

Can the supply of medicines in Ireland be improved?

Research dissertation presented in partial fulfillment of the requirements for
the degree of MSc in Pharmaceutical Business and Technology (QQI)

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I certify that the dissertation entitled: “Can the supply of medicines in Ireland be improved?” submitted for MSc in Pharmaceutical Business and Technology is the result of my own work, and that, where reference is made to the work of others, due acknowledgment is given.

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ABSTRACT

This dissertation aims to examine the complex dynamics of the pharmaceutical supply chain in the Republic of Ireland, and the potential for improving accessibility and availability of medicines in the country. Many countries in the world have been impacted by the COVID-19 pandemic, among other challenges. Ireland inclusive seeks to ensure its citizens are provided with an efficient, reliable and resilient supply chain that produces medications in a timely manner.

This study employs a comprehensive mixed-methods approach utilizing quantitative and qualitative analysis for the primary research. The use of questionnaire surveys and interviews to fully grasp the state of medicine supply in the Republic of Ireland and feasible recommendations for improvement of the supply chain.

The research examines and identifies the essential stakeholders within the pharmaceutical supply chain and their roles. The various stakeholders of the pharmaceutical supply chain include manufacturers, wholesalers, healthcare providers, and regulatory bodies. The dynamics of each stakeholder vary according to the regulations in the Republic of Ireland.

The study further examines the factors that influence the supply of medicines in Ireland. These factors include regulatory frameworks, logistics, pricing mechanisms, procurement practices, and external influencers such as manufacturers, the market like other EU nations and international bodies.

The study also observed external factors that influence the supply of medicines in Ireland through the analysis and evaluation of existing literature. The research reveals bottlenecks, weaknesses and inefficiencies that contribute to shortages of medicines and disruptions in drug distribution caused by supply chain issues.

The dissertation further delves into best practices, mitigations and methods that potentially improve the supply of medicines in Ireland. The observance of best practices from case studies was gleaned on, and insights highlighted to better improve Ireland's supply chain. The measures and strategies gleaned include transparency among stakeholders, better supplier relationships, collaborative measures among stakeholders, including demand

forecasts, innovative technologies, better transportation, better regulatory procedures and pricing rates.

Finally, the aim of this dissertation is to provide a comprehensive understanding of the Irish pharmaceutical supply chain. The complexity of the supply chain requires thorough exploration, because it is dependent on many variables. The research reveals the use of an adaptable, resilient and flexible set of methodologies, such as innovations, pricing rates and reimbursement. This dissertation also essentially contributes to the resilient pharmaceutical supply chain industry in Ireland.

Table of Contents

CANDIDATE DECLARATION	ii
ACKNOWLEDGEMENTS	iii
ABSTRACT	iv
LIST OF FIGURES	ix
LIST OF ABBREVIATIONS	x
CHAPTER 1: INTRODUCTION	1
1.1 Background	1
1.2 Significance of Study	2
1.3 Objectives	3
1.4 Research Question	3
1.5 Supply of Medicines in Ireland	3
1.6 Licensed and Unlicensed Medicines	5
1.7 Background to Drug Shortages	6
1.8 Shortages in Ireland	7
1.9 Managing Drug Shortages and Improving the supply Chain	9
CHAPTER 2 – LITERATURE REVIEW	10
2.0 Introduction	10
2.1 Key Components of the Pharmaceutical Supply Chain	11
2.2 Retail Pharmacies in the supply chain	13
2.3 Challenges and Issues in the Pharmaceutical Supply Chain	14
2.4. Challenges and Issues in the Irish Pharmaceutical Supply Chain	15
2.5 Best Practices and Innovations in Pharmaceutical Supply Chain Management	21
CHAPTER 3: RESEARCH METHODOLOGY	24
3.1 Overview of Research Methodology	24
3.2 Research Design and Approach	24
3.3 Research Philosophy	25

3.4 Research Strategy	26
3.5 Data Collection.....	27
3.6 Sources	28
3.7 Ethical consideration	28
3.8 Conclusion.....	29
CHAPTER 4: FINDINGS AND ANALYSIS	30
4.1 Overview	30
4.2 Qualitative Analysis: Demographics.....	30
4.3 Qualitative Analysis: Interview Insights	47
4.4 Conclusion.....	50
CHAPTER 5- RESEARCH CONCLUSION.....	52
5.1 Answering the Research Question	52
5.2 Comparing results between primary data and secondary research.....	54
5.3 Contributions and Limitations.....	55
5.4 Conclusions	56
REFERENCES AND BIBLIOGRAPHY	57
APPENDICES	61

LIST OF TABLES

Table 1: shows the list of some medications from the HPRA website (*HPRA, 2023a*)

Table 2: The overview of the research method

Table 3: Response rate of questionnaire survey

Table 4: Results showing top major wholesalers

Table 5: Response rates on recommendations to improve the supply of medicines to retail pharmacies in Ireland

LIST OF FIGURES

Figure 1: Are there issues with the supply of medicines to retail pharmacies in Ireland?

Figure 2: Are there issues concerning supply of medicines to retail pharmacies?

Figure 3: Do you have more than one supplier of medicines?

Figure 4: How many medicines do you have authorization to distribute?

Figure 5: How many pharmacies do you have authorization to distribute?

Figure 6a: Most common challenges in the supply of medicines

Figure 6b: How often do you experience drug shortages?

Figure 6c: Most unavailable medications

Figure 7: Major challenges with the supply of medicines

Figure 8: Factors impacting drug shortages

Figure 9: Can there be improvements made to the supply of medicines to retail pharmacies?

Figure 10: Can these issues be improved on? (Wholesaler)

LIST OF ABBREVIATIONS

HPRA- The Health Products Regulatory Authority

EMA- European Medicines Agency

IPHA- Irish Pharmaceutical Healthcare Association

EU- European Union

ULM- Unlicensed Medicines

DP – Decentralized Procedure

MRP- Mutual Recognition Procedure

CMSs – Concerned Member State

RM – Reference Member State

CMDh- Cp-ordination group for Mutual and Decentralized Procedure -Human

MA – Marketing Authorization

GDP – Good Distribution Practices

WDA- Wholesale Distribution Authorization

NAFDAC- National Agency for Food and Drug Administration and Control

PSI- Pharmaceutical Society of Ireland

NHPC- National Health Product Catalogue

FDA- Food and Drug Administration

IPU- Irish Pharmacy Union

POM – Prescription Only Medicines

PMed- Pharmacy Medicines

OTC- Over the Counter Medicines

GSL- General Sales Medicines

PMDA- Pharmaceuticals and Medical Devices Agency

UK- United Kingdom

QR- Quick Response

HSE- Health Service Executive

DPS- Drug Payment Scheme

GMS- General Medical Services

PCERS- Primary Care Eligibility & Reimbursement Service

CHAPTER 1: INTRODUCTION

1.1 Background

As a pharmacist from Nigeria, working in a major pharmacy company in the Republic of Ireland, it is disheartening for the author to not provide medications either on prescriptions or over the counter for patients with little to no explanation other than the drug is in short supply and currently unavailable. The author has observed over time, from the commencement of work in November 2022, continuing through May 2023, the steady irregularity in availability of some drug products.

Ireland is known for its high over-the-counter drug restrictions, such as not more than 24 tablets of paracetamol can be sold in one transaction to a customer (Mhaoláin *et al.*, 2007). Therefore, because many medications are not over the counter, customers are limited to the drugs available and regulated by the government.

An example is the eye medication for conjunctivitis (stye), known as Brolene, which is currently unavailable due to a supply shortage (HPRA, 2023b). This is the only medication for the treatment of stye available without a prescription. Shortage in supply due to increased demand results in customers having to book a doctor's appointment, which costs €65-80 (The Irish Times, 2023b), while Brolene costs €10, a financial implication of €55-70.

The accessibility, availability and reliability of medicine supply are integral for effective delivery of healthcare services. The pharmaceutical supply chain consists of various stakeholders, from manufacturers to wholesalers, regulatory authorities and retail pharmacies, all working together to ensure patient satisfaction, i.e., the right medications are obtained when they are needed by the patients. The Irish healthcare system is known for its commitment to providing optimal care for its citizens. However, the challenges and issues inherent in the pharmaceutical supply chain are evident, especially when there is increased demand, unanticipated global disruptions, and regulatory or political shifts and changes.

The COVID-19 pandemic came as a shock to the world and revealed the fragility of the supply chains system globally, which has prompted reevaluation of responsiveness, resilience and adaptability to unexpected situations.

This research aims to investigate existing supply chain issues and the possibility of improving the supply of medicines in Ireland. The study aims to explore the methodologies and measures that can improve the efficiency, transparency, and responsiveness of the pharmaceutical supply system within Ireland. This research adds to the current discourse on the optimization of the pharmaceutical supply chains in the Irish context, which is important given recent global events that have highlighted limitations in supply chains even in technologically advanced countries.

1.2 Significance of Study

The research aims to highlight the impact of the drug supply chain on the healthcare system, the importance of accessibility, and availability of quality healthcare services in Ireland. The author aims to emphasize the importance of a reliable, stable and adaptable supply chain and its impacts on patient care. The significance of a stable supply system cannot be overemphasized, as it contributes to better disease management and health improvements, which is the desire of the Irish governed system.

The implications of this research contribute to the resilience of the pharmaceutical supply chain in Ireland, promote best practices, and adaptable methodologies that yield consistent results, especially in the events of disruptions.

Methodologies or measures observed to be suitable and achievable for the Irish pharmaceutical industry can lead to cost savings for the healthcare sector and final consumers, which are the patients.

The study aims to foster and encourage collaboration among stakeholders within the pharmaceutical industry, such as manufacturers, wholesalers, regulatory authorities, retail pharmacies, and healthcare providers, to improve the supply chain system and healthcare system as a whole.

The study's originality and contribution are in the analysis of the Irish pharmaceutical supply chain. The study offers new perspectives by examining a significant gap in a localized context, which is the pharmaceutical industry in Ireland, and provides measures suitable to the system.

1.3 Objectives

- To review the existing supply chain process
- To determine if there are supply issues whose resolution would improve the process
- To examine how improvements in the supply chain could be implemented

1.4 Research Question

- What methodologies can be implemented to improve the supply chain to retail pharmacies in Ireland?

1.5 Supply of Medicines in Ireland

The Irish system esteems its dedication to achieving quality healthcare, through the provision of essential medicines for patient care, from prescription medications to over-the-counter drugs. Ireland's healthcare system aims to achieve a patient-centric ecosystem, which provides optimal and accessible patient-care for the treatment of various diseases, from chronic diseases to acute conditions.

The pharmaceutical industry is important to the healthcare sector for its ability to provide a stable and optimal production of medications for its consumers. By ensuring the availability of medicines in a timely manner, the pharmaceutical industry allows the treatment of patients to be feasible. The collaboration and intricate network of manufacturers, wholesalers, and pharmacists enables patients to be provided with optimal care and satisfaction needed for their wellbeing.

The Irish healthcare system, like any other system, has faced challenges and setbacks after the COVID-19 pandemic (Chowdhury *et al.*, 2021). The pandemic caused disruptions and major setbacks to supply chain systems globally, including Ireland. This has impacted the steady supply of medicines across Ireland, resulting in unavailability of medications in a timely manner.

According to the European Parliament (2020), the European Union (EU), which includes Ireland, obtains the bulk of its active pharmaceutical ingredients from countries like China

and India, making the country dependent on factors that govern these nations. These countries which provide raw materials having been impacted as well by global changes, such as the COVID-19 pandemic, faced disruptions as well in their supply chain.

After manufacturing, in the ideal case where manufacturing companies can obtain raw materials for production, distribution by wholesalers is the next step. Wholesalers distribute to hospitals and retailers based on demand. The wholesalers must have a license to distribute medicines in Ireland. The Health Product Regulatory Authority (HPRA) provides information on licensed wholesalers to distribute in Ireland. Wholesalers need to be authorized to ensure Good Distribution Practices, such as proper storage of medicines, maintenance of quality, etc. According to HPRA, the Irish pharmaceutical supply chain involves the Marketing Authorization Holder, the distributor, which acts to place the products on the market for the MAH, the wholesaler and the retailer.

