematic literature review was conducted, following PRISMA methodology where were defined 2 research questions:

1. What's consumer/patient's perspectives on online pharmacies?
2. How could regulations limit online pharmacy adoption?

Taking into consideration the objectives of this study, the information system architecture of a mobile application to support medication access and delivery, it's important to obtain relevant scientific knowledge that supports the use of this type of technology.

Systematic literature reviews are used to synthesize scientific evidence that support research questions, in a way that is transparent and reproducible while attempting to include published evidence on the research topic. As so, a standard conducting process is defined followed by the definition of inclusion and exclusion criteria's, analysis, and results (Lame, 2019).

The inclusion and exclusion criteria are the definition of a set requirements to find quality studies to be reviewed.

The literature review was made in two different scientific articles databases, more precisely, *ebSCO.discovery* and *PMC – PubMed Central (US National Library of Medicines Digital Archive)*.

Scimago, a journal rank tool, was utilized in support with the intention of understanding papers scientific relevancy. The search was carried in January of 2022.

The selected studies combined general studies about online pharmacies, cross-sectional research about online pharmacies adoption and, multistate legal reviews associated.

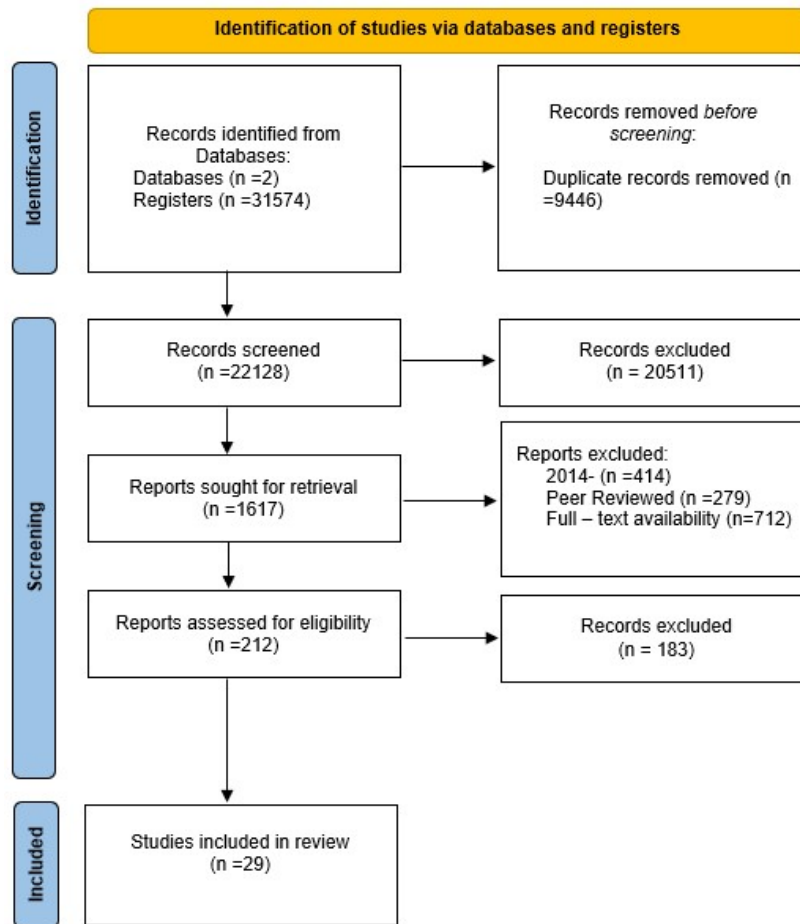


Figure 4 - PRISMA methodology (Adapted from Page MJ (2021))

The defined keywords were: *Online Pharmacy, Regulation, Patient, Pharmaceutical Industry, Pharmacy Apps* and *Electronic Commerce*. Synonym as *ePharmacy, Telepharmacy, laws, policy, e-commerce, user, medication, and pills* were also included with the intention of including other acronyms that would retrieve the desired outputs.

Primarily, the articles selection process was based on the previous mentioned keywords obtaining a total of 31 754 articles. In the identification phase, all duplicated articles were removed excluding a total of 9 446 articles.

On the screening phase, the research string was adapted where the keywords must be prompt to the articles abstract instead of all fields present in the article. The research string was defined combining all different keywords: “AB (online pharmacy AND regulation) or AB (law or policy or legislation) AND AB (pharmacy apps) AND AB (*telepharmacy*) AND AB (*epharmacy*) AND AB (*user or patient*) AND (*electronic commerce*)”

Then, the following filters were applied:

- Publishing date after 2014 (2015 – 2022)
- Full article availability
- Written in English
- Only peer reviewed articles were selected for attaining more trustworthiness

In addition, due to the high number of articles (212), a verification was conducted by analyzing the articles relevancy for the study. Hence, concluded the examination, 29 articles were selected to be included.

4.3.1. Discussion

The sale of medicines over the internet, constitutes an uptrend in the pharmacy market. Pharmaceutical e-commerce can be seen, due to internet expansion and the increment of portable connected devices (Miller et al., 2021).

Adoption has been enlarged across the globe due to the internet, a free-entry-market place that offer advantages for buyers and sellers globally. While initially this upswing was preserver in developed and high-income countries, ecommerce is now attaining significant market shares, with tendency to rise in low-and-middle income countries attaining significant market shares (Saraswat et al., 2020).

However, practicing online pharmacy constitutes risks to consumer specially associated with inappropriate medicine supplying.

For that reason, regulations have gained impotency for consumers protection manners.

Laws regulating online pharmacies vary from country to country and as previously mentioned, have been slow to adapt to continuous market changes. However, due to the market complexity, regulametary and enforcement policies will be faced with difficult challenges.

There is an identified lack of strong national worldwide laws since 66% of the countries doesn't regulate online medicines sales. This constitutes a huge problem. Prescribed meds can be acquired and sold by anyone. For that reason, regulatory entities can only advise and alert consumers about the risks of online pharmacies (Hock et al., 2019). There are also concerns about regulatory jurisdiction boundaries since medication acquiring could be made outside country boarders.

To extend jurisdiction beyond borders, authorities need to agree such measurements. Law enforcements also lack from resources to make sure that the current legislation is applied making it difficult to control the market even if regulatory legislations are demanded (Hock et al., 2019).

These matters can be seen as a challenge but also an opportunity.

The online pharmacy practice is at yearly ages in many countries. This could constitute opportunity to market consolidate the sector, promoting stability and transparency without over-regulating it (Miller et al., 2021).

Although current legislation is insufficient and inadequate, there are some concerns about over-regulating since benefits of current online pharmacies could be neutralized if too restrictive measures are applied.

Brushwood (2001) also alerted for the dangers of regulating towards illegitimate online pharmacies, instead of inappropriate medicine use that could lead to smothering innovation.

There's so an opportunity to outline the ePharmacy future while it's still growing.

Online pharmacies have been accepted by consumers has a convenient alternative for buying medication. Liu et al. (2020) explored consumers satisfaction factors when purchasing medication online in China. The research counted with more than 197 thousand reviews in two different Chinese online pharmacy websites (*JD Pharmacy and J1.com*). The factor analysis was previously divided in 4 categories: logistics, price, drug effects and customer service.

Logistics were the main client's concern. Slow dispatch and transportation were the main customer critics when utilizing the referred epharmacies. Medication couriers must be performed by specially trained professionals, usually a third-party, making it difficult to control time and logistics speed.

Regarding the price, the opinion was very positive since B2C e-commerce pharmacies possesses price advantages when compared with normal community pharmacies due to less circulation links and operational costs. Customers services had the second highest rate of satisfaction and was considered as important for clarification of medicines utilization. The drug effects attained the higher satisfaction factor, and the medicines were considered as being authentic. The overall rate of satisfaction was above 90%, indicating that Chinese online pharmacy customers attained a positive perspective about online pharmacy.

A similar study was conducted in India where despite the interdiction of medication online sales the prohibition is not legislated. Saraswat et al., (2020) studied the online pharmacy adoption and reasons behind it's utilization.

ePharmacy has attained significant importance leverage by Indian local's government initiative on e-health and e-governance.

According to *Ernst and Young* (2019), the Indian online market size has an approximately value of 9.3 billion dollars with an expectation to reach 181 billion by 2023. This tendency highlights the uptrend in popularity of online pharmacies. The research showed that most online pharmacies sales, were made by patients with chronic illnesses that needed their medication regularly, corroborating with other previous mentioned studies, as Islands, (2018).

The author also enunciates privacy of information has a matter of great concern by Indian's, reason why they preferred to acquire their medication online instead of retail pharmacies.

Chronic patients benefited from 20 to 30 percent discounts when ordering online thanks to bigger quantity orders. Although, there were some drawbacks that could decelerate mass-adoption. There was some distrust due to the high number of illegal online pharmacies that sold counterfeit drugs and medicines without any prescription. Even though, there are some concerns on e-pharmacies about the lack of clear regulations that could lead to uncertainty about their practice, and lead to court problems.

There's so a positive perspective about online pharmacies while the lack of regulation could lead to more constrained growth since there is no law protection of customers sellers, leading to unpredictability.

A cross-sectional study was also conducted in Hungary, to understand Hungarians attitudes towards medication online purchasing. Fittler et al., (2018), realized a survey with a sample of 1 055 that were asked about their age, gender, level of education, frequency of internet use and frequency of online pharmacy. Concluded that the internet usage and online purchase behavior would predict attitude towards online pharmacy adoption and that although only a few Hungarian purchase currently medication online, they pretended to do in the future.

There is so a clear trend towards online pharmacies, and Portugal's demographic characteristics such as, internet users and population ageing as possible factors for future online pharmacy adoption.

5. PROJECT DEVELOPMENT

5.1. DEVELOPMENT METHODOLOGY (HEALTH INFORMATION SYSTEMS CONTEXT)

eHealth provides improvement by the adoption of information and communication technologies to improve health and the overall healthcare system (Alvarez, 2002).