The wholesaler collates products from different manufacturers, primary wholesalers, and supplies to the retailers and hospital.

The wholesaler and distributor are used interchangeably, but may differ in some cases. The distributor obtains products directly from the manufacturer and supplies to the wholesaler, which continues the supply to retail consumers. A distributor can also directly supply to retail consumers. Some companies in the supply chain act as both wholesalers and distributors.

The HPRA provides a list of approved wholesalers. These wholesale distributors must possess Wholesale Distribution Authorization (WDA). Below are a few:

- Allegro Limited
- Alliance Pharma (Ireland) Limited
- Abbvie Limited
- Baxter Healthcare Limited
- City Pharmacy Limited
- Clinigen Ireland Limited
- Ennogen Healthcare Europe Limited
- Ellillily Ireland Housing Ltd
- Euromed Pharma Limited

- GlaxoSmithe Consumer Healthcare (Ireland) Limited
- Hickeys Pharmacy
- IMED Healthcare Limited
- Uniphar Wholesale Limited
- United Drug (Wholesale) Limited
- Roche Products (Ireland) Limited

United Drug is a major wholesale distributor in Ireland, according to the McKesson group, now Phoenix company (2022). Distributing to retail pharmacies, hospitals, nursing homes, etc. on demand, and allocating medicines in the event of shortages, is a responsibility of the wholesaler.

A supplier or manufacturer can have multiple wholesale distributors. According to HPRA (2021), it is the responsibility of the wholesalers to ensure that the drug suppliers possess the required licenses, such as WDA, current GDP certificates, and are fit to supply drug products.

The HPRA requires the application and approval of WDA certificates.

1.6 Licensed and Unlicensed Medicines

The HPRA provides a list of licensed medicines, which are drug products approved for the market in Ireland, while the unlicensed have not been approved. Unlicensed medicines are also known as exempt medicinal products. These are products that have not obtained regulatory approval in Ireland, but may be approved for use in other countries, including the European Union.

The supply of licensed medicines is based on demand of retail consumers, while those of exempt medicinal products are usually based on prescription of a doctor to meet the needs of a patient. These products are sourced directly from manufacturers and wholesalers by healthcare providers, only with approval in Ireland to procure (PSI, 2017).

Factors affecting the supply chain;

- Environmental and Political factors: These are usually national or global influences, such as COVID-19, Brexit, which directly or indirectly affect the supply chain. The

disruptions can be either predictable in the case of Brexit or unpredictable in the case of COVID-19.

- **Logistics and Transportation:** Every chain of distribution is influenced by the use of transportation and proper logical planning to provide products in a timely manner. The pharmaceutical industry is heavily dependent locally and globally on transportation.
- **Communication:** The stakeholders of the pharmaceutical industry require the sharing of information across board for the proper and proper functioning of the system. Lack of information more often than none incapacities segments of the industrial ecosystem.
- **Regulations:** The regulatory authorities are the backbone of any system. They determine the progress and setbacks often times of the pharmaceutical industry. Regulations on manufacturing, distribution, pricing, impact the flow of the supply chain.
- **Forecasting and Demand:** These are tools utilized by the stakeholders of the pharmaceutical industry for adequate planning. These strategies are used to optimize inventory control by retail pharmacies and provide adequate stocks by wholesalers and manufacturers.

1.7 Background to Drug Shortages

Medicines are essential for people because they provide cure, wellness, and management of health. There are different types of drugs, and they provide different functions. Some medicines, such as paracetamol, are basic needs to relieve a headache or mild pain, while metronidazole, an antibiotic, is to treat an infection, preventing it from becoming exacerbated.

Other medicines, such as blood pressure medications such as Valsartan, cholesterol treating tablets such as Atorvastatin, anti-diabetic tablets such as Metformin, are essential for maintaining the health of people on long-term illnesses. These medications are integral to improving the general well-being of patients.

A drug shortage is the unavailability of medicines required by patients when needed, and when demand for a product exceeds the supply. Shortages can be caused by many factors, including lack of raw materials, delays in manufacturing, unavailability of packaging, discontinuations, etc., (FDA, 2023).

Drug unavailability has been an occurrence over the years, especially in low-income nations. Overtime, it has become an issue prominent in middle and high-income countries (Shukar *et al.*, 2021). The COVID-19 pandemic set the world on a different trajectory and increased the factors that influenced shortages. The lockdown and workplace restrictions limited the processes in sectors such as manufacturing raw materials, packaging and finished products, transportation, extending the production and supply of medicines.

1.8 Shortages in Ireland

According to the HPRA(2023a), there are over 200 drugs as of June 2023 short in supply in Ireland for various reasons. The regulatory body provides an up-to-date list of medicines currently unavailable with information on reasons for shortage and return dates made available by manufacturers.

The list involves prescription-only medicines and over-the-counter medicines as well. Some of these drugs include:

No.	Drug	Reason for shortage	Return date
1.	Atenomel 50mg tablets	Quality issue	Qtr 3 2023
2.	Aspirin 75mg gastro resistant tablets	Unexpected increase in demand	Early October 2023
3.	Brolene eye drops	Manufacturing delay	July 30, 2023
4.	Benylin phlegm cough plus decongestant	Unexpected increase in demand	2 nd July 2023
5.	Clarithromycin 500mg film coated tablets	Unexpected increase in demand	July 2023
6.	Ciprofloxacin Teva 250mg Film Coated Tablets	Manufacturing delay	Week ending of August 2023
7.	Efavirenz Rowex 600mg Film-coated Tablets	Manufacturing delay	Unknown at present
8.	Exforge HCT 160/12.5/10mg Film Coated Tablet	Manufacturing delay	Unknown at present
9.	Ezetimibe/Simvastatin Rowex 10mg/80mg Tablets	Manufacturing delay	Unknown at present
10.	Galfer 305 mg Hard Capsules	Awaiting information from company	25 th June 2023

Table 1 showing the list of some medications from the HPRAs website (HPRA, 2023a)

Numerous bodies and organizations provide information on drug shortages in Ireland such as National Health Products Catalogue (NHPC) and Irish Pharmacy Union (IPU).

A recorded number of 248 medicines were reported unavailable by The Irish Times (2023a) in a report which is a significant amount of medicines to be out of supply.

1.9 Managing Drug Shortages and Improving the supply Chain

Public Service Obligations are imposed on wholesalers in the EU, although for reimbursed medicines alone (Bochenek *et al.*, 2018). This increases the availability of medicines for consumers based on needs.

The European commission has proposed a reform to the pharmaceutical legislation for medicine use (Department of Health, 2023). This reform is the first in 20 years, this is to ensure and improve better and affordable medicines to patients. The reform aims to evaluate and analyze the stakeholders of the pharmaceutical industry involved in the supply of medicines. This is eliminate supply chain issues and provide potential measures too improve the supply chain.

CHAPTER 2 – LITERATURE REVIEW

2.0 Introduction

"The right to health must include access to affordable healthcare services, essential medicines, and information needed for the promotion and maintenance of health." - United Nations Human Rights Council

Ireland is a European country situated in the north-west of Europe. It is an island with a population of over 5 million people (BBC, 2022). Ireland is known as a major pharmaceutical country. The Irish Pharmaceutical Healthcare Association (2022) states the country hosts 9 out of 10 of the world's largest pharmaceutical companies such as Pfizer, Johnson and Johnson, Abbot, Roche, Merck and Co. AbbVie and more. Ireland houses over 120 pharmaceutical companies. Globally, Ireland has a strong presence for both big and small pharmaceutical companies.

The pharmaceutical sector is known to be prominent through its provision of job opportunities for local residents and international members. The Health Products Regulatory Authority (HPRA) oversees the licensing and approval of medicines by companies in the country through high scrutiny to ensure the safety, efficacy, and quality of the medicines.

Ireland is one of the largest exporters of medicines in the EU, behind Belgium and Germany (IPHA, 2022). Many factors drive Ireland's position as one of the largest industry-dominated countries, such as tax incentives. With tax rates as low as 12.5%, Ireland provides corporate businesses with more profits to reinvest and encourages domestic growth while attracting foreign companies.

Access to a larger consumer base in the European Union is also a factor that encourages many pharmaceutical companies to set base in Ireland. Job opportunities arise as more companies set up, making Ireland a favorable place for many pharmaceutical business owners.

2.1 Key Components of the Pharmaceutical Supply Chain

The supply of medicines follows a cycle from manufacturing, which includes the production of medicines, to packaging, after proper validation and qualification of all processes and materials have been verified. This is to ensure the quality, safety and efficacy of medicines.

Manufacturers of medicines obtain licenses to market in Ireland via different routes, dependent on certain criteria. According to the HPRA, they include:

1. Centralized Procedure: Approval via this procedure grants the company license to market its products in all European countries via a single marketing entry. Applications are submitted to the European Medicines Agency (EMA). Some medicines can only be granted approval via the centralized procedure. They include;
 - Advanced therapy medicines
 - Orphan medicines
 - Medicines obtained from biotechnology processes
 - Medicines with new active ingredients for treating specific conditions, such as diabetes, cancer, etc.
2. Decentralized Procedure: Approval via this route is for medicines that have no marketing authorization in any member state and are not mandated to be marketed via centralized procedure
3. Mutual Recognition Procedure: Approval via this route is, as the name implies, there is already authorization for a member state, the company wants to obtain mutual approval for other member states.

Decentralized Procedure (DP) and Mutual Recognition Procedure (MRP) are monitored by the Co-ordination group for Mutual and Decentralized Procedures -human (CMDh). All information concerning the procedures are evaluated through them.

Companies utilizing either DP or MRP can choose the member states in which they want to obtain approval; one state is chosen as the Reference Member States (RMS) while the others act as the Concerned Member States (CMSs). The RM is in charge of all procedures and evaluates the Marketing Authorization (MA) application on behalf of the CMSs, queries and

concerned are directed to the RM. Approval by the RM give authorization for marketing in all the CMSs, while rejection does the same.

4. National Procedure: Companies which desire approval in just one member state such as Ireland can apply via this procedure directly to the HPRA. When the companies want to obtain MA in other member states, they can use the MRP.

Marketing Authorization Holders (MAH) are representatives of manufacturing companies that have been provided legal rights to market and distribute medications in a country. Manufacturing companies require a MAH to market their products in Ireland. Licensed medicines have marketing authorization while unlicensed medicines do not.

After a company obtains approval to market, it then distributes their products via a wholesaler.

The wholesale distributor is required by the HPRA to obtain a Wholesale Distribution Authorization (WDA) in order to distribute products in Ireland. Application is submitted to the HPRA and approved after the regulatory body ascertains the wholesaler follows Good Distribution Practices (GDP). One of the criteria for approval of WDA is, the presence of a permanent physical site for wholesale activities with the necessary equipment available. The sites must always be easily accessible to the HPRA.

Another criterion is the presence of at least one staff member in the physical site in Ireland with all necessary knowledge of wholesaling activities and responsibilities.

To ensure compliance with GDP, the HPRA performs inspections on wholesalers prior to approval of WDA and routine inspections for wholesaling operations. Some inspections are carried out for variations to operations by the HPRA, i.e., changes to certain procedures by the wholesaler which may pose risks. These procedures are inspected by the regulatory body to ensure safety, quality and efficacy is maintained before approval.

2.2 Retail Pharmacies in the supply chain

A retail pharmacy can commence the business of selling drugs to the public after obtaining certain licenses and proper registration. The pharmacy must comply with the regulations and apply for registration to the Pharmaceutical Society of Ireland (PSI) at least 60 days before opening of business (2023).

After approval of registration, the pharmacy renews its registration annually and is mandated to display its certificate of premise registration and superintendent pharmacist certificate on its premise at all times.

A retail pharmacy in Ireland can only sell medicines to the public which have been registered or approved by the HPRA. The HPRA classifies medicines into 4 categories:

- Prescription Only Medicines (POM): As the name implies are medicines that can only be dispensed on provision of a prescription by a healthcare professional such as a doctor or dentist. They require supervision by a knowledgeable professional which is the pharmacist to ensure safety and proper guidance on use. They are usually kept in the dispensing area of the pharmacy. Examples are medicines for long term illness; Diabetes, Hypertension, epilepsy, cancer, other conditions such as asthma, etc.
- Pharmacy Medicines (PMed): These are medicines available in the pharmacy under a section referred to as Over the Counter medicines. These medicines require extra supervision by the pharmacist before purchase by consumers to ensure safety, appropriate use and avoidance of interactions. Examples are; products containing diphenhydramine, domperidone, sildenafil (Viagra), etc.
- Over The Counter Medicines (OTC): These are medicines that can be bought without prescription by consumers. They can only be sold in pharmacies where a pharmacist is present. Examples are cough syrups such as those containing Dextromethorphan, Loperamide, antacids, acetaminophen, etc.
- General Sales List (GSL): These are medicines available in both retail and non-retail stores without prescriptions. Examples are paracetamol (12 pack), antacids, etc.
- Unlicensed medicines: These are medicines usually on prescription in Ireland that have not been authorized for marketing. These medicines can only be dispensed on

prescription by a doctor or dentist for specific needs of a patient where there is no alternative.

The pharmacy is an essential component to the pharmaceutical sector in order to meet patient care and need.

Retail pharmacies obtain medicines from wholesalers based on demand and allocation. Allocation is a system of fairly providing medicines and supplies to healthcare providers in the event of a shortage (HPRA, 2023a).

2.3 Challenges and Issues in the Pharmaceutical Supply Chain

For any system to function properly, there needs to be elimination of risks. The pharmaceutical supply chain faces challenges requiring mitigation and elimination as any other system. Some of these issues are classified under:

1. **Supply Disruptions:** These vary from logistics to unavailability of raw materials for production or packaging to storage issues. It also includes manufacturing problems as a result of quality issues (Shukar *et al.*, 2021). Environmental or political factors can influence the supply of medicines and cause a disruption to the supply chain
2. **Demand issues:** This is as result of higher demand of medicines in relation to supply (Shukar *et al.*, 2021). Demand can be expected or unexpected, due to seasonal changes, epidemic or pandemic occurrences such as COVID-19 etc.
3. **Regulatory Issues:** There are many drug regulatory bodies across the world; FDA(US), EMA(EU), HPRA(Ireland), NAFDAC(Nigeria), PMDA(Japan), all with the common goal of protecting and promoting public health and safety (Weisfeld *et al.*, 2013). The regulations by each body impacts directly and indirectly the manufacturers down to the consumers. Guidelines stated to provide quality and safe medicines often take a while to implement (Steinborn, 2004).

Disruption to any part of the supply chain results in drug shortages, quality and safety risks which has an impact on patient health. One of the goals of each member of the supply chain is to ensure minimal disruptions.

2.4. Challenges and Issues in the Irish Pharmaceutical Supply Chain

World Health Organization states drug shortage is a global problem affecting high, middle, and low-income countries. Drug shortage is defined as the inadequate supply of medicine in response to demand (HPRA, 2023a).

The EU in recent years have occurring events of drug shortages (Bouvy and Rotaru, 2021). In Austria as of July 2023, over 600 medicines are either limited in availability or currently unavailable (BASG, 2023), close to 300 critical medicines in France (ANSM, 2023), more than 200 in Germany (BfArM, 2023), and over 300 medicines in Ireland (HPRA, 2023b).

Different factors attribute to the growing unavailability of medicines in Ireland. These includes:

- Supply chain disruption caused by events such as COVID-19. The pandemic caused a surge in unavailability of raw materials from countries such as China, India, which were Ireland's biggest suppliers due to difficulty in transportation and logistics, unavailability of worker as a result of regulatory restrictions (Ayati *et al.*, 2020).
- The impact of Brexit on trade between Republic of Ireland and UK. Medicines imported from the UK are subjected to regulations of 3rd countries with its exit from the EU (MedDoc, 2020). Pharmaceutical industries from the UK providing seamless medicines to Ireland before 2016 are now under stringent restrictions.
- Population increase: The population in Ireland is increasing daily, with this is an increase in demand of healthy living and the use of medicines. Apart from increase in immigrants from different parts of the world, over 62,000 Ukrainians have been added to the population of Ireland (CSO, 2022).
- The population in Ireland as increased significantly since 2016 to 2022, from 4.7 million to over 5.1 million, an increase of 1.2% (CSO, 2022).

COVID-19 Pandemic

The outbreak of the coronavirus in year 2019 had a significant impact on the world globally. The pharmaceutical industry and supply chain was not left out. The unanticipated pandemic resulted in rapid changes the pharmaceutical industry was unaccustomed to. These changes resulted in pharmaceutical industries having to reevaluate methodologies and measures to enable proper functioning of their systems.

The pharmaceutical industry consists of various stakeholders responsible in the supply of medicine which commences from manufacturing of raw materials such as active pharmaceutical ingredients to excipients. The pharmaceutical system also consists of manufacturers of finished products, wholesalers, and retail pharmacies providing medicines to patients across the world. Every sector of the pharmaceutical supply chain was disrupted by the event of COVID-19 (Chowdhury *et al.*, 2021).

The onset of COVID-19 pandemic resulted in lockdowns of pharmaceutical companies across the globe including Ireland to dissipate the spread of the virus. There were transportation restrictions and workforce shortages. The closure of manufacturing sites, significantly reduced workers, and transportation delays led to disruption in the supply chain. The production of raw materials, packaging, distribution of medicines were hindered (Ayati *et al.*, 2020).

Eventually, there was major shortages of essential medications across the world and the Republic of Ireland was not left out.

Both unanticipated and anticipated demand of medicines began to occur. Medicines such as antiviral medication and critical care medicines increased in demand (Ayati *et al.*, 2020). With the unanticipated demand for certain medicines, manufacturing companies had to produce these medications while maintaining production of regular medications. This caused additional strain on the supply chain which already had low workforce and restrictions in place. The impact of this disruptions highlighted the weaknesses in Ireland's pharmaceutical industry sector.

Changes were made by regulatory authorities to expedite regulatory approvals for the pharmaceutical industries in order to provide treatment for the virus. Although these expeditions raised concerns regarding quality, safety, and efficacy.

During the pandemic, pharmaceutical companies across the world were restricted in travel movements and had to incorporate work strategies such as remote working, the use of digital technology in the industry and online platforms to facilitate supply chain coordination. Retail pharmacies also adapted to the use of e-prescription, which were online prescriptions to better serve patients.

The COVID-19 pandemic underscored the need for innovation, resilience, and adaptability in the pharmaceutical sector. Unanticipated disruptions and demands challenged the supply chain, exposing its vulnerabilities. This resulted in stakeholders of the pharmaceutical industry exploring measures to enhance supply chain resilience, thereby ensuring uninterrupted supply of medicines and optimal patient care.

Brexit

Ireland is significant for its large pharmaceutical industry sector. The country is also a major trading source for many European countries (IPHA, 2022). It is well established in the pharmaceutical sector as holding place for giant pharmaceutical companies.

Brexit is the withdrawal of the United Kingdom from the European union (EMA, 2020). On its occurrence, various changes impacted the Republic of Ireland. Concerns about the gravity of the impact of the political change was debated among many bodies.

Disruptions to sectors such as the economy, supply chain were anticipated. The pharmaceutical industries in Ireland rely heavily on the transportation of goods between Ireland and the United Kingdom (EMA, 2020). These goods include medicines, raw materials, excipients, active pharmaceutical ingredients, and packaging materials. This system and means of transportation were therefore disrupted in the event of Brexit.

Regulatory complexities also occurred as a result of Brexit. Transactions between the EU and UK which was initially frictionless had become difficult (European Commission, 2023).

Every EU member nation including the Republic of Ireland utilizes a harmonized regulatory framework to ensure uniform quality, safety, and efficacy of pharmaceutical products. The exit of the United Kingdom introduced complexities caused by separate regulatory standards regarding the country.

The implications resulted in regulatory changes such as marketing authorization, regulatory submissions, and approvals. Disruptions in manufacturing and supply chain due to changes in custom procedures, regulations and licensing requirements, which lead to delayed approvals of pharmaceutical products (EMA, 2020).

There were also concerns relating to data sharing with the United Kingdom on its exit. Pharmaceutical professionals were also affected, as challenges concerning data sharing were considered.

Although the exit of the United Kingdom caused reverberation in the pharmaceutical sector in the Republic of Ireland, it also provided opportunities for improvement. The need for the Irish pharmaceutical industry to adapt and reevaluate were considered. Investment in pharmaceutical sectors and regulatory frameworks to encourage resilience and adaptability were encouraged (European Commission, 2023).

The Windsor framework was introduced to better improving trading through Northern Ireland, a member part of the United Kingdom to the Republic of Ireland.

Government Pricing and Reimbursement Rates

The Health Service Executive (HSE) is responsible for the reimbursement of pharmacies in the Republic of Ireland. The Primary Care Eligibility and Reimbursement Service (PCERS) is a part of the HSE responsible for processing payments to healthcare professionals, such as pharmacists, doctors, and dentists (HSE, 2020).

Pharmacists are mandated by the HSE to follow certain rules and guidelines provided by the PCERS to claim payments according to the scheme types provided for. There are different types of pharmacy reimbursement schemes;

1. General Medicine Scheme (GMS): This scheme is for medical card holders in Ireland. It provides medical services at a significantly reduced cost for users of the medical card. Pharmacies are able to claim and receive reimbursement by the HSE for medications dispensed for GMS patients.
2. Drug Payment Scheme (DPS): this scheme enables patients and family units to limit medical expenses on prescription medications. A certain threshold is placed monthly on drug payment scheme users, once the threshold has been reached, medications purchased after are covered by the scheme. The current threshold for drug payment scheme users is 80 Euro. Pharmacies are reimbursed by the HSE for DPS-covered prescriptions.
3. Long-Term Illness Scheme (LTI): Pharmacies are reimbursed by the HSE for providing medications for patients on this scheme. The conditions are usually of a chronic nature and require ongoing treatment. The patients get medications from the pharmacy with no charge. Patients on a long-term scheme include diabetes, epilepsy, chronic obstruct pulmonary disorders (COPD), neurological disorders, etc.
4. High Tech Drugs Scheme: This scheme covers expensive, specialized medications and treatments for specific medical conditions. The HSE provides reimbursement for medicines under this scheme.
5. Medical Card Prescription Levy: A prescription levy is collected and charged by pharmacies on medical card holders for each prescription item dispensed. The HSE may reimburse pharmacies for this levy charges.

Claims under each scheme are submitted electronically by pharmacists usually at the commencement of a new month. Unlicensed medications are not covered or reimbursed by the Health Service Executive.

There are issues affecting the timeline of reimbursement to pharmaceutical industries in the Irish sector. Reimbursement delay results in hindering patients' access to treatments and medications. The factors that affect reimbursement and cause delays include negotiations of pricing, the development of prescribing guidelines, and management protocols (Doyle-Rossi and Gallagher, 2022).

The negotiations of pricing between the government and the manufacturing company vary depending on factors such as availability of medicine in other EU countries, innovativeness of the medication, etc. Delays may also occur as a result of processes involved in adding a medication to the reimbursement list.

The timeline to obtain reimbursement from state manufacturing companies due to lack of funding can be significantly long. Manufacturing companies must achieve a set of standards by the HSE in order to place their drugs on the reimbursement list. The lack of transparency concerning the timeline of reimbursement processes can be frustrating to stakeholders of the pharmaceutical industry including patients.

Ireland ranks as the 27th out of 37 countries in time of availability of medicines by the HSE. The standard 180 day rate set by the HSE for reimbursement time frame was delayed further for availability in the Republic of Ireland by 567 days (Doyle-Rossi and Gallagher, 2022).