The healthcare system, currently one of the largest and biggest industries in the world and with ambitious growth tendencies, suffers inefficiencies and inequities in service provision and quality.

eHealth goes beyond healthcare informatics and incorporates advanced information technologies to medicine and healthcare in general. Among the most significant applications of the technologies to health care are:

- **Citizen oriented information** – patients share their experiences / information about health subjects.
- **Health e-commerce** – involves providing value-added electronic services to professionals and patients while economically exploiting the provided services. In this regard, e-health is supported by the internet and other technologies and integrates topics such as medical informatics, business, and public health.
- **Virtual healthcare teams** – composed by a group of healthcare professionals that share information electronically about patients to improve their knowledge and decision making.
- **Evidence based medicine** – composed by a system that updates information about the most appropriate treatments for each patient.
- **Electronic medical records** - allows healthcare professionals to share medical information about patients.
- **Specialist oriented information** where a system distributes information to professionals about medical journal articles, practices, and protocols in their area of action and specialty.

As information technology evolves healthcare delivery, a broad range of personal health information management tools have been obtained by patients. The variety and quality of information delivered by these tools will define how successful and useful consumers perceptions of it.

To create quality information systems, designers must take into consideration, the needs of users by engaging them in the design processes.

User-centered design also known by UCD, is a design formal approach to ensure that new products respond to users' needs and preferences by including them on the whole design process. UCD pays special attention to the intended users, what they want from the product, where they will use it, why it would be useful and what features should be included. These interactive contacts approaches ensures that users' needs are met and increases the probability of user's acceptance of the final product.

The appropriate identification of user's needs is pivotal at an early stage.

There are several methods that could be used in combination. Interviews are one of the methods utilized under the UCD methodology. They could be unstructured interviews where's no predetermined questions, semi-structured where the investigator defines in advance the topics that will be addressed but is flexible regarding the order of the specified list of questions, formal interviews where the investigator and the interviewee are sensible to the fact that all the answers are being recorded, informal interviews where spontaneous discussion is conducted between both parties and structured interviews, which is the approach that will be adopted in this research, where a set of questions are presented to each participant using the same words and in the same order (Hannah & Ball, 2006).

A structured interview method was conducted previously in this research where a set of 2 general questions were asked in which the interviewed had total freedom to tell their perspective and opinions regarding the adoption of the intended artifact.

5.2. ANALYSIS AND DEFINITION OF FUNCTIONAL REQUIREMENTS

The definition and analysis of functional requirements is pivotal for information systems development and design. The set requirements could be seen as the expected goal that the proposed artifact want to achieve or resolve. This could be considered as a key step for the overall success of an information system. Clear and well-defined requirements will provide a more explicit path for the development of a more cohesive and clear information system and achieve the expected goals.

The definitions of functional requirements (FR) embed advantages such as guidance weather the applications all the functionalities that were mentioned in the functional requirements of that application and defining the functionality of a system or one of its subsystems, assist expected system behavior and service and avoid more costly expenses on errors fix since errors caught in functional requirement gathering stage are cheapest.

The assessment and analysis began with the identification of existing problems, identification of principles surrounding the system and seek solutions. A set of base requirements were identified thought the interviews conducted with pharmacists and doctors.

5.2.1. Functional requirements

Understanding current physical pharmacies limitations and patients' needs constituted an important step on the definition of functional requirements, allied with the feedback acquired from this area of field professionals, more concretely, pharmacists and doctors who also deal with patients and have a direct contact daily, other requirements are inherent in every on-demand delivery application and that are considered essential for quality service and customer satisfaction.

The defined functional requirements were:

1. A new user/client will result in an account creation process.
2. After the registration of a prescription will result in a package order process.
3. The patient will have a direct channel communication with the pharmacist to clarify possible questions about the medication use and counseling.
4. A package order process will trigger the creation of a package order preparation process.
5. After concluded the package order preparation process, a delivery process will be created involving the pharmacist and the delivery driver.
6. The patient should be able to follow all delivery process status.

Table 1 - Information System functional requirements

Code	Name	Description
FR1	Account login	Patients must create an account on the application to login and use the app.
FR2	Edit account data	Application user can add/modify information regarding their wealth condition and medication.
FR3	View order / previous orders	Users' necessity of consulting previous orders.
FR4	Manage and edit system databases	System administrator must be able to control and edit data when necessary.
FR5	Create an order	User's must be able to fill their electronic prescriptions.
FR6	Verify prescription validity	The system must be able to confirm prescription validity.
FR7	Confirm products to order	Client must be able to choose which products wants to order and respective quantity.
FR8	Stock availability	Necessity to see and compare different medicines availability and prices.
FR9	Suggest product alternatives	In case of product unavailability, the system should be able to propose alternatives such as generics.
FR10	Modify order status	System, pharmacists and drivers must be able to change order status.
FR11	Create ticket	When the order is confirmed, a ticket must be created for consultation.

FR12	Consult ticket	Pharmacists and drivers must be able to consult the tickets for order preparation and delivery, respectively.
FR13	Communicate with pharmacist	Necessity of a communication channel between clients and pharmacists. A chat, calls and video calls will be available.
FR14	Alter delivery address	Clients must be able to choose/alter the address where they want to receive their medication.
FR15	Choose payment method	Necessity to choose the payment method.
FR16	Verify payments	After introducing payment details, the system must validate the payment.
FR17	Request ride	When the order is being prepared, the system must request a ride for the order in process.
FR18	Confirm ride	Drivers must be able to confirm the delivery service.
FR19	Communicate with delivery driver	Necessity of a communication channel between client and driver.
FR20	Rate service	Clients and drivers must be able to display ratings.
FR21	Receive notifications	Clients, pharmacists, and driver should receive notifications from the system.

5.3. DIAGRAMS

5.3.1. Use case diagrams

The use case diagram is a tool utilized to describe system functional features including the descriptions and it's actors. The use case-driven analysis, is composed by 3 steps described on the figure below:

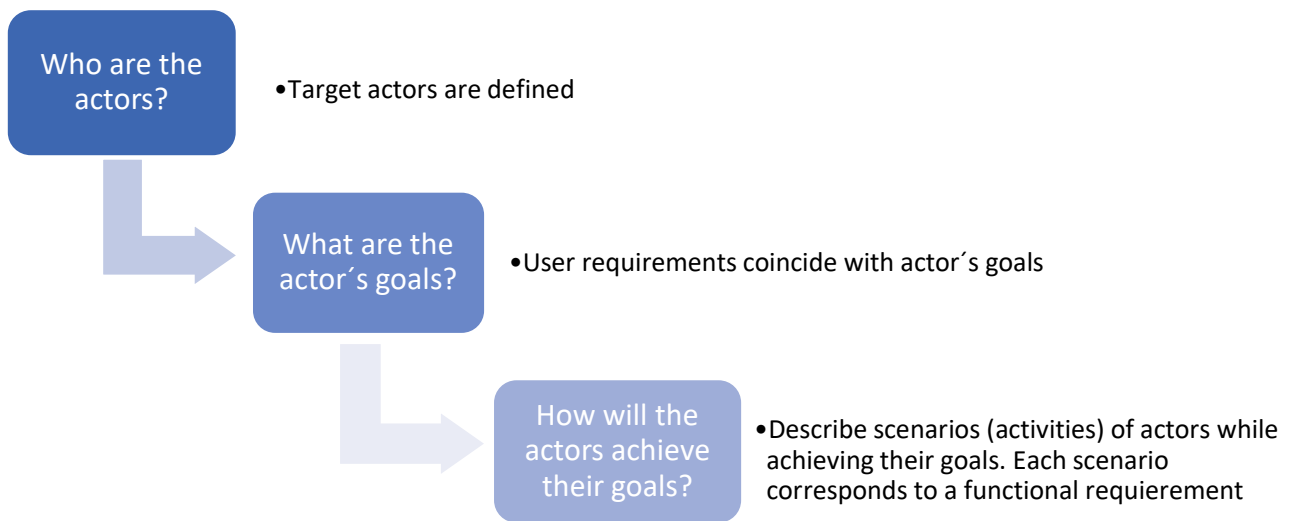


Figure 5 - Use case driven analysis adapted from (Moreira & Araújo, 2003)

Following the steps mentioned on the previous on figure 5, a set of interrelated actors were defined as well as, the functionalities that should integrate the system and furthermore, developed. The following Table 2 describes the different actors that prevail on the proposed system.

Table 2 - System Actors description.

Actor	Description
<p style="text-align: center;">Client</p>	<p>Clients must be able to create an account and login into the application. They must be able to add and modify data, place new orders, communicate with pharmacist and driver and follow delivery by receiving notification across different order stages.</p>
<p style="text-align: center;">Pharmacy</p>	<p>Pharmacies could be considered as the system main actors. They are responsible for preparing orders, communicate with users regarding medication utilization and questions clarification and should also be able to change order status. They will receive notifications from the system when a new order is displayed.</p>
<p style="text-align: center;">Administrator</p>	<p>The administrator is responsible for managing the system, as well as edit and manage databases associated.</p>
<p style="text-align: center;">Driver</p>	<p>The delivery driver receives notifications from new delivery request orders and are also able to change order status whenever the package is delivered to the final consumer (client). They also communicate with the client.</p>

The use case diagrams permit to have a general view of the system and describes in summary, the required functionalities, and activities, associated with the general activity diagram represented on figure 6.