The reference pricing system introduced in 2013 aimed to reduce the cost of pharmaceutical products and improve the healthcare system. This is a system introduced by regulatory authorities to control the cost of pharmaceuticals and medical treatments. The healthcare sector was encouraged to adopt measures of substituting expensive medications with generics and reference pricing.

Ireland's reference pricing when compared to other European countries is significantly lower (Medicines for Europe, 2022).

The Irish healthcare sector has had no increase on financial allocation over the last decade even in the event of an ageing population (Doyle-Rossi and Gallagher, 2022). The HSE was stated to have exhausted its additional budget within 8 weeks. The budget for the state's pharmaceutical sector was estimated at 2.6€ billion in 2022.

These factors have impacted strategies such as reference pricing. Medications not within the reference pricing are covered for by patients because they cost more.

The combination of various factors, including low reimbursement rates and delays, have significantly impacted the supply of medicine in the Republic of Ireland.

Rising Population

There has been an increase in the ageing population in the Republic of Ireland over the past years by 8%. The increase in ageing population from ages 65 as resulted in the demand of chronic medications. Ireland is predicted to have more ageing population in the next 20 years as the life expectancy has increased to 82.2 years.

The implications of demographic shifts affect the pharmaceutical sector, placing higher demand on certain medications. The older population is more likely to require long-term illness medications, which are ongoing. This can drive up the pharmaceutical expenditure of Ireland, requiring more investment by the government in this sector.

There is a need for strategic planning by governing and regulatory bodies in preparation for the projected future of the pharmaceutical and health sector in Ireland.

2.5 Best Practices and Innovations in Pharmaceutical Supply Chain Management

Drug shortages impact the country economically through financial setbacks and effects on population health. Delayed treatments can have physical or psychological impacts on humans that could become fatal. Healthcare professionals are left dissatisfied and frustrated because of the overwhelming nature of these situations (Shukar *et al.*, 2021).

Improvements must be made to the supply chain to facilitate better drug availability. In the US, the FDA commenced a Drug Shortage Program (DSP) with the aim of evaluating the entire pharmaceutical supply chain to minimize drug shortages, and also to evaluate the impact caused by COVID-19 (FDA, 2023).

Some mitigations which could be adopted to improve the supply of medicines to retail pharmacies include:

- Transparency in the supply chain: Communication among stakeholders in the pharmaceutical industry is integral to the evolving of the supply chain (Shukar *et al.*,

2021). The need for transparency from manufacturers to wholesalers, regulatory authorities and retail pharmacies can aid to improve supply chain challenges and mitigate disruptions. Shared information about upcoming shortage provides pharmacies with the opportunity to order ahead and prepare in the event of drug unavailability.

Wholesalers are better able to serve retail pharmacies when drug companies and manufacturers provide real-time information on supply issues, reasons for unavailable, and return dates. Regulatory authorities are also better able to serve the public when the accurate information on drug shortages and supply issues is provided.

- Strengthen regulations: Encourage more generic manufacturers in Ireland and strengthen importation of raw materials from other sources such as EU countries or other international suppliers to reduce dependency on global suppliers such as India and China (Scholz., 2020). The implementation of regulation and extensive research, such as the United State to mitigate drug shortages. The adoption of other regulations, such as France, to involve more healthcare professionals in the inventory, logistics of supply (Shukar *et al.*, 2021). Information concerning available medicines are shared among healthcare providers. Pharmacists inform prescribers on alternatives available and reach out to suppliers to query cause of shortages and return dates. This encourages collaboration and transparency among healthcare professionals, eliminating waste through accurate inventory, no overstock, and demand for medicines only when needed.
- Review of previous years: Implementation of the European verification system to monitor data across EU countries, including Ireland, to monitor data through the supply chain (Bouvy and Rotaru, 2021). Data collection from retail pharmacies on consumer-based use of medicines.
- Adoption of multiple suppliers: The use of multiple suppliers by retail pharmacies can help mitigate supply chain issues. This is a strategic approach that encourages the resilience, adaptability, flexibility, and efficiency of the supply of medicines in the supply chain (Ivanov, 2022). This measure minimizes supply chain disruptions by placing pharmacies ahead of drug shortages due to varying outsourcing options. Pharmacies are able to mitigate issues that arise in the supply chain such as demand

fluctuations, supplier failure, demand forecasting issues, etc. Multiple suppliers distribute risk and prevent supply failures more likely to occur with a single source, known as risk diversification.

Multiple suppliers encourage preparedness and absorb shock from unexpected events in the pharmaceutical industry. Pharmacists are able to mitigate these risks and provide optimal care for their patients. The adoption of multiple suppliers also encourages agility in the supply chain for the supply of medicines.

- The increase of expiry dates: The United States employed the use of increase in expiry dates of medications such as coral snake antivenin in the event of drug shortages (Shukar *et al.*, 2021).
- Establishment of raw materials and generic manufacturer in Europe, investment through regulations in the setting up of more localized production of generic brands to reduce dependency on international market (Fischer *et al.*, 2023). Also, the investment by the government to provide incentives and encourage production of raw materials across Europe, (European Parliament, 2020).
- Improving access to unlicensed medicines by facilitating the movement of medicines both licensed and exempt through EU countries (European Parliament, 2020)

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Overview of Research Methodology

No	Primary Data	Part A	Part B
1.	Approach	Quantitative Analysis	Qualitative Analysis
2.	Design/Philosophy	Positivism	Pragmatism
3.	Source/Strategy	Questionnaires- Google survey form	Zoom and In-person interviews
4.	Structure	1 section each consisting of 18 questions	5-20 minutes conversation based on 3 questions
5.	Participants	Retail Pharmacists- 120 (86) Wholesalers- 10 (9)	Retail Pharmacists- 7 Pharmacy Technician -1

Table 2: The overview of the research method

3.2 Research Design and Approach

The author applied the use of quantitative and qualitative analysis to determine if there were issues affecting the supply of medicines to retail pharmacies in Ireland. These methods include the use of questionnaires and interviews via zoom meetings and in-person recordings.

The author generated a QR code from an online QR generator website, printed hardcopies, and distributed physically both the copies of the code to participants as well as electronically via online platforms such as LinkedIn, Facebook, etc., for the survey. The questions were designed by the author to obtain information on the knowledge of drug shortages, its existence, impact, causes and mitigative approaches implemented. Questions on the use of

multiple suppliers was asked by the author to evaluate the impact of supply issues across multiple wholesalers

The author was able to gain information on the state of the supply of medicines in Ireland by observing the differences and similarities between the pharmacists and wholesalers and proposing suitable recommendations.

For the qualitative analysis, the author interviewed the participants via online platform, Zoom and recorded conversations which occurred in person. The interview aimed to better understand the perspectives of the pharmacists on the state of the drug supplies in Ireland, comparing the challenges occurring prior to COVID-19 and after, methods utilized in the stores to address issues and proposed means of improving the situation.

The data was subsequently collected and compared with the literature findings in order to convey the author's viewpoint concerning the study.

3.3 Research Philosophy

The research philosophy employs both positivism and pragmatism. The evaluation of data seeks to identify drug shortages patterns and its correlations. The author employs a positivist approach of obtaining knowledge and results by means of objective observations and measurements. The use of quantitative data to analyze and evaluate factors affecting drug shortages in Ireland to extract the supply chain issues through objective data. The focus of the author by positivism approach is to highlight common and replicable variables i.e., constant causal relationships resulting in existing in the supply of medicines.

The pragmatic approach aims to provide possible solutions to potential and existing supply chain issues in Ireland after collecting and evaluating quantitative and qualitative data from stakeholders of the supply chain. The author utilizes both quantitative and qualitative data analysis approach to the research and provide practical solutions. The pragmatic approach utilized by the author allows for a holistic comprehensive understanding of the supply of medicines in Ireland and drawing practical implications.

3.4 Research Strategy

The research strategy was to evaluate the state of supply of medicines to retail pharmacies in Ireland, to explore if any issues exist, and how they can be improved on. The literature review reveals the existing supply issues but shows no approach to resolving these problems in Ireland.

All the participants; the pharmacists and wholesalers were involved at the onset of the survey on the purpose of the research being conducted by the author and it being a requirement for the completion of M.Sc. in Pharmaceutical Business and Technology.

The questionnaire was created using a google form and made easy and simple to answer by the author. The questionnaire was sent out to over 400 pharmacist participants and 50 wholesaler representatives in Ireland across all counties.

Survey questionnaire for participants

The questionnaire for both the pharmacists and wholesalers had one section and 18 questions each for the purpose of the study. The questionnaires were distributed electronically via online platforms to wholesalers and pharmacists and scanning of QR codes by pharmacists to complete the survey. The participants were reminded consequently to complete the survey at their volition.

The introductory question was to give consent permitting the use of data obtained from the research after reading through the overview of the purpose and aim of the study. All participants via the survey were informed that all data obtained from the research are kept strictly confidential and stored in accordance with general data protection regulation (GDPR). The question to give consent was mandatory and had to be answered to complete the survey.

Interview questions for participants

The interview ranged from 5-20 minutes. A copy of informed consent form and the designed questions for the interview was sent prior to the meetings to enable preparedness by the participants. There were 3 questions which factor around the current state of drug

supplies/shortages in Ireland, the participant's perspective on the cause of shortages and recommendation as priority solutions to these challenges.

The consent forms were signed and stored accordingly.

3.5 Data Collection

The primary data was collected using surveys via questionnaires and interviews. These were collected electronically. The pharmacy respondents and wholesalers were selected based on their practice and supply of medicines in Ireland.

The questionnaire comprised of 18 questions, commencing from identifying what sector of the pharmaceutical industry the participant was, i.e., a retail pharmacist, pharmacy technician or a representative of a wholesaler while the interviews consisted of 3 questions to determine the retail pharmacist's or technician's perspective on the issues of medicine supply.

The questionnaire for the pharmacist and pharmacy technician commenced with information on work experience. It evolved into questions on the state of supply of medicines, which if existent is followed up with reasons for the challenges they face.

The author established through the questionnaire the number of suppliers each pharmacy has and factors each pharmacist presumed and had knowledge of were the reasons for supply issues.

From the questionnaire, the author sought to establish if there were any issues with supply of medicines, their frequency, possible reasons, adaptation by pharmacists and potential solutions to these issues. The questionnaire ended with request for availability of participants for follow-up interviews.

The questionnaire for the wholesalers was similar to that of the pharmacists and pharmacy technicians with a few differences. The participant is to indicate their years of experience, the number of medicines distributed and the number of pharmacies distributed to. This was to ascertain the scope of the wholesaler in the Irish market and the significance of their impact on the supply of medicines.

The questions also included the potential challenges faced by wholesalers in the supply of medicines to retail pharmacies and recommendations for improving the supply.

3.6 Sources

The questionnaire was distributed via electronic devices and in person using platforms such as LinkedIn and Facebook. The participants distributed to were Retail pharmacists and wholesalers in Ireland.

86 pharmacists and 9 wholesalers completed the survey, while 7 pharmacists and 1 pharmacy technician were further interviewed on the research topic.

The author collated the results from the quantitative analysis and evaluated the information using pie and bar charts. The results from the wholesalers and retailers were compared to find similarities and differences.

Selection of Participants

The retail pharmacists and pharmacy technician were selected based on their practice in Ireland, some were in pharmacist association groups, others were indicated as professionals on LinkedIn.

The wholesalers were selected based on identification by pharmacists as major suppliers of medicines, they were reached out to also via LinkedIn.

3.7 Ethical consideration

All interviews and surveys were carried out with caution. The participants were informed and given a brief introduction on the research and its purpose, also that it was part of the author's requirement to obtain a Masters' degree. All interviewees signed informed consents before conducting interviews. All interviews were recorded and transcribed for data collation.

The participants were informed participation was voluntary and they could withdraw their data at any time.

3.8 Conclusion

The primary research involved a quantitative approach using questionnaires containing 18 questions and qualitative approach with 3 in-depth questions. The survey involved participants in the supply of medicines which were retail pharmacists/ pharmacy technicians and wholesalers. The survey utilized positivism which to ensure qualifiable results and deductions. Interviews were carried out to further obtain qualitative results for the research.