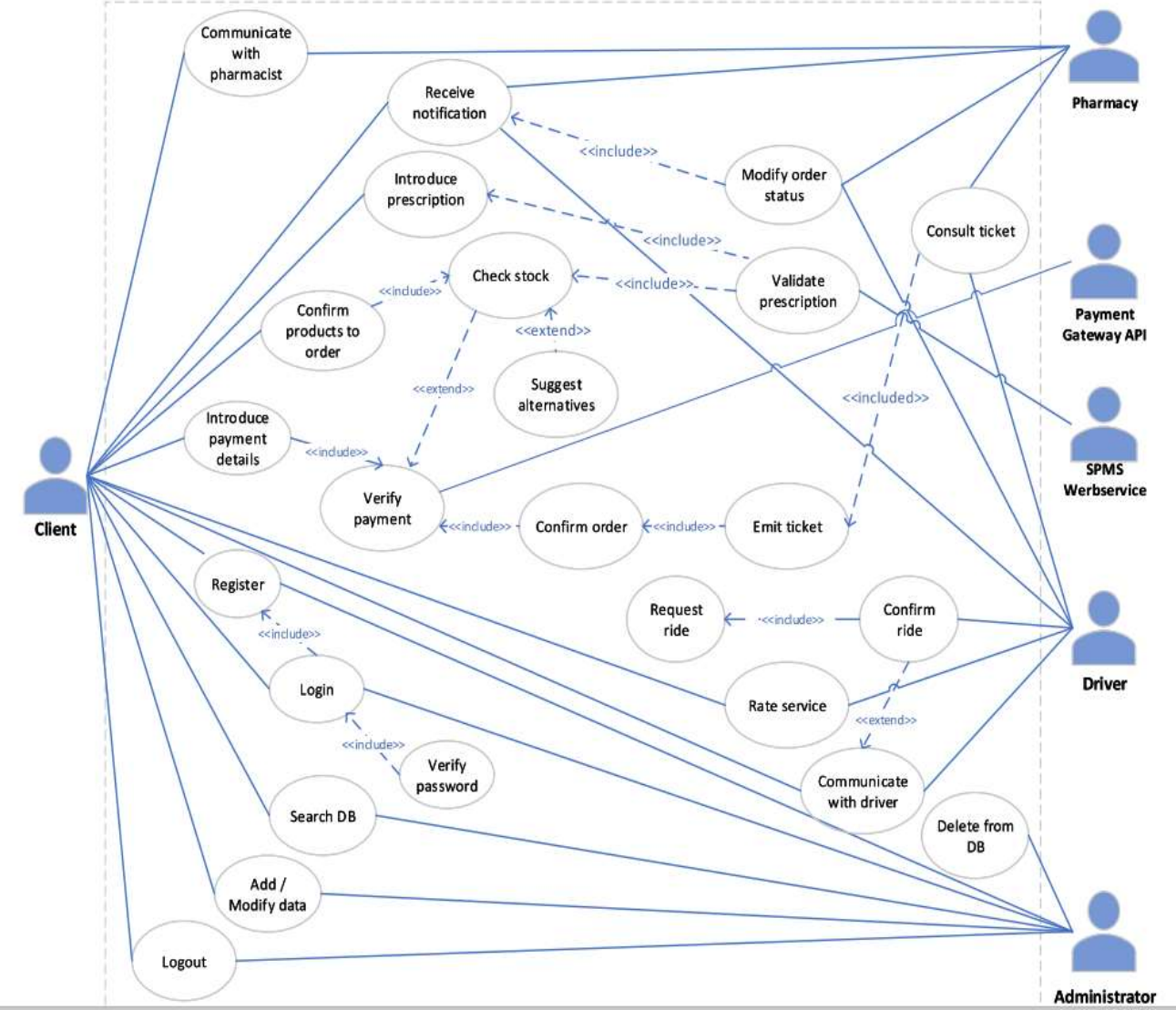


Figure 6 – Information System- Use Case diagram.

The use cases diagrams (USD) were grouped in five main processes to explain in detail each process:

- **Account creation process** – This process initiates and triggers another process since each client needs a user account to fill their prescriptions and furthermore, request the delivery. Account management processes are also included.
- **Package order process** – This process consists of the steps needed to fill a client order. This process starts with the introduction of prescription details and follows a group of processes until the request for delivery is created.
- **Package preparation order process** – This process describes how the system will function when receiving and preparing an order until the request for delivery is send to the delivery driver.
- **Communication process** – This process consists of the communication process between the client and the pharmacist. Clients could contact pharmacist for different reasons and manners, thought chat, call or video call to clarify their questions.
- **Package delivery process** – This process consists of the delivery of delivering orders that were processed on the three previous steps. This process starts with a request of a ride and ends with the delivery of the package to the final consumer, namely, the user. In the final stage of this process, the user could leave a rating to regarding the service offered by the delivery driver and rate the service.

The system UCD's are then presented and detailed, allowing the description of the different functionalities that will be required in the system.

5.3.1.1. Account login process

Table 3 - Use case and flow of events - Account login

Use case diagram – Account login process		
Description	User can create, login, logout, search database and add and modify data regarding their user accounts. The administrator can also perform all the previous actions plus delete users and information from the database.	
Actors	(System) Administrator and Client.	
Event flows		
Code	Actor actions	System actions
FR1	Create an account and then proceed to login.	Add user data into database. Validate user credentials.
FR2	Client and administrator could edit data.	Database must be open and in constant update.
FR3	View previous orders (order history).	Quest for previous client orders.
FR4	View and manage databases.	Add and edit database data.
FR14	Alter delivery address.	Add delivery address to client profile.

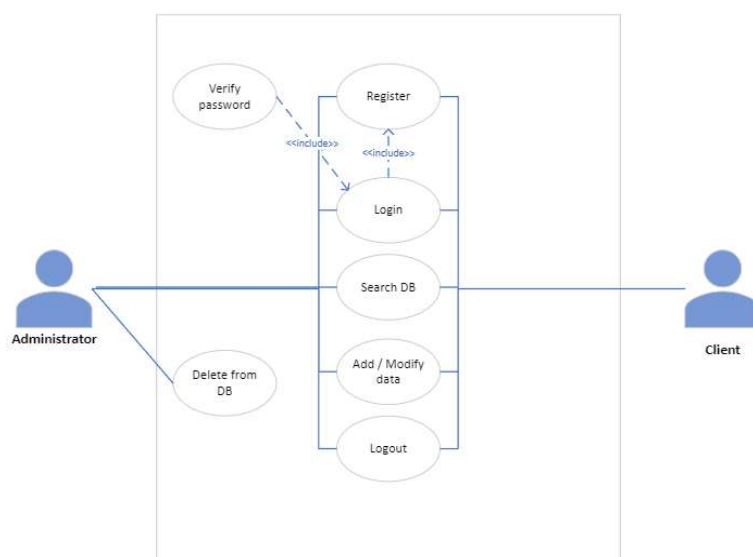


Figure 7 - Use Case diagram – Account Login process.

5.3.1.2. Package order process

Table 4 - Use case and flow of events - Package order

Use case diagram – Package order process		
Description	User can request orders.	
Actors	Client, pharmacist, SPMS API and Payment gateway API.	
Event flows		
Code	Actor actions	System actions
FR5	Create an order	Show form to introduce electronic prescription.
FR6	Introduce prescription details	Communicate with SPMS services to validate prescription.
FR7	Choose products and quantity to order	Display prescription information and allow client to choose quantity to order.
FR8	-	Verify establishments stocks on the products to order.
FR9	Accepted or reject suggested alternatives	Verify product that were pretend and display alternatives (generics if available).
FR10	-	Change order status for “In preparation”.
FR11	-	Create ticket for further consultation of pharmacist and driver.
FR15	Choose payment method and introduce details	Display form to introduce payment details.
FR16	-	Verify payment validity.

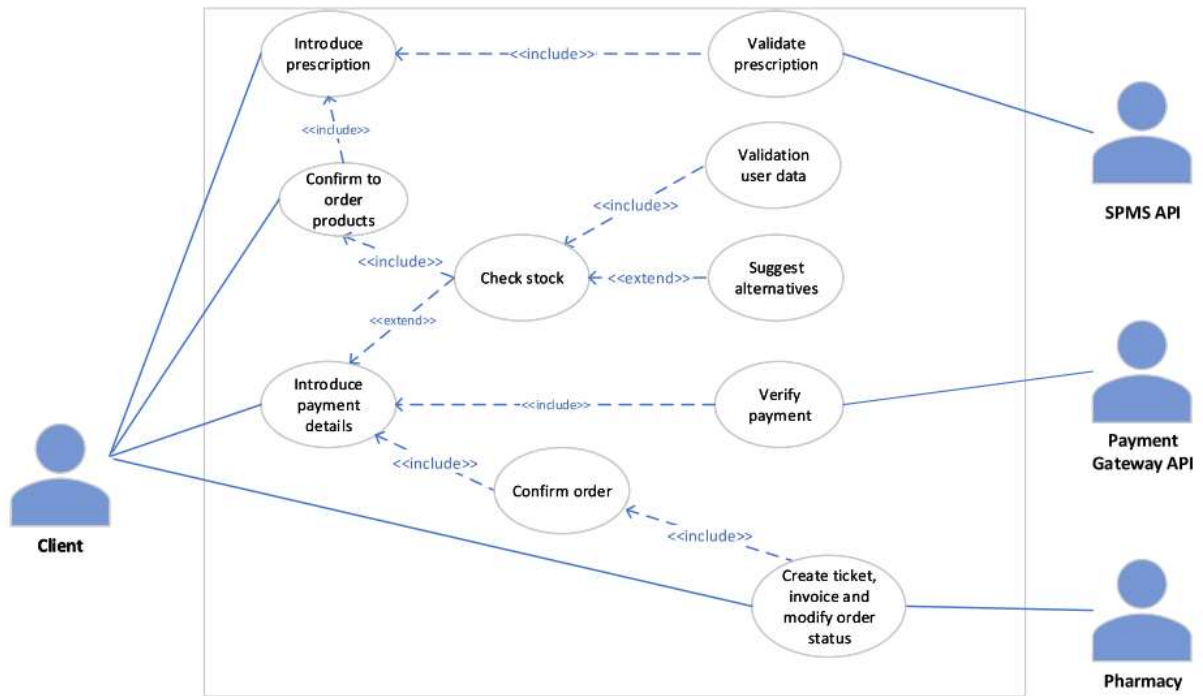


Figure 8 - Use Case diagram - Package order process.

5.3.1.3. Package preparation process

Table 5 - Use case and flow of events - Package preparation

Use case diagram – Package preparation process		
Description	After the order process is concluded the package starts to be prepared for delivery.	
Actors	Client, pharmacy, and driver.	
Event flows		
Code	Actor actions	System actions
FR12	Consult ticket	System must provide ticket for pharmacy (pharmacist) consultation.

FR17	-	When an order is confirmed, there's an automatic request for delivery.
FR18	Confirm ride	The driver must receive a notification and needs to accept/reject the delivery. The system should associate the driver to the order.
FR10	Modify order status	Modify order status on database.
FR21	-	Send notifications to clients, pharmacy, and drivers across different stages.

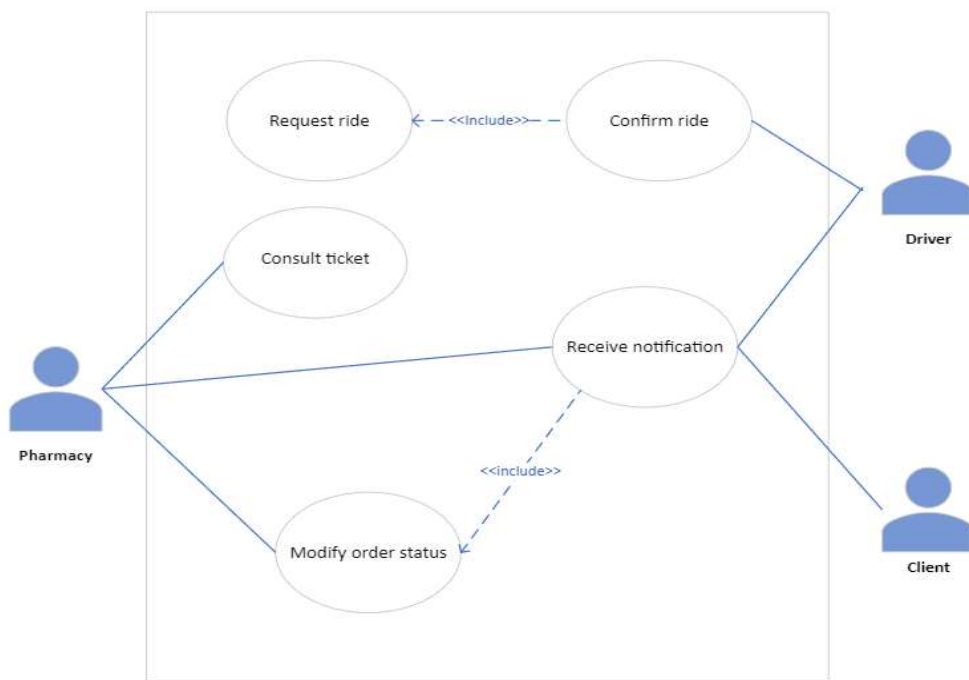


Figure 9 - Use Case diagram - Package preparation process.

5.3.1.4. Communication process

Table 6 - Use case and flow of events – Communication.

Use case diagram – Package preparation process		
Description	Clients have the possibility to contact pharmacist across the whole process.	
Actors	Client and pharmacy.	
Event flows		
Code	Actor actions	System actions
FR13	Open chat and select communication method.	Send notification.

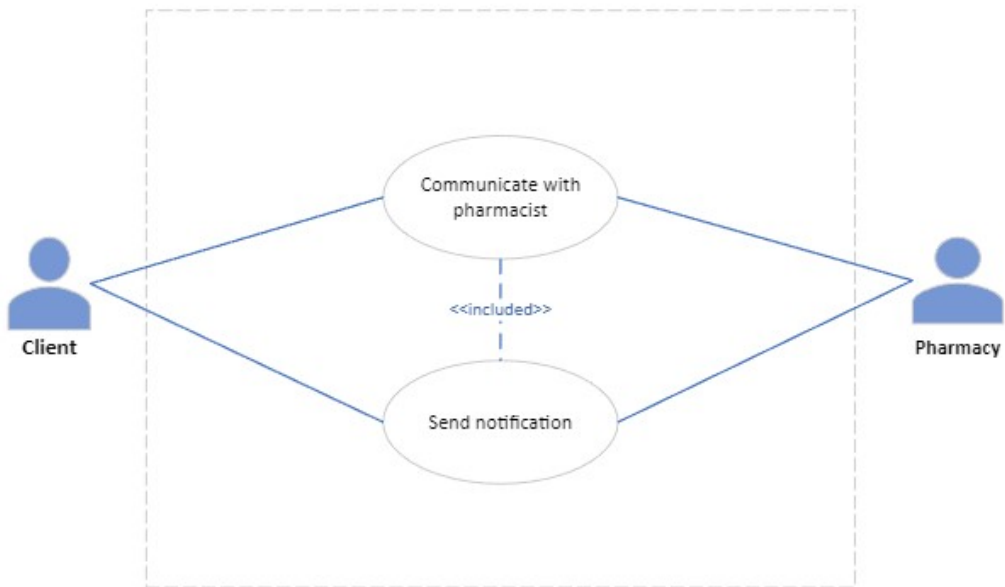


Figure 10 - Use Case diagram - Communication process.

5.3.1.5. Package delivery process

Table 7 - Use case and flow of events - Package delivery

Use case diagram – Package delivery process		
Description	Driver must deliver the ordered package to the client.	
Actors	Client and driver.	
Event flows		
Code	Actor actions	System actions
FR12	Consult ticket	Emit and provide a ticket to be consulted by the driver with information regarding client’s name, address, phone number and validation code.
FR10	Modify order status	Driver must be able to change order status when the order is collected from the pharmacy and posteriorly delivered. Those changes should be recorded into the systems DB.
FR19	Open chat	Provide a communication channel between client and the driver.
FR20	Rate service	Lay out rating scoring.
FR21	Receive notifications	Client must receive a notification when the order status is changed for “delivered”. A validation code would be sent.



Figure 11 - Use Case diagram - Package delivery process.

5.3.2. Business Process Model and Notation Diagram (BPMN 2.0)

BPMN primary goal is to provide a notation readily understood by all business users through illustration of an overview on how work is performed in an organization to ensure consistent outcomes and take advantage of improvement opportunities such as cost, execution times and errors reduction allied with competitive advantage gained through innovation (Geambaşu, 2012).

To that end, and due to a broad specimen of actor's backgrounds involved in this research, BPMN was the notation chosen in contrast to UML activity diagrams. On figure 12, the developed BPMN diagram is represented serving as auxiliary to the use case diagrams illustrated previously.

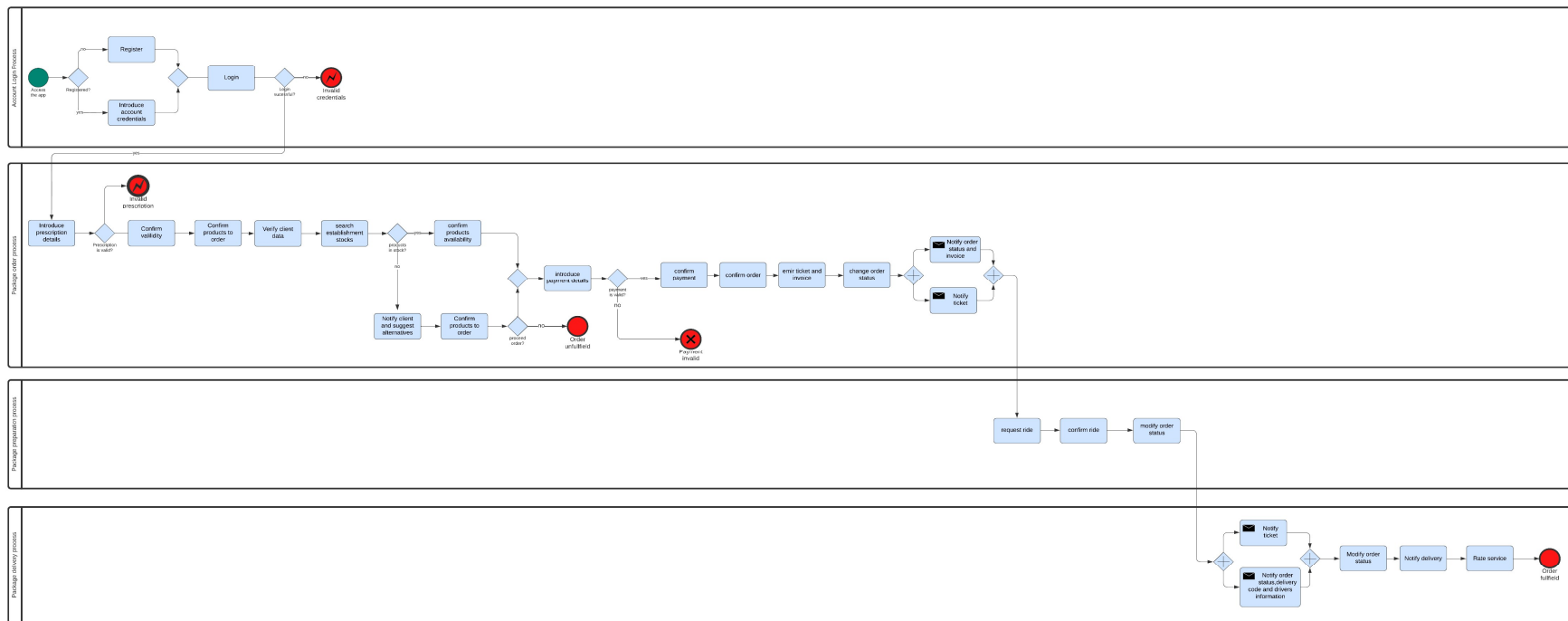


Figure 12 – BPMN Diagram.

5.3.2.1. BPMN diagram – Account login process

On figure 13 is represented the first steps when the user accesses the system.

Only registered users can full field orders so, for that same reason, the system provides to alternatives represented by a gateway:

1. The user is already registered and only needs to introduce account credentials (username and password) and then the system validates the credentials.
2. On the other hand, the user could be accessing the application for the first time and so, a registering process will be performed.

Then a validation is conducted to validate the credentials introduced (username and password).

The login could be successful, or the credentials could be considered invalid, and an error message is triggered.