The data collected was organized and prepared to ensure there were no errors and all information was accurate.

The data was evaluated for commonalities in the questionnaires and interviews. Any trends or reoccurring patterns within the supply chain was evaluated.

The interviews were transcribed and documented. The key insights were extracted and compared with reference information to confirm causal factors of shortages and recommendation for improvement.

The data analyzed was interpreted to contribute to the understanding of supply chain.

Based on the data analyzed, recommendations in relation to the research objectives was recorded and stated.

CHAPTER 4: FINDINGS AND ANALYSIS

4.1 Overview

This chapter provides the findings and analysis of the questionnaire survey conducted among retail pharmacists, pharmacy technicians and wholesalers in Ireland. The survey generated responses from 86 pharmacists and 9 wholesalers. The data generated from the survey provided the author with insight on the state of the supply of medicines to retail pharmacies in Ireland. This provided the author with conclusive evidence of the supply of medicines in Ireland and possible recommendations to improve the supply chain.

The data analyzed from the interviews conducted with retail pharmacists provided depth to the research questions and helped to determine and highlight consistency with the questionnaire results and literature review on the supply of medicines in Ireland.

The mixed-methods approach allowed for a comprehensive exploration of the challenges and opportunities in the medicine supply chain from the wholesalers to retail pharmacies.

4.2 Qualitative Analysis: Demographics

4.2.1 Response rate

The surveys were distributed to 120 pharmacists/pharmacy technicians and 10 wholesalers. 86 representatives of retail pharmacy and 9 out of 10 wholesalers completed the survey yielding 71.6% and 90% response rate.

The significant response rate was achieved through reminders and follow-ups to the participants.

4.2.2 Level of Experience

Out of 86 participants representative of the retail pharmacists, 75 participants indicated their level of experience while 11 did not. 45 participants had 0-5 years working experience, 13 had 6-10 years, 10 had 11-15 years, while 7 participants had more than 15 years.

More than half of the participants had a working experience of 0-5 years as retail pharmacists/pharmacy technicians.

The survey filled by the wholesalers had 3 participants with 0-5 years' work experience, 3 with 6-10years, 2 with more than 15 years working experience, and 1 with 11-15 years' work experience as wholesalers.

	No	Level of Experience				Overall Response Rate
		0-5years	5-10years	11-15years	More than 15years	%
Participants						
Pharmacists/pharmacy technicians	75(86)	45	13	10	7	71.6
Wholesalers	9(10)	3	3	1	2	90

Table 3: Response rate of questionnaire survey

4.2.3 Questions: Are there Issues with the supply of medicine in Ireland?

a.) Pharmacist/Pharmacy Technician: The responses obtained from the pharmacists/pharmacy technicians were majorly agreeable to the apparent issues with the supply of medicines in Ireland.

80 participants responded and admitted to the present issue of drug supply in Ireland, 4 participants were not sure of the state of medicines supply while 1 indicated there were no issues and 1 indicated not applicable.

Are there issues with the supply of medicines to retail pharmacy in Ireland?

86 responses

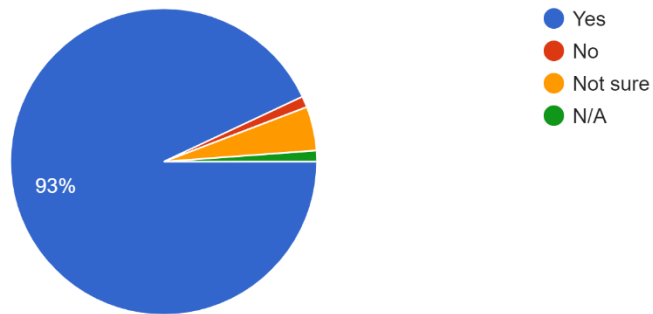


Figure 11: Are there issues with the supply of medicines to retail pharmacy in Ireland?(pharmacists/pharmacy technician)

b.) The wholesalers responded on a ratio of 7:2, with majority agreeing to the existence of supply issues to retail pharmacies in Ireland.

Are there issues concerning supply of medicines to retail pharmacies?

9 responses

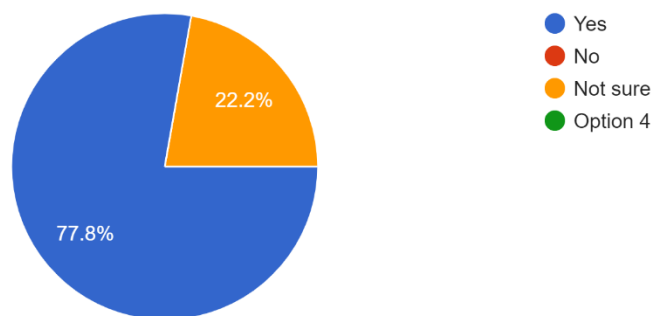


Figure 12: Are there issues concerning supply of medicines to retail pharmacies?(wholesalers)

4.2.4 Distribution of medicines

a) Pharmacist/Pharmacy Technician: Do you have more than one supplier?

The question on the use of more than one supplier by each pharmacist for a retail pharmacy is to highlight the impact of issues across the wholesalers.

83 of the participants indicated they had more than one supplier of medicines to its pharmacy while 1 participant each indicated they had just one supplier, 1 was not sure and 1 indicated not applicable. It is of importance to note a highly significant number of participants had more than one supplier of medicine.

Do you have more than one supplier of medicines?

86 responses

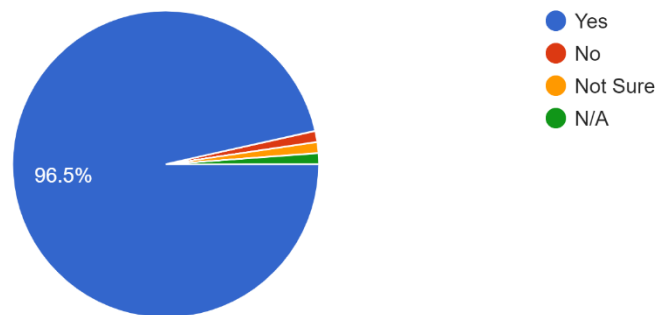


Figure 13: Do you have more than one supplier of medicines?(pharmacists/pharmacy technicians)

b) Wholesaler: How many medicines do you have authorization to distribute and how many do you distribute?

Out of 9 wholesalers, 5 have authorization to distribute more than 50 medicines, 2 have less than 20 medicine authorization to distribute, and 2 have 21-50 medicines authorization to distribute to pharmacies in Ireland. A majority of the wholesalers distribute to more than 50 pharmacies, 2 distribute to more than 20 pharmacies, while 2 distribute to less than 20 pharmacies in Ireland.

How many medicines do you have authorization to distribute?

9 responses

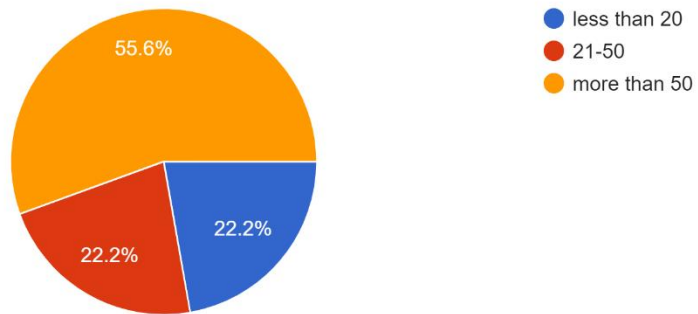


Figure 14: How many medicines do you have authorization to distribute?(wholesalers)

How many pharmacies does your company distribute to across Ireland?

9 responses

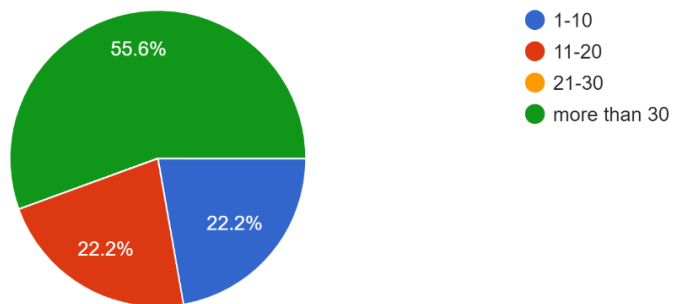


Figure 15: How many pharmacies do you have authorization to distribute?(wholesalers)

4.2.5 Top Major Wholesalers (Suppliers of Medicine)

Out of the 86 participants, 70 responded which of the major drug suppliers distributed medicines to their pharmacy in Ireland.

Wholesaler	Number of times indicated
United Drugs (UD)	62
Uniphar (UP)	62
Pharmaco	1
PCO	16
Clonwell	3
Clinigen	4
IMED	5
Axium	2
Medisource	4
O'neills	1
Baxter	1
Johnson and Johnson	1
Pharmed	1
Pfizer	1
Bayar	1
Pharmax	1
KRKA	1
HSE High tech hub	1
Lawlor's Pharmaceutical	1
Alma	1
EMP	1

Table 4: Results showing top major wholesalers

The major wholesalers were evaluated to be United drug and Uniphar with 62 respondents indicating this. 16 respondents also indicated PCO manufacturing as a major supplier. 5

pharmacists indicated they were supplied by IMED, 4 pharmacies were supplied by Clinigen as well as Medisource, 3 were supplied by Clonwell, 2 were supplied by Axiom, while Pharmaco, O'neills, Baxter, Johnson and Johnson, Pharmed, Pfizer, Bayar, Pharmax, KRKA, and HSE High tech hub supplied one pharmacy each.

United Drugs and Uniphar were indicated by the respondents to be major suppliers in Ireland, distributing to more than half of the of the participants' pharmacies.

4.2.6. Most common issues affecting the supply of medicines in Ireland

a) Pharmacists/Pharmacy Technician:

The top major issues identified by participants as the most common issues affecting the supply of medicines in hierarchy are unavailability of medicines, distribution delay, and difficulty to order. Closely behind are communication issues faced by retail pharmacies with wholesalers.

One respondent wrote, "We often do not know the reason for unavailability so it is possible that some are due to regulatory constraints".

The issues and challenges faced by retail pharmacists were highlighted to occur consistently. Shortages were noted to occur at least once every week. Pharmacists lamented their frustration on having to deal with drug unavailability every day of the week with very minimal information on return dates.

70 participants responded they had drug shortages at least once a week, 9 responded every other week while 6 responded not so often.

The majority of the participants indicated the level of drug unavailability occurred more often than they would prefer which significantly impacted their work activities and ability to serve the patients optimally.

Participants also indicated in the questionnaire drugs which were observed to be mostly unavailable. These were identified to be majorly prescription only medicines which are drugs prescribed by healthcare professionals for different conditions. Over-the-counter medicines were also indicated to be unavailable and the supplies being affected by

various factors. Unlicensed medicines and high-tech medications followed closely behind as being impacted by drug shortages.

Overall, when asked to identify which of the medication sector in the pharmacy was facing shortages impacted by supply chain issues, participants picked more than one sector.

81 participants identified Prescription only medicines as being unavailable.

53 participants indicated Over-the counter medicines to be unavailable.

33 identified unlicensed medicines as either unavailable or difficult to order, while 18 indicated high tech medicines as more unavailable.

Pharmacy respondents when asked what reasons were made available as the causes of drug unavailability and shortage, the responses comprised of regulatory constraints, unavailability of medicines with no specific information;

The Ukraine-Russian war and Brexit were identified as a political influence which may have influenced the supply chain.

The Irish market providing packaging services more than manufacturing services which may be influenced in the case where there were raw materials being unavailable.

The low reimbursement rate by the government resulting in less manufacturers distributing to Ireland.

The COVID-19 pandemic is stated to have significantly impacted global pharmaceutical industries.

A participant emphasized on distribution monopoly in Ireland resulting in supply chain issues.

The presence of many unlicensed medicines.