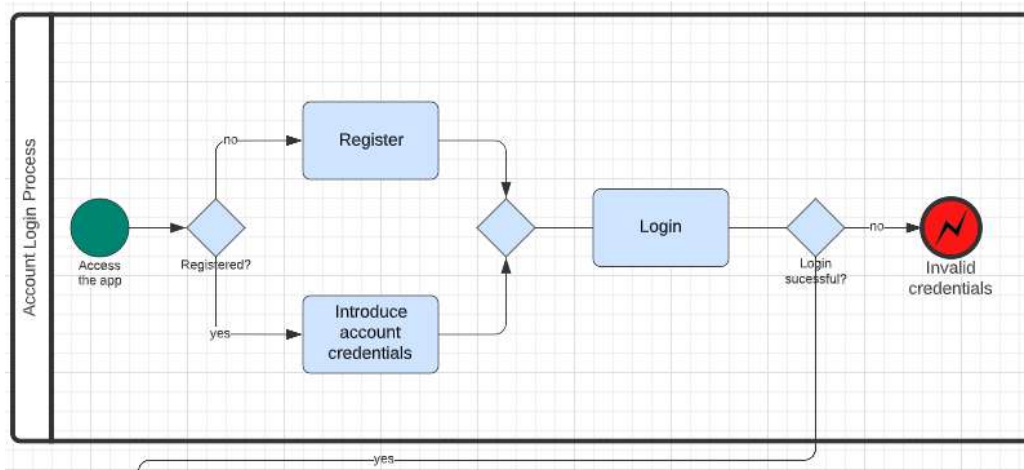


Figure 13 – BPMN Diagram – Account Login process.

5.3.2.2. BPMN diagram – Package order process

On figure 14 are represented the steps following the login into the system.

When logged in into the system, user must fill prescription details composed by the electronic prescription number, waiver code and option code. When introduced the information, the prescription would be validated through the integration of *the Serviços Partilhados do Ministério da Saúde* (SPMS) API that is responsible and is a shared service that is provided for all establishments that are part of the ANF (Associação Nacional de Farmácias). There could be two outcomes:

1. The prescription is valid, and the client can proceed the process or;
2. The prescription is considered invalid and will lead to the cancelation of the whole process (the client can't proceed).

If the prescription is valid, the client must see and select which products he wants to order. When selected, the system will check the products availability (stock) on the adherent pharmacies. If the product is not available, the client will be notified and suggested with new alternatives such as generics (based on prescriptions option code), if in stock. The client could accept to continue and accept the alternatives or cancel the order.

If the client proceeds, the products to order are confirmed and moves to make the payment. There could be two follow-ups:

1. The payment is accepted, and the order is confirmed.
2. The payment is rejected and could lead to order cancelation.

The payment would be validated through the integration of a Payment gateway API on the system. The payment gateway can be described as an interface that enables processing and transmission of payment data between an online business, client, and the bank. Then, the tickets are emitted for the pharmacy in conjunction with the invoice. The order status is modified, and notifications are sent to the client and the pharmacy.

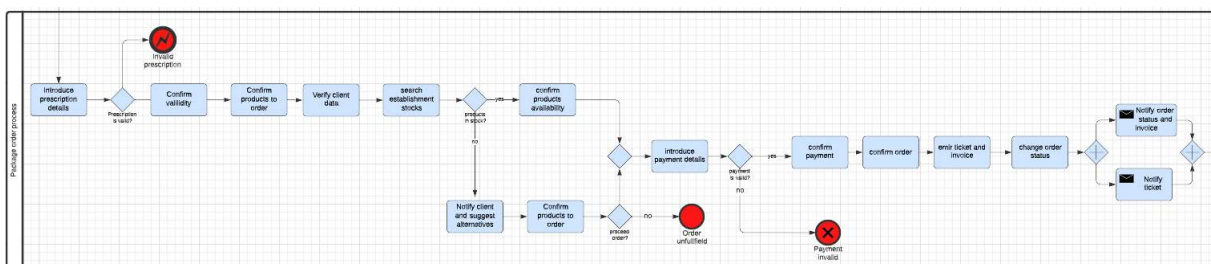


Figure 14 - BPMN Diagram - Package order process.

5.3.2.3. BPMN diagram – Package preparation process

When the ticket is sent to the pharmacy, the order preparation begins.

Meanwhile, a ride request is sent to the drivers and when is accepted, the ride is confirmed.

After concluded the order preparation the package is ready for delivery.

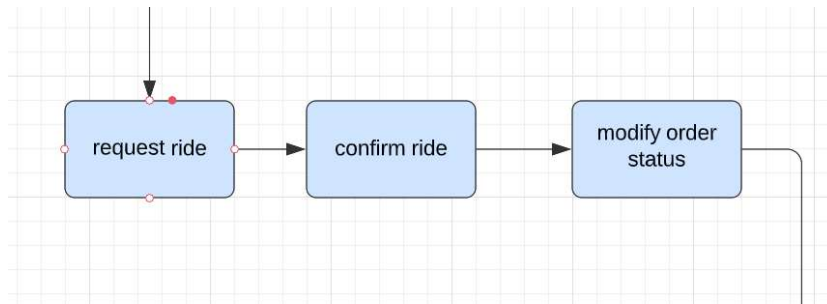


Figure 15 - BPMN Diagram - Package preparation process.

5.3.2.4. BPMN diagram – Package delivery process

The package is then delivered to the driver. The driver will then receive a ticket with the delivery information such as, address, client name, delivery code and phone number. A notification will be sent simultaneously to the client with information regarding the order status, the same delivery code, and the driver. The delivery code is a code that is generated by the system to guarantee that the order is delivered at desired client. When delivered, the driver will have the role to change the order status and the client will receive a notification. Subsequently, the driver and the client could leave rating regarding the service provided.

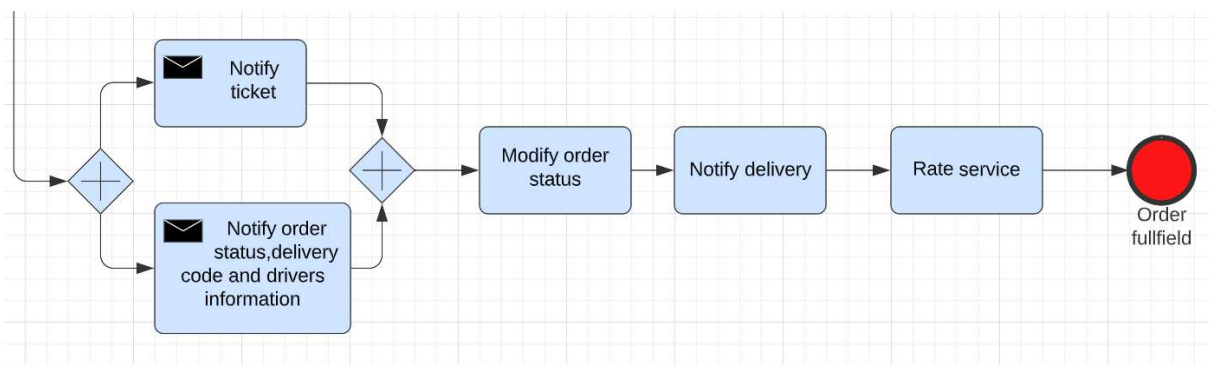


Figure 16 - BPMN Diagram - Package delivery process.

5.3.3. Sequence diagram

The Unified Modeling Language, also known as UML, is a modeling toolset that guides the creation and notation of many diagrams.

The sequence diagrams represented in figure 17,18,19,20 and 21 shows the interaction between the different system object in a sequential order that those interactions occur.

5.3.3.1. Sequence diagram – Account login process

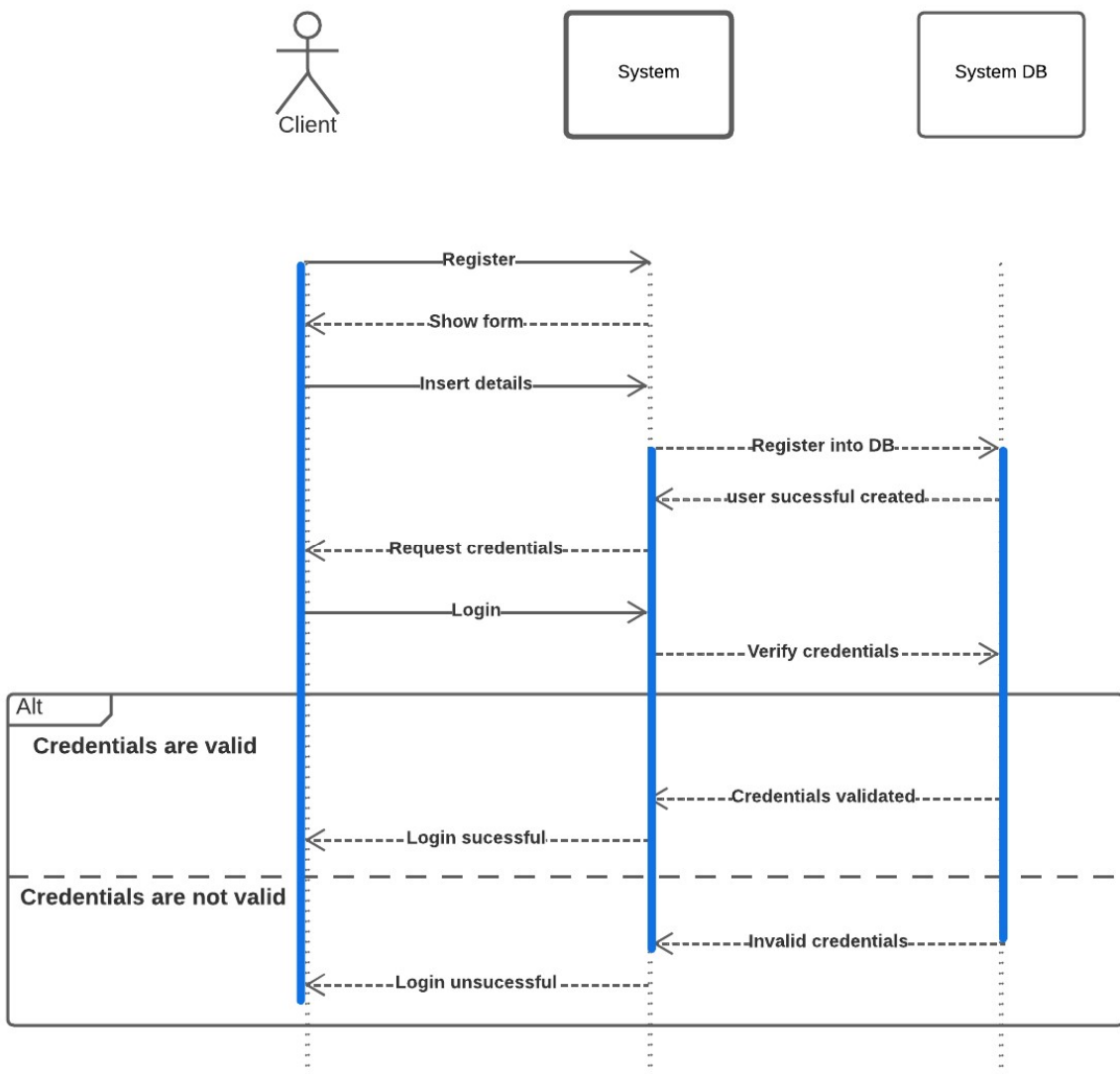


Figure 17 - IS Sequence diagram – Account Login process.