The most common information known to participants were manufacturing issues.

Majority of the reasons behind a drug shortage is unknown to the correspondents which can be very dissatisfying as a healthcare provider.

If any, what are the most common issues/challenges to the supply of medicines you face? Please indicate the most common three (3)?

86 responses

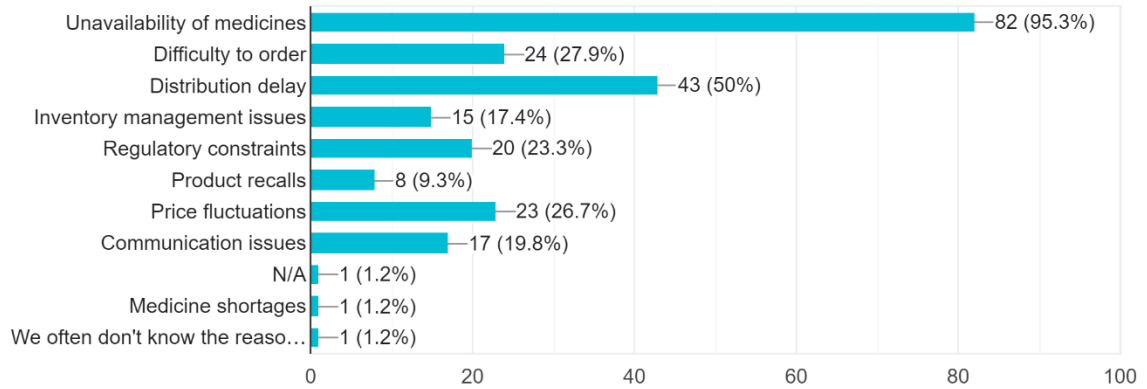


Figure 16a: Most common challenges in the supply of medicines (Pharmacists/pharmacy technicians)

How often do you experience drug shortages?

86 responses

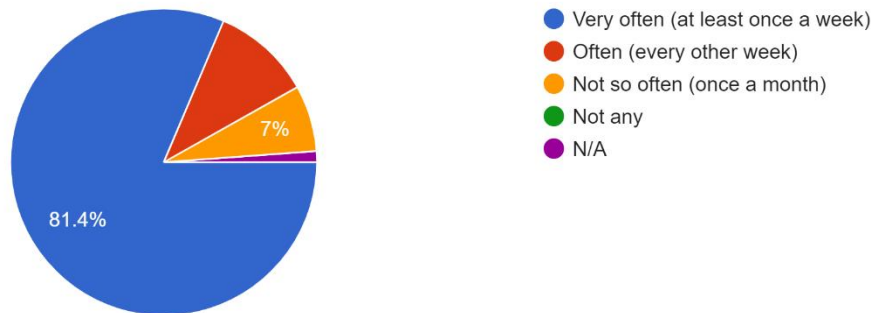


Figure 6b: How often do you experience drug shortages?

What section of medicines are often unavailable or difficult to order in?

86 responses

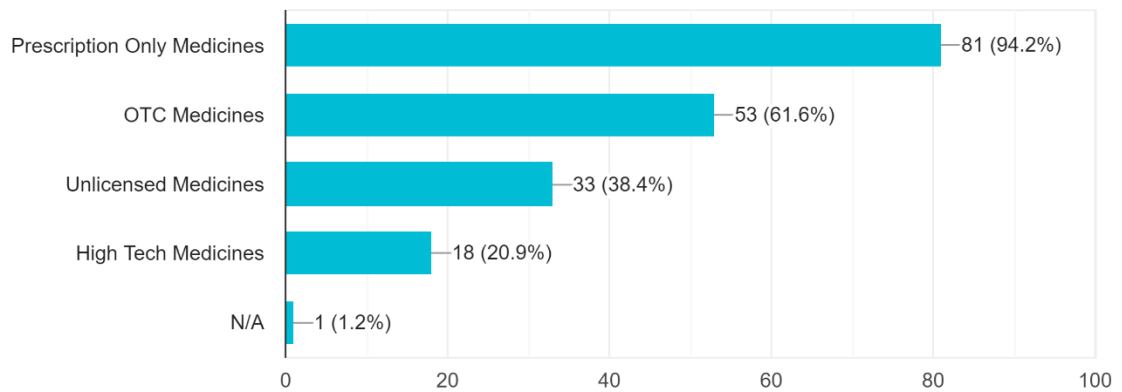


Figure 6c: Most unavailable medications

b) Wholesalers: The wholesaler respondents identified the following as the major issues with the supply of medicine to retail pharmacies as Unavailability from manufacturers, Increased demand, and shortage of components. Transportation and logistics were also highlighted as major issues affecting the supply of medicine.

Some of the reasons further highlighted by wholesalers include discontinuation by manufacturers, irregular supply from agency, shortage of components, and quality issues.

If any, what issues (at least 3) have affected the supply of medicines to retail pharmacies?

9 responses

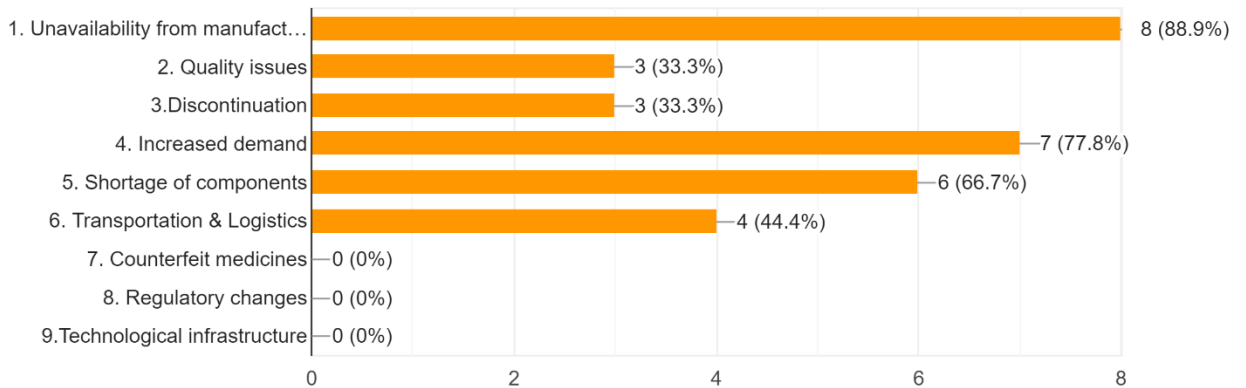


Figure 17: Major challenges with the supply of medicines (wholesalers)

Management of effect of supply chain issues by Retail pharmacies participants

Retail pharmacies respondents were asked how they were able to manage drug unavailability and supply issues. Participants utilized a variety of methods to handle drug shortages in their pharmacies.

49 Participants employed inventory management to manage drug distribution among patients.

40 participants employed the use of demand forecasting to prioritize ordering of medicines for patients.

64 participants utilized the option of more multiple suppliers to ensure medicines are orders for their patients.

3 participants stated prioritizing medicines for those who needed them more than others. An example being the case of Ozempic for diabetes and use in the elderly over the use in people for weight loss.

Some participants managed the supply of medicines in the event of shortages by limiting supply to once a month for patients rather than bulk purchases.

A pharmacist stated most of the time they employ other methods such as sourcing for generics by different manufacturers. The method of manipulating dosing such as providing lower strength medications in more numbers e.g., ramipril 2.5mg is available whereas ramipril 5mg is unavailable, the pharmacist provides ramipril 2.5mg at 2 tablets each for a patient taking a higher strength was utilized by 4 respondents.

Most times, respondents state having to reach out to prescribers to change the medication prescribed entirely in the event of unavailability of alternatives.

A respondent indicated medications are provided on a first come, first serve basis. Some respondents indicated medicines were prioritized for regulars of the pharmacies in comparison to new patients.

Overall, participants mostly implemented the use of multiple suppliers as a means to improve drug availability and better manage patient expectations. Participants also employed the use of inventory management and demand forecasting as a means to better serve the patients in the events of drug shortages caused by supply chain issues.

4.2.7 Factors influencing shortages in Ireland and means of improvement

a). Retail pharmacies respondents were inquired on what factors might have affected the supply of medicines in Ireland; a majority indicated COVID-19, Brexit, and unanticipated demand were influencers. 42 participants indicated all the factors stated which were COVID-19, Brexit and unanticipated demand of medicines were major factors influencing the shortage and supply issues in Ireland. Some participants 11 in number identified COVID-19 as a sole factor, 8 selected Unanticipated demand, while 6 selected Brexit.

Further observation with responses to the question showed some participants identified both COVID-19 and Brexit as the major factors influencing drug shortages and supply issues in Ireland.

Some participants gave more reasons and factors influencing shortages and causing supply issues in Ireland:

A participant emphasized unexpected increase in demand coupled with pharmaceutical manufacturing companies investing major resources in vaccine developments may have influenced the supply of medicines in Ireland. Another participant stated supply chain issues were primarily caused by issues with sourcing of Active Pharmaceutical Ingredients.

The drug shortages and supply chain issues may also be a result of the mixture of war indicated one respondent while another responded from the government pricing point of view, stating the factors lie in the government’s reimbursement strategy as there were small profit margins for generic medicines.

Finally, a respondent stated a major cause or factor influencing drug supply is the unanticipated demands such as in the case of Ozempic, a diabetic medicine, marketing for cosmetic reasons and cause an unanticipated increase in demand leaving manufacturers with limited forecast and resulting in unavailability for use by primary users which are diabetics.

Which of the following do you think has impacted drug shortage issues in Ireland?

86 responses

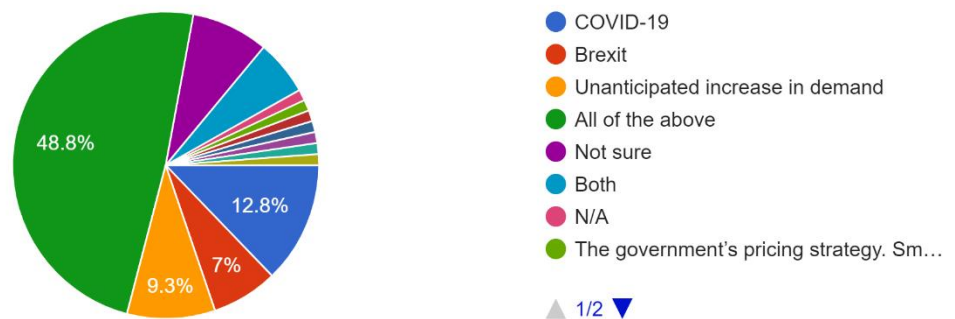


Figure 18: Factors impacting drug shortages (pharmacists/pharmacy technicians)

When asked if there were issues with the supply chain in Ireland, 39 participants indicated yes, while 31 were not sure, 11 indicated there was no issues and 5 not applicable. A majority of the participants identified existing issues to the supply chain of medicines.

On the improvements of supply since April 2021, post COVID-19, 48 participants indicated there had been no improvements to medicine supply, 20 participants indicated there had been

improvements post COVID-19, 16 participants were not sure, and 1 participant indicated no response.

When asked if the supply of medicines to retail pharmacies in Ireland could be improved on 63 participants, a majority indicated yes.

Can there be improvements made to the supply of medicines to retail pharmacies?
85 responses

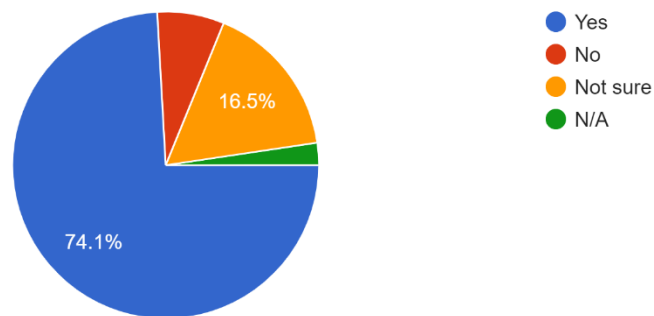


Figure 19: Can there be improvements made to the supply of medicines to retail pharmacies? (pharmacists/pharmacy technicians)

Recommendations on the improvements of the supply of medicines by respondents.

a) The retail pharmacy respondents indicated certain recommendations to cause improvements to the supply of medicines. These recommendations aim to mitigate existing issues in the supply of medicines to retail pharmacies in Ireland.