5.3.3.2. Sequence diagram – Package order process

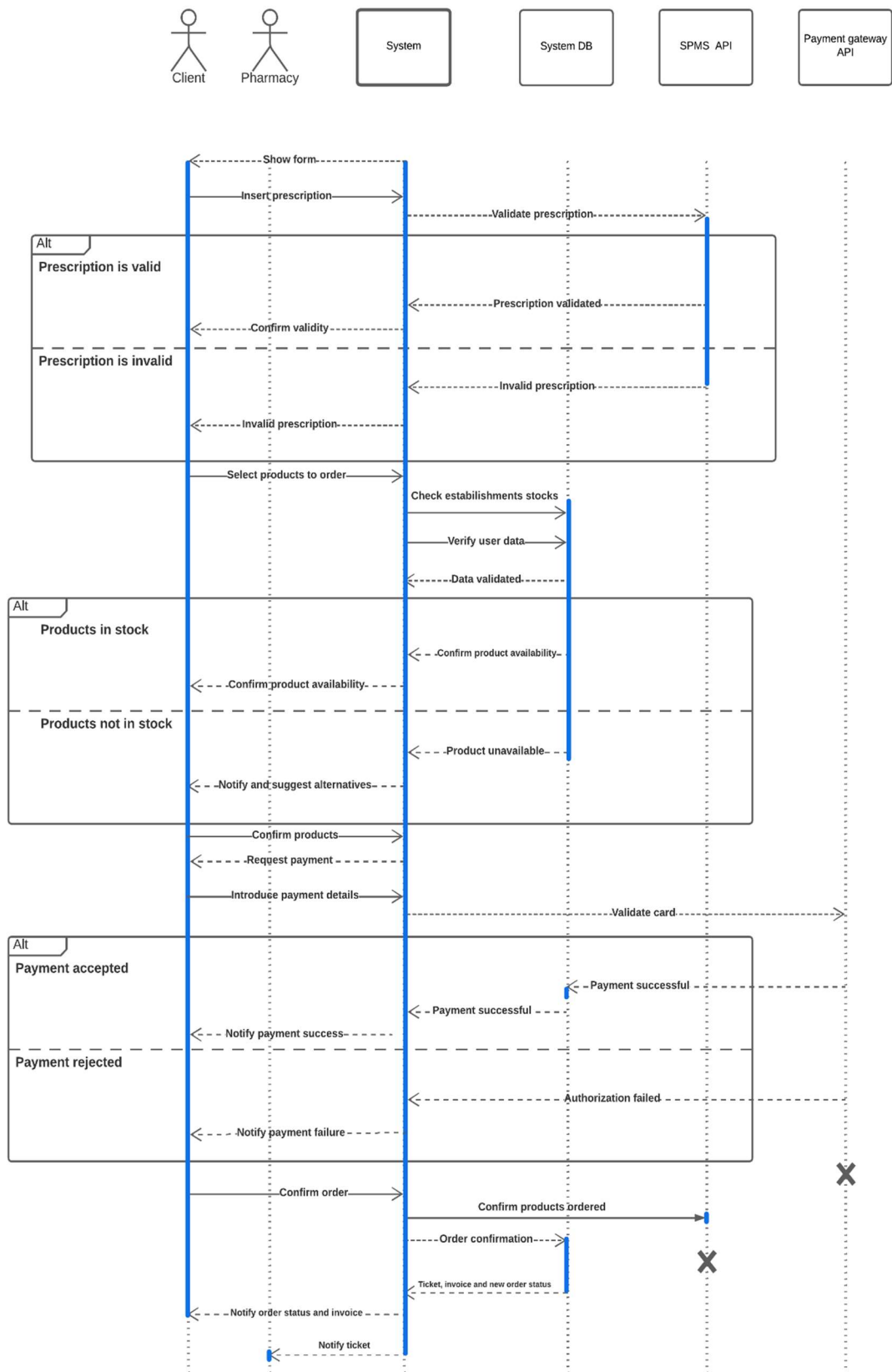


Figure 18 - IS sequence diagram - Package order process.

5.3.3.3. Sequence diagram – Package preparation process

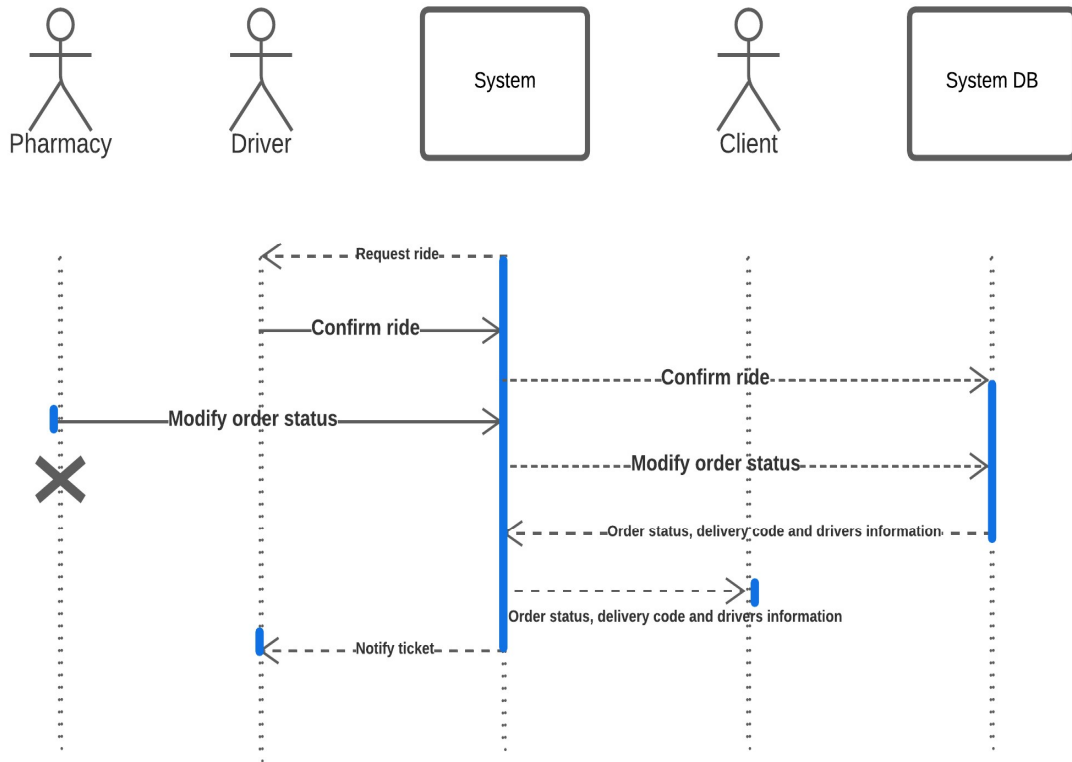


Figure 19 - IS Sequence Diagram - Package preparation process.