There was a variety of responses from the correspondents, the answers have been evaluated, collated and summarized. 18 participants indicated the need for government interventions such as better pricing and reimbursement rates. More flexibility in regulations and improvement to regulations regarding parallel import.

14 participants identified communication gap as a major issue to be resolved. The need for transparency and information being made available to all healthcare providers would serve to improve the supply chain through transparency.

Pharmacists emphasized on frustration caused by lack of information reaching doctors and dentists who prescribed medicines with no knowledge of their unavailability resulting delay for patients to obtain medicines. Therefore, there is the need for wholesalers and manufacturers to provide information concerning drug supply issues.

7 participants indicated demand forecasting as an important recommendation and solution to the drug supply issues. By obtaining information through collaboration with other stakeholders in the supply chain, the issues could be mitigated. Planning by manufacturers and purchasing by wholesalers based on accurate demand forecasts would significantly impact the supply of medicines.

6 participants recommended less restrictions to the role of pharmacist in the supply of medicines. A major recommendation was to allow for pharmacists to easily dispense Unlicensed medicines especially in the event of drug shortages, reducing back and forth conversations between healthcare providers and time wastage.

5 participants recommended a better and fair allocation of medicines by major drug suppliers to all pharmacies. Wholesalers should distribute medicines to all pharmacies especially in the event of shortages according to demand and not favoritism.

4 participants recommended regulatory bodies should incorporate penalties for failed demand forecasting by manufacturers and wholesalers. All sectors in the supply chain are to be held accountable for failure to meet needs based on inadequate demand forecasting.

Finally, 2 participants recommended the addition of more suppliers to the Irish market to increase healthy competition and better drug supply while 1 participant recommended syncing cycles.

Recommendations by Pharmacists/Pharmacy technicians	Response Rate	Recommendations by Wholesalers	Response Rate
Incorporating technology/Innovation	3	Direct orders to manufacturers	1
Better Communication; transparency, informing all healthcare professionals	14	Demand forecast by manufacturers	2
Sync cycles	1	Better communication Supplier relationship	4
Demand forecasting by wholesalers	7	Less strict regulations	1
Penalties for failed demand forecasting	4	Innovation/Technology	2
Less restrictions to pharmacist rights More ULM	6	Local production	1
Improvement by government; pricing, regulations, parallel imports, flexibility	18	Increase importation	1
More suppliers	2		
Fair allocation	5		

Table 5: Response rates on recommendations to improve the supply of medicines to retail pharmacies in Ireland

b). Wholesalers were also of the opinion that the supply of medicines in Ireland can be improved on as 6 participants indicated yes while 3 indicated not sure. From table 5 above the correspondent of wholesalers are detailed.

The recommendations by wholesalers were a mix of options. It varied slightly in regards to its impact on the supply chain in Ireland.

4 wholesalers recommended the need for better communication among the supply chain. A better supplier-relationship would guarantee and encourage transparency in the supply of medicines.

2 wholesalers recommended the use of demand forecasting by manufacturers. Through this the manufacturers are better able to produce medicines according to demand.

2 wholesalers recommended the integration of innovation and technology into different sectors of the pharmaceutical industry to enable advancement.

1 participant recommended direct orders to manufacturers while another participant recommend increased importation. This may provide multiple manufacturing options and increase healthy competition.

1 participant recommended increase in localized production of medicines. This would eliminate dependency on international manufacturers.

A participant also recommended less stringent regulations governing the supply of medicines in Ireland.

Can these issues be improved on?

9 responses

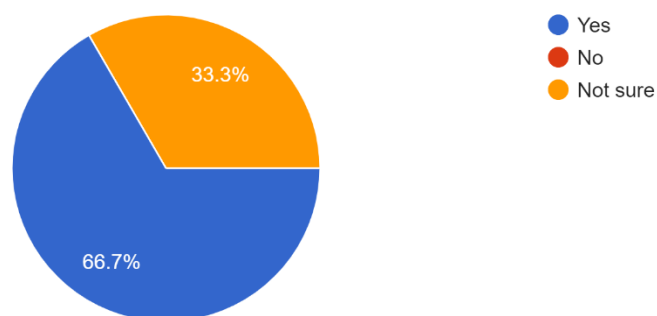


Figure 20: Can these issues be improved on? (Wholesaler)

4.3 Qualitative Analysis: Interview Insights

The author reached out to 7 retail pharmacists and 1 pharmacy technician for the interview on the topic of issues in the supply of medicine and the possibility of improving the supply of medicine in Ireland, 8 responded. Their level of work experience ranged from 2 to more than 15 years

The interview questions allowed for in depth perspective of the participants on the issues affecting supply of medicines. The interviews aimed to capture the perspectives of pharmacists in the state of supply chain issues and the potential for improvements available.

Drug shortages in Ireland

On the question of drug shortages in Ireland, all 8 of the interviewees highlighted the severity of drug shortages across Ireland, the unavailability of medicines had impacted the community pharmacies gravely. There were scenarios of patients on long term medications being unable to get their drugs, having to get their medications changed to a similar and available medicine, having to wait and hope a medication would become available or opting for a more expensive unlicensed medication not covered by the government.

An interviewee responded the event of drug shortages was well-rounded and had affected all of Ireland. The supply issues were significantly impacted by COVID-19 pandemic and various sectors of the pharmaceutical industry was recovering from its impact. Another interviewee with background in hospital pharmacy as well as retail pharmacy stated, “the current state of shortages is a mess to start with. They are really bad”. The participant stated the degree of severity of drug shortage was such that low-dose aspirin which was the only drug of choice to prevent preeclampsia in all stages of pregnancy for women was unavailable. This the participant stated to be outrageous.

The number of drugs unavailable was significantly more than the onset of COVID-19 stated another interviewee.

A participant working in a constantly busy retail pharmacy expressed how very challenging working in the community pharmacy had become. Medicines which were never short in supply or unavailable had now become difficult to get. Pharmacists were tasked with

searching out loopholes for medicines not covered by government schemes in order to make it available for their patients.

The pharmacists could only work with the allocation provided by wholesalers for some medications such as Ozempic. No new patients could be accepted on allocated medicines because one of the old and regular patients would have to be replaced.

The supply disruptions resulting in drug shortages were considered to be caused by various factors.

7 of the participants highlighted the Health Service Executive (HSE) and COVID-19 as major contributors to the supply issues in Ireland due to the low reference pricing on majority of medications compared to other European countries by the former and disruptions caused in the event of the latter. These low pricing discouraged pharmaceutical industries from supplying medications to Ireland as it is less financially beneficial. Other European countries with better pricing reference could afford to order medicines in the event of drugs becoming more expensive from manufacturers due to issues such as low raw materials, shortages, etc. An interviewee stated most pharmacies opt to supply patients with cheaper generic medicines due to the low reimbursement rates provided by the HSE. Pharmacies suffer losses in the event of supplying patients with more expensive generics. Manufacturers of non-generics also suffer losses because pharmacies prefer not to dispense their brands for their patients, therefore reducing availability of branded medicines in the Irish market.

COVID-19 was also highlighted to be a major influence resulting in the disruption of supply of medicines. Interviewees stated there were still backlog in the manufacturing industries caused by the global event of COVID-19. They stated that the countries which supplied pharmaceutical industries raw materials and active pharmaceutical ingredients to Ireland, such as India and China were operating on less work capacity thereby impacting the volume of excipients and active pharmaceutical ingredients shipped out to pharmaceutical industries further impacting the supply chain and medicines available. COVID-19 also accounted for manufacturing issues.

4 interviewees identified Brexit, the Ukraine-Russian war, and manufacturing delays as factors resulting in supply issues and drug shortages. An interviewee stated a major

contributor by the United Kingdom's exit from the EU, also known as Brexit greatly affected the Irish market. The reason being, the Ireland and the UK were the only predominantly English-speaking countries in EU, it had always been a requirement that all medicines provided for Ireland and the UK have all labels and information written in English. The UK is known to have a very large population, on its exit from the EU, the requirement for English packaging was solely affixed to Ireland with its smaller population. Manufacturing industries were reported by the interviewees to be less inclined to manufacture medicines for a smaller population with low pricing by the government. The Irish government would have to provide better reimbursement rates for more medicines production.

The events of unanticipated demands were also stated to have impacted the supply chain. A pharmacist identified the scenario of Ozempic, a treatment for diabetes, advertised by celebrities for the treatment of weight loss. This resulted in great increase in demand for Ozempic in various strengths which was not forecasted by manufacturers as well as wholesalers. Another interview identified the shortages of Hormonal Replacement Therapies (HRT) such as Utrogestin caused by campaigns for menopausal women.

Some drug shortages occurred with no rationale to the cause such as the shortage of Doxazocin to treat High Blood Pressure (HBP).

An interviewee pointed out while some manufacturing companies caused drug unavailability for genuine and understandable reasons such as quality issues and manufacturing delays, others caused drug shortages because of change of packaging. "It is ridiculous that they stopped manufacturing or placing these drugs in the market because they want to change the pack size. They should at least give us prior notice" stated another interviewee.

Recommendation for improvement

The author provided a list of possible recommendations for the improvement of the supply of medicines in Ireland and encouraged the interviewees to identify their top 3 solutions.

6 of the interviewees recommended more transparency by wholesalers and manufacturing companies to all healthcare professionals on the issues concerning shortages. There should be ample and prior notice to unavailability of medicines to enable preparedness in the pharmacy. The interviewees also suggested wholesalers and the HPRA provide more up-to-

date and real-time information on drug shortages and supply issues. Sometimes the information gotten from the wholesalers differ from the government website, hence the need by the interviewees for these bodies to be more transparent. Realistic return date should also be provided by manufacturers and wholesalers so pharmacists can consider alternatives and inform patients.

5 of the interviewees recommended better pricing and reimbursement rates by the government for medicines to encourage manufacturing companies to distribute more medicines in Ireland.

4 of the interviewees also highlighted and recommended the need for there to be less stringent rules by the regulatory bodies on pharmacists and more demand forecasting by wholesalers and manufacturers. The processes involved in the dispensing of unlicensed medicines can be quite tasking for the interviewees especially in the event of shortages. The minimal to no reimbursement rates as well need to be addressed by governing bodies to enable ease and flow in the supply of medicines to the community.

The need for manufacturers and wholesalers to put more effort in demand forecasting is defined as critical to improving medicines supply and reduce drug shortages in Ireland. Drug companies should in the event of campaigns for medicines use provide sufficient amount ahead to minimize drug unavailability.

3 pharmacists recommended the establishment of more generic and raw materials manufacturers in Ireland while 2 recommended the better use of technology, transportation and logistics as mitigating factors in the supply of medicines.

4.4 Conclusion

In conclusion, the combinations of insights obtained from both interviews and questionnaires provides a comprehensive understanding of the current state of the drug supply chain in Ireland and outlines potential means for improvement. The merging of perspectives from diverse stakeholders within the pharmaceutical supply chain offers a holistic view to

addressing supply chain challenges to ensure patient well-being and healthcare system efficacy.

The findings highlight the critical impact of supply chain disruptions on patient care. The testimonies of interviewees and respondents resonate with a shared concern for patients who face treatment interruptions due to unanticipated shortages.

The need for communication and transparency emerges as a cornerstone of supply chain resilience. The consensus on the need for transparent communication regarding disruptions echoes that improved dialogue can mitigate uncertainties and empower healthcare providers to make informed decisions for their patients.

The call for government intervention and policy reform echoes participants' recognition of the nature of supply chain challenges. Recommendations, ranging from better pricing and reimbursement rates to local production of medicines and raw materials, indicate the need for systemic changes by regulatory bodies to necessitate improvements to the supply chain (European Parliament, 2020).

Technology as well as digital tools for real-time tracking holds promise to enhance supply chain transparency, minimize disruptions, and enable ease amongst healthcare providers.

As this study concludes, it is evident that the insights gleaned from interviews and questionnaires collectively advocate for a patient-centric, collaborative, and technology-driven approach to enhancing the drug supply chain in Ireland. The envisioned strategies emphasize not only operational efficiency but also the ethical imperative to safeguard patient well-being.

In closing, the findings emphasize that the drug supply chain is a complex, interdependent system requiring a multilayered approach. By taking these observations into consideration and embracing collaborative efforts, Ireland's healthcare system can move closer to an optimized and patient-centric medication supply chain, ultimately leading to improved patient care and public health outcomes.

CHAPTER 5- RESEARCH CONCLUSION

5.1 Answering the Research Question

Question: What methodologies can be implemented to improve the supply chain to retail pharmacies in Ireland?

From the results obtained from the quantitative and qualitative analysis, the study question of “*Can the supply of medicines in Ireland be improved?*” can be answered positively. The existence of supply issues and challenges in the Irish pharmaceutical system commencing from manufacturing to wholesalers down to retail pharmacies in direct contact with patients is highlighted.

The study therefore delved into methodologies that have the potential to enhance the supply of medicines to retail pharmacies through recommendations by the author and participants in the research. The findings from the mixed methodology approach suggest a collection of measures and strategies that can significantly improve the efficiency, transparency and reliability of the pharmaceutical supply chain. They include;

Communication and Transparency Gaps

The findings indicate the substantial gap present in communication and transparency across the supply chain. Stakeholders, especially the pharmacists voiced out their frustrations caused by the lack of proper communication and real-time information on supply chain disruptions which resulted in being unable to meet patient expectations or having to struggle to find alternatives.

Wholesalers also expressed frustration due to the limited information obtained from manufacturing companies, being the middle-men between the consumer and the manufacturers, there is need for more real-time tracking innovation to eradicate communication gaps (Shukar *et al.*, 2021)

Government Reimbursement and Regulatory Flexibility

Majority of participants of both interviews and questionnaire survey highlighted the need for government involvement through better reimbursement and pricing schemes which can significantly improve the supply chain. Better pricing and timely reimbursements of medicines would encourage manufacturers to maintain steady supply of the Irish market thereby reducing the risk and existence of drug shortages.

There should be less stringent regulations and processes concerning the dispensing of medicines such as ULMs by pharmacists to patients in the event of shortages. Evaluation of regulations should also impact the importation of medicines such as parallel imports or medicines already approved in other EU countries, this would further enhance supply chain resilience (European Parliament, 2020)

Collaborative Forecasting and Planning

Forecasting by manufacturers, wholesalers, retail pharmacists is essential to the advancement of the supply chain. By sharing data and insights across the pharmaceutical system, stakeholders can collectively anticipate demand shifts and optimize their inventory levels to reduce the occurrence of drug shortages, as well as excess or overstock situations.

Demand forecasting is a pivotal methodology to be implemented to properly manage the supply chain and provide a patient-centric system.

Lean and Agile Principles

While the interviewees were not familiar with the term lean and agile principles, they were accustomed to some of its practices through inventory methods utilized in the pharmacies. The incorporation of these principles allows for stakeholders in the supply chain to adapt faster to changes. Elimination of waste through demand forecasting and not overstocking

enables a uniform availability of medicines across the country to satisfy patient needs (Ivanov, 2022)

Transportation, Technology, and Innovations

More investment for effective transportation and logistics is paramount to every point of the supply of medicines. Investments in employees to increase availability of drivers to enable on-time deliveries is integral to patient-satisfaction.

The potential available in technology and innovation can be a promising solution to many challenges highlighted in the discussion. Innovations and digital platforms such as real-time tracking, better communication channels encourage for supply chain visibility and transparency. Although the author recognizes the challenges associated with technology adoption such as implementation costs and system integration.

5.2 Comparing results between primary data and secondary research

For this study, on the research of improving the supply of medicines to retail pharmacies in Ireland, primary data collection involved questionnaire surveys from retail pharmacists/pharmacy technicians and wholesalers, and interviews with retail pharmacists. The interviews provided in-depth perspectives on experiences and challenges faced by participants to the supply chain. Pharmacists expressed concerns about drug shortages affecting patient care, while wholesalers stated limitation to information obtained from manufacturers.

Through the primary data collection, valuable insights involving stakeholders in the supply chain in Ireland was obtained. The insights obtain were specific to the context pf understanding the challenges and opportunities in Ireland.

The secondary research involved evaluating the existing literature, government publications, and industry esports related to the supply of medicines in Ireland. The information obtained

from the literature revealed holistic overview of trends in the supply chain. This helped to contextualize the primary data findings through comparing methodologies, challenges and solutions in different countries.

The literature available although concise was not localized to Ireland. The results from the primary highlighted the intensity of supply issues and the concerns by stakeholders for mitigating factors to be adopted.

5.3 Contributions and Limitations

The study aimed to provide insights on the potentials available to the improvement of the supply of medicines specific to Ireland through the combination of questionnaire surveys and interviews. This provided a holistic view and understanding of the challenges and opportunities within the pharmaceutical supply chain.

The research identifies a collective of practical methodologies to enhance the efficacy and reliability of the supply chain and bridges the gap between academic research and practical industry applications.

Although there were major contributions by the author, there were also limitations.

The research primarily focused on methodologies for improvement of the supply chain from the perspectives of retail pharmacies and minimally the wholesalers. This emphasizes on communication gaps, inventory managements and demand forecasting, logistics, and innovation while not taking into consideration other stakeholders such as manufacturers, regulatory authorities and patients which could provide a more comprehensive understanding and viewpoint on the challenges and opportunities available.

Also, the sample size is limited in comparison to the retail pharmacies present in Ireland which is due to resource constraints and limited time frame for the research. There is also the potential for participants from interviews to reflect personal bias in their responses

5.4 Conclusions

In conclusion, the research evaluated the state of drug supply across Ireland to retail pharmacies and explored strategies and methodologies suitable for improving the supply chain. Through implementation of varying comprehensive methods such as collaborative forecasting, eliminating communication gaps and encouraging transparency, regulatory flexibility and better pricing, embracing technology and applying lean principles, there is hope for a better and efficient supply chain.

Only the cooperation of stakeholders across the pharmaceutical industry including manufacturers, wholesalers, pharmacists, and regulatory bodies can there be successful implementation of these strategies. Challenges to these changes must be proactively acted on to mitigate risks.

Finally, the recommended methodologies ultimately advocate for operational excellence in the pharmaceutical industry and prioritizes patient care. These methodologies encourage a reliable, stable and adaptive supply chain which plays an integral role in the overall healthcare system and patient wellbeing.

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APPENDICES

QUESTIONNAIRE -RETAIL PHARMACIES

Can the supply of medicines to retail pharmacies be improved in Ireland?

Hi, my name is Ife Elizabeth Anwo, I am a student at Griffith College undergoing my Master's degree in Pharmaceutical Business and Technology. I am a qualified pharmacist in Nigeria and my interest lies in the study of the supply of medicines to retail pharmacies in Ireland.

The reason for the study is to **identify if there are any issues with the supply chain to retail pharmacies in Ireland and how best to improve them.** This research is for my dissertation and is a part of the course of study to obtain a Master's degree. Below is a questionnaire to obtain information on the supply chain process between the wholesaler and retail pharmacist/pharmacy technicians. This is to explore and evaluate the supply chain challenges and how they can be mitigated.

Please note that participation is **voluntary** and your information will be kept confidential. The data from this research will be used for this research and stored following the General Data Protection Regulation (GDPR).

This survey may take about **3-5 minutes** of your time. By participating in this survey, you will be granting consent to use your data in this research.

By ticking the boxes below, you are consenting to your participation in this survey

*

For Pharmacists/Pharmacy Technician

Please tick relevant box(es)

Which of the following is your profession?

*

How long have you been in the field?

*

Are there issues with the supply of medicines to retail pharmacy in Ireland?

*

Do you have more than one supplier of medicines?

*

Please name three (3) of your major suppliers

Short-answer text

If any, what are the most common issues/challenges to the supply of medicines you face? Please indicate the most common three (3)?

*

Other...

Which of the following do you think has impacted drug shortage issues in Ireland?

*

Other...

How often do you experience drug shortages?

*

What section of medicines are often unavailable or difficult to order in?

*

Other...

What are the reasons for these challenges?

*

Short-answer text

Are there any issues in the supply chain you think contribute to these challenges?

*

If yes to no(7), please give an example

*

Short-answer text

How do you prioritize supply of medicines to patients in the event of a shortage?

*

Other...

Has there been any improvements since April 2021 post COVID-19 to the supply of medicines to retail pharmacies?

*

Can there be improvements made to the supply of medicines to retail pharmacies?

*

If yes, what do you suggest?

*

Short-answer text

Thank you for taking the time to participate in this survey.

Description (optional)

P.S. Would you be available for a 10-15 minutes interview?

*

If yes, please write down your contact details below (email address and/or phone number)

*

Short-answer text

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QUESTIONNAIRE- WHOLESALER

Can the supply of medicines to retail pharmacies be improved in Ireland?

Hi, my name is Ife Elizabeth Anwo, I am a student at Griffith College undergoing my Master's degree in Pharmaceutical Business and Technology. I am a qualified pharmacist in Nigeria and my interest lies in the study of the supply of medicines to retail pharmacies in Ireland.

The reason for the study is to **identify if there are any issues with the supply chain to retail pharmacies in Ireland and how best to improve them**. This research is for my dissertation and is a part of the course of study to obtain a Master's degree. Below is a questionnaire to obtain information on the supply chain process between the **wholesaler** and retail pharmacist/pharmacy technicians. This is to explore and evaluate the supply chain challenges and how they can be mitigated.

Please note that participation is **voluntary** and your information will be kept confidential. The data from this research will be used for this research and stored following the General Data Protection Regulation (GDPR).

This survey may take about **3-5 minutes** of your time. By participating in this survey, you will be granting consent to use your data in this research.

By ticking the boxes below, you are consenting to your participation in this survey

*

Which of the following is your profession?*

*

How long have you been in the field?*

*

What is the name of your company?

(optional)

Short-answer text

How many pharmacies does your company distribute to across Ireland?

*

How many medicines do you have authorization to distribute?

*

How many medicines do you distribute?

*

Are there issues concerning supply of medicines to retail pharmacies?

*

If any, what issues (at least 3) have affected the supply of medicines to retail pharmacies?

*

Other...

Please indicate in order of hierarchy a minimum of three (3) issues which are most occurring from above

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Short-answer text

Can these issues be improved on?

*

If yes, how best can these issues be addressed? Any suggestions?

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Short-answer text

Modification to which sector(s) of the supply of medicines would be most advantageous?

*

Other...

P.S. Would you be available for a 10-15 minutes interview?

*

Thank you for taking the time to participate in this survey

Description (optional)

If yes, please write down your contact details below (email address and/or phone number)

*

Short-answer text

INTERVIEW QUESTIONS

Interview Questions

1. Can you describe the current state of drug shortages in Ireland?
2. What do you think are the challenges or issues causing these shortages?
3. Based on the table below, what recommendations would be most suitable to improve the supply of medicines to retail pharmacies in Ireland?

The table below shows challenges causing drug shortages in no particular order and possible solutions:

No.	Challenges	Possible solutions
1.	Ireland pricing strategies and low reimbursement rate	Less stringent regulations such as ease to dispense ULM
2.	Unavailability of raw materials	Better pricing and reimbursement rates by the government
3.	Unanticipated increase in demand for certain medications	Transparency in the supply chain, better communication, and collaboration among drug companies, suppliers, and pharmacies
4.	Distribution Delay	Demand forecasts by wholesalers and adequate implementation
5.	Regulatory constraints	More generic manufacturers in Ireland
6.	Insufficient generics	Implementation of technology, better logistics, and transportation system