5.3.3.4. Sequence diagram – Communication process

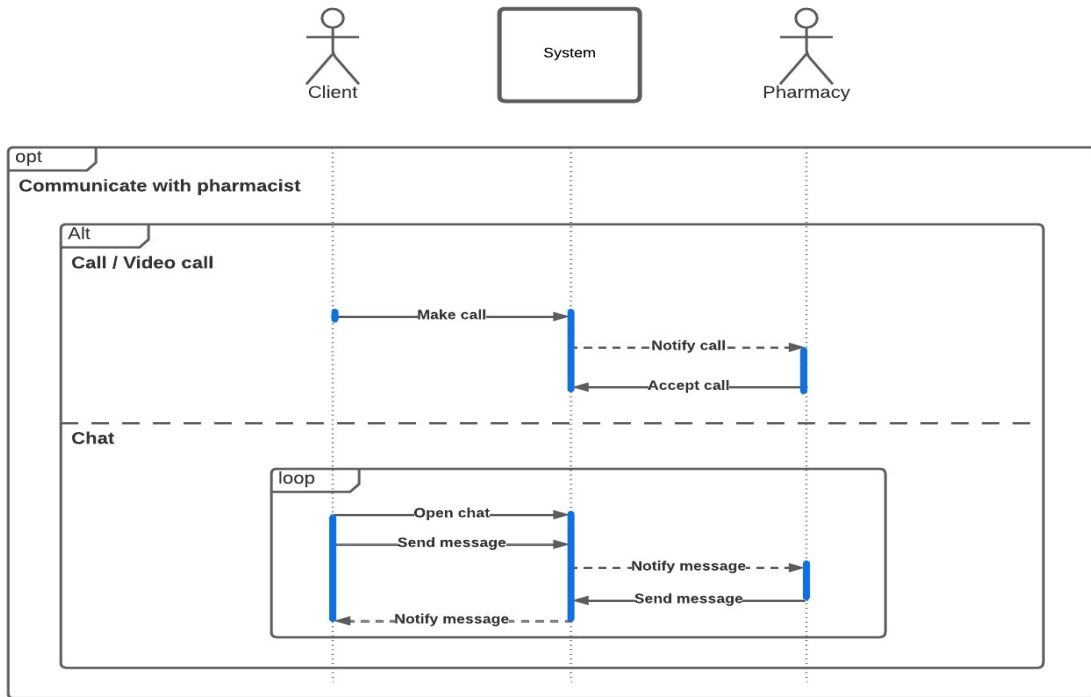


Figure 20 - IS Sequence Diagram - Communication process

5.3.3.5. Sequence diagram – Package delivery process

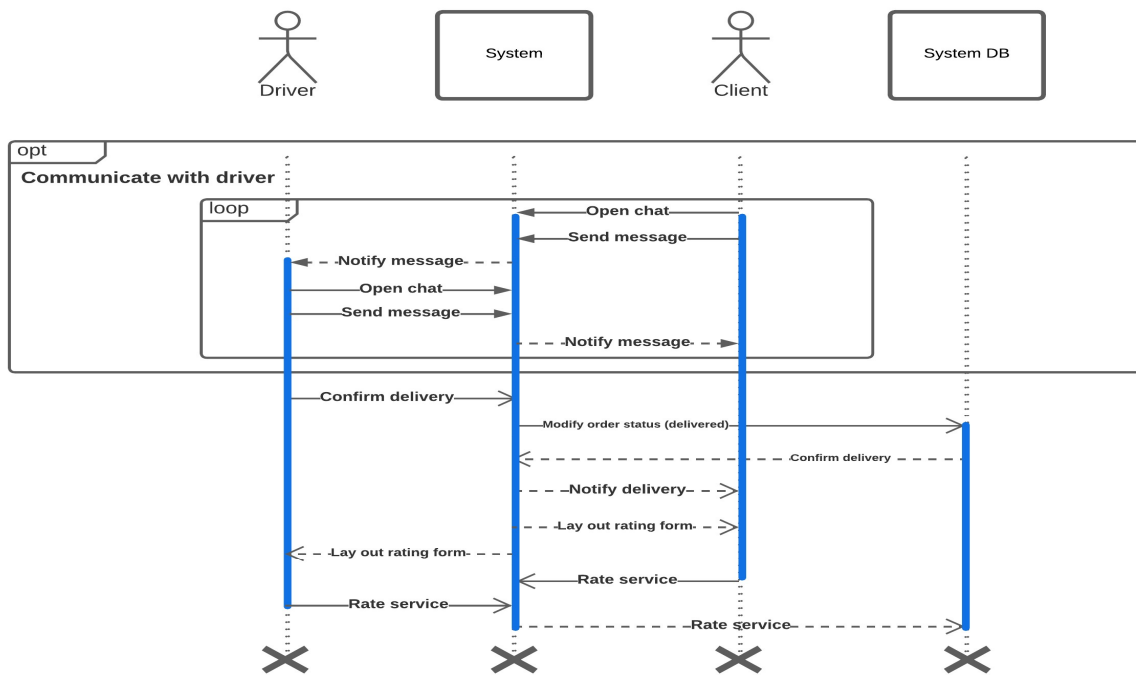


Figure 21 - IS Sequence Diagram - Package delivery process.

5.4. SYSTEM DESIGN AND ANALYSIS

This chapter presents the design and analysis of the IS, through the class diagram and logical data model. These developments could allow a better understanding and serve as basis for further and future IS developments.

5.4.1. Class diagram

The UML class diagrams are used to construct and visualize object-oriented systems. Is a type of structure diagram that describe the structure of a system by showing the system's classes, attributes, operations, and relationships among objects.

On figure 22 is represented the system class diagram. It permitted to map the system structure in an efficient and simple way and could serve as base for future developments.

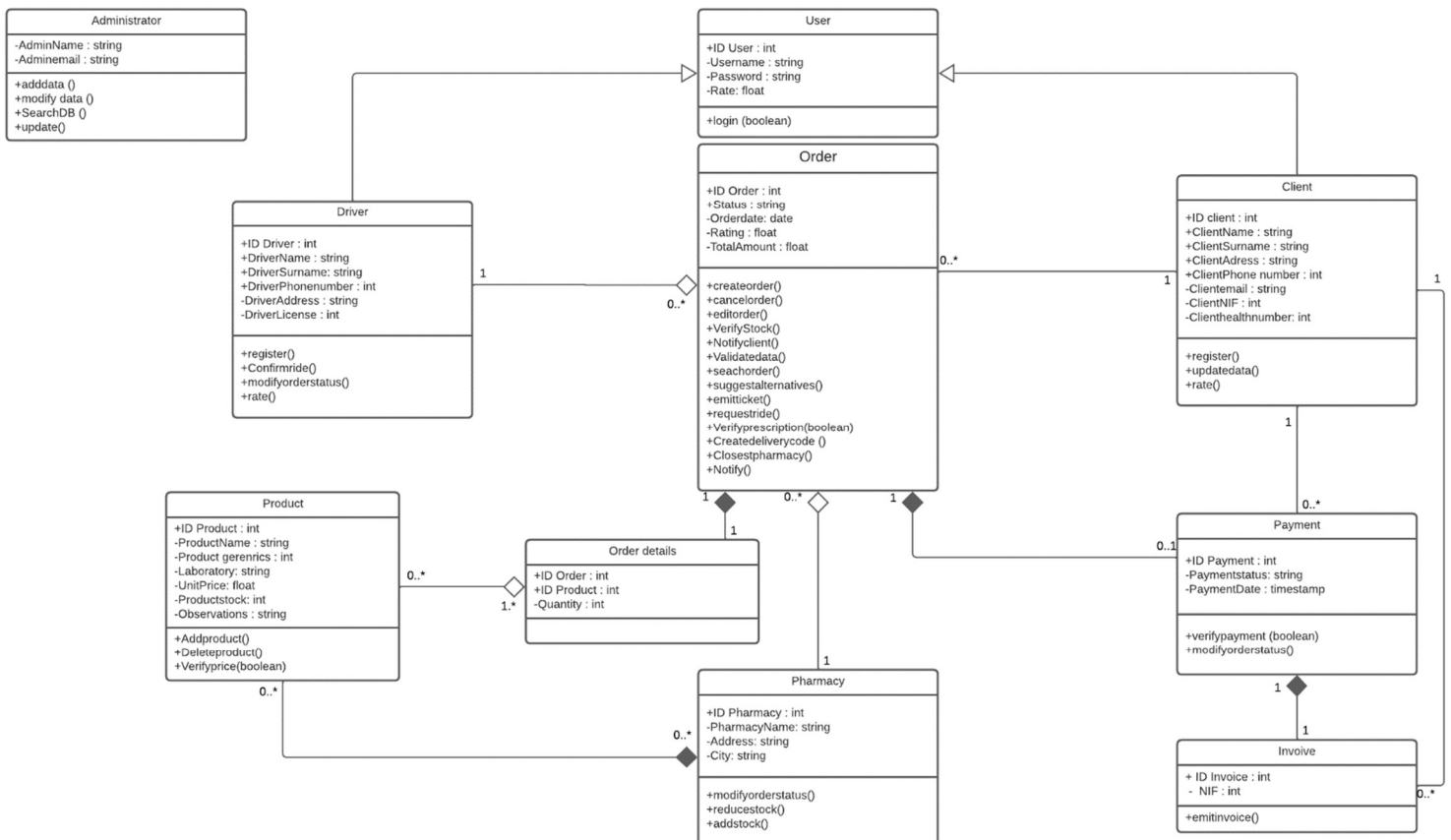


Figure 22 – Information System - Class diagram.

5.4.2. Logical Data Model

A Logical data model is a type of data model that describes data elements in detail and is used to develop visual understanding of a systems data model.

The Logical Data Model (LDM) represented on figure 23, permitted to map the various entities, their attributes and relationships that allowed a better understanding of data structure for the IS development.

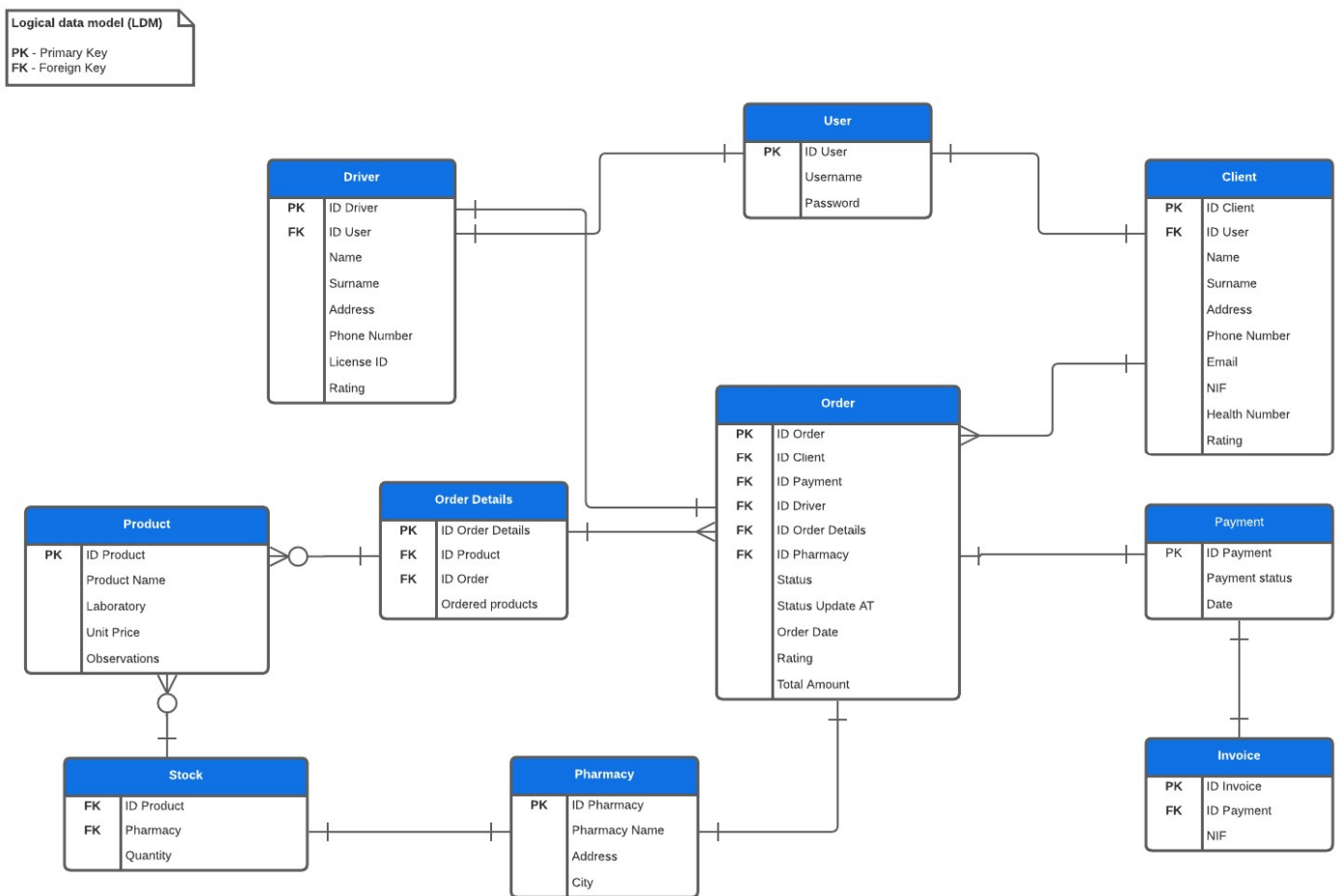


Figure 23 – Information System - Logical Data Model.

6. EVALUATION

The proposed IS architecture was evaluated, on order to recognize its utility, suggest improvements and validation. Thus, and in concordance with the selected methodology, interviews were conducted with specialist of information systems and technology, software engineering, innovation, computer science and artificial intelligence fields. The literature review conducted previously in this research served as base for the interview questions. They were made online through video call using Microsoft Teams.

The selected specialist were: Prof. Dr. Gonalo Rijo (**GR**) graduated in Electrical Engineering from Instituto Superior Tcnico, also has an Executive Master of INDEG in Project Management and a MINI-MBA at ISCTE. Is currently attending a PhD at UTAD, investigating accessibility and artificial intelligence. Teaches Project Management and Entrepreneurship at various centers of the Nova University of Lisbon. He is an entrepreneur, in charge of a few companies and startups that develop innovative software.

Prof^a. Maria Anastasiadou (**MA**) is an Invited Professor and a PhD student at Nova Information Management School, University Nova in Lisbon in Information Systems Management with a specialization in Information Technologies, more specifically in Data science. Is teaching Artificial Intelligence at Nova Information Management School and has been working as an IT consultant for the past 7 years in governmental related IT projects, and she holds a first class with honors B.Sc. in Computer Sciences by the University of Hertfordshire, Hatfield UK, and a master's degree in information management, with a specialization in Information Systems and Technologies Management from the University of Nova IMS in Lisbon, Portugal.

Dr^a. Snia Arruda (**SA**) is a pharmacist with over 20 years of experience on the field. Has a B.Sc. degree in pharmacy by the Universidade de Lisboa and is currently the head pharmacist at *Farmcia Santo Antnio* in Lisbon, Marvila.

6.1. INTERVIEWS

After a brief presentation of the whole context and research, the participants were asked to respond to 3 questions to collect their insights and feedback (Table 8).

Table 8 - Validation Questions.

Q1	Do you consider the proposed information system (application) to be useful to common citizens?
Q2	What recommendations/suggestions would you consider improving the proposed architecture?
Q3	Do you have any comments on the proposed IS?

The selected question allowed to acknowledge if the information system architecture contained all the required features to provide the expected service and suitable improvements for future work.

Regarding question 1 (Q1), the answers were the following:

SA: It would be useful for many people who have access to a smartphone and the internet and who aren't able to go to the pharmacy. However, many people who live in less developed environments and who do not find easy to understand and grasp the doctor's indications during a medical appointment would have more difficulties in taking and manage their medication.

GR: Yes, without a doubt if well implemented. We are currently in a digital era where ecommerce is needed and essential. I wouldn't have any doubts in using such a service.

MA: The application and the service provided would be very useful. My only concern is regarding the difficulties that older people that are less familiarized with technology would have when using the application. As an example, my parents rely on other people for using this kind of applications and technology in general. The app should be as intuitive as possible. Although, I don't have any concern that if well applied, the application would provide an asset for the overall community, if implemented.

Regarding question 2 (Q2), the answers were the following:

SA: Clients should be given the information about the prices of available drugs and whether a specific pharmacy would be able to dispense all the medication in the prescription and not just part of it. Apart from that it seems, from my point of view, that everything is in accord with some formalities that pharmacies must follow.

The fact that the stock would have to be updated manually by the pharmacies would not constitute a stumbling block since is a common practice in Portuguese pharmacies including the ones that I've worked on.

GR: I found your point of view very interesting. I have some concerns regarding this kind of services that need to be acknowledged because we are not dealing with the delivery of a simple product or a meal. Medication is a whole different and more sensible topic. It would be important to guarantee that antibiotics that are prepared by the pharmacies or certain medication that need to be transported in some specific conditions. Those concerns need to be examined and applied to make sure that the medication is delivered following safety and in the right conditions.

The certification that the medication is delivered to the right person and to the correct place. I was part of a project that consisted in delivering medication using drones. The main drawback that we had and that consisted in a hard problem to solve was to make sure that the medication was delivered in the correct location and to the correct person.

MA: The payment is something that is pivotal in every ecommerce platform. The payment process should be carefully considered since it deals with sensible data. I noted that the payment would be made via API. It is important to make sure that the required safety methods are guaranteed.

The communication between the pharmacist and the client should be always available at any time, even if the client didn't fill an order. The pharmacist could give suggestions to the client according to their needs and symptoms providing a more customized service. That it's a feature that I consider very important in this kind of services. An email communication channel could be added.

Also, the introduction of the Ip. citizen code could offer more validation and security.

Regarding question 3 (Q3), the answers were the following:

SA: Considering the idea as being particularly interesting and useful, I must add, based on my 20 years of experience in working in a community pharmacy, that it would be useful to have the dosage indicated by the doctor written in some way, in the packaging. That could help to avoid excessive contacts by patients.

6.2. DISCUSSION

After the evaluation of the artifact, a careful analysis of the given feedback was made in this section. This discussion has its focus on the artifact utility, feasible improvements and observations made by the participant interviewees.

Regarding the utility of the artifact and the service provided, all participants agreed on the usefulness and convenience that this service would provide to society in general. However, all participants highlighted the importance would only be measurable, if well applied.

Specialist shared the same concerns and importance regarding the user-friendliness of such an application focusing on the needs but also, the characteristics of the target audience.

When developing user-friendly is essential to focus on the needs of the target audience, offering a great design, make onboarding easy, use push notification wisely and keeping the app intuitive and easy to use.

Concerns regarding grasping the doctor's indications regarding the prescribed medication could lead to more difficulties for patients to manage their medication. Concerns were also raised about the difficulties that older demographics would have when using the application, aspect that could be mitigated if application user-friendliness is certified.

Concerning the improvements and recommendations, points were raised about different topics.

Specialist highlighted the importance of displaying and have a product catalog available for the client to know if the wanted products are available at a specific pharmacy. With this feature, clients could use the application as an information tool to go directly to the pharmacy, if pretended, and collect their products avoiding unnecessary efforts.

Concerns about the delivery process were also raised. Professor Gonçalo Rijo underlined the importance and special cares that would be needed when transporting medication, bringing out the examples of specific antibiotics that are prepared by pharmacies and other meds such as, insulin for example, that would have to be transported in certain ways to guarantee the necessarily safety and quality requirements.

The delivery certification process was also a point raised by specialists. It would also be pivotal to avoid delivery mistakes and guarantee that order's arrive at the right destination introducing more restricted procedures.

Payment's process and security associated was also aborded. The payment processes would be provided by the integration of a payment gateway API, a mechanism that reads and transfer information from a customer to a merchant's bank account. As design on the information system architecture, the payment gateway would be provided by an external entity via API. Specialist Prof^a. Maria Anastasiadou emphasized the importance to guarantee the reliability of the chosen partner certifying that the service provided would keep the financial information secure through encryption or other protection methods.

Still regarding the suggestions, Prof^a. Maria Anastasiadou referred the importance to assure effective and available communication channels between the client and pharmacy to offer a more customized service allowing clients to share their needs and symptoms. It was suggested to add to the existing ones, an email communication channel.

To confirm the client's identity, was also suggested the introduction of a validation method through citizen card Ip.

Additionally, Dr^a. Sónia Arruda highlighted, based on her 20 plus years of experience in community pharmacies, the importance to have, in some way, the dosage indications avoiding possible overload of communication channels.

7. CONCLUSIONS

This chapter concludes the developed work of this dissertation by reviewing the conclusions attained, the limitations and future work. It also allows a general overview and evaluation of whether the objective was achieved.

7.1. SYNTHESIS OF DEVELOPED WORK

Conducting this investigation conceded the overview of different subjects from online pharmacies, information system architecture and the overall environment where the application is aimed for, the Portuguese pharmaceutical sector including its professionals. Gathering knowledge on these areas made possible to build a more fitted design for the application architecture that supported professionals and user perspectives and requirements. The application design and utility were validated by technical specialist according with features considered as pivotal in this type of services.

7.2. LIMITATIONS

This research had some limitations regarding the Portuguese pharmaceutical regulations. The online Portuguese pharmacy sector have been limited by the severe and inadequate regulations. Current applied regulation could be considered as undated and inappropriate when compared to other countries. The objective of this study was to create an artifact that could be introduced in the real world although, with laws restrictions concerning the forbiddance of delivering prescribed medication, assumptions had to be made. These limitations could also be seen as an opportunity since the national online pharmacy is still at a relatively at an early stage and the creation of new and more innovative regulations could shape the market instead exclusively limit and constraint development and innovation.

Additionally, even though the application design and useful was validated by a technical audience, the number of participants, including non-technical, could have been higher and consequently provide more credibility and general validation.

Attempting to include more information regarding existent online pharmacies technology and features was also limited to articles, websites and try out simulations.

In addition, there's a lack of previous studies in the research area on the Portuguese online pharmacy topic narrowing the foundations used during the literature review phase.

7.3. FUTURE WORK

Regarding the future work, the validation process could be improved by collecting more insights from a broad number of participants, making the application more suitable and perhaps more complete by introducing new features.

A continuous update of new regulations and online pharmacy new concepts would also benefit the application future developments. As the Portuguese regulations evolve and readapt, with would be important to develop the application and provide such a service for the general population. As technology is always innovating, new products and features will be inevitably launched to gain competitive advantages and responded to society needs, thus a follow-up of them would be recommended for future work.

Lastly, making this investigation available to the academic public though, for instance, a publication, would arise further investigations and draw attention for the topic.

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