

The analysis and impact of adopting
sustainable blister packaging on solid
dosage form in pharmacies in Ireland.



Griffith College

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FOR MSc IN PHARMACEUTICAL BUSINESS AND TECHNOLOGY (QQI)

RESHMA ANTONY

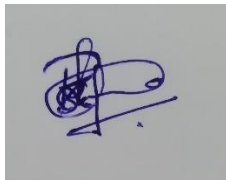
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SEPTEMBER 2023

DECLARATION

I confirm that the dissertation titled “The analysis and impact of adopting sustainable blister packaging on solid dosage form in pharmacies in Ireland”. which I am submitting for evaluation as part of the M.Sc. in Pharmaceutical Business and Technology program, is an original piece of work. It is based on my independent study and research, and I have properly cited and acknowledged all the sources and materials used in its creation. I further affirm that I have not engaged in any form of plagiarism, including copying from others or fellow students, either partially or entirely.

Candidate Name: Reshma Antony



Signature:

Date: 27/08/2023

Supervisor Name: Susanna Coghlan.

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In the name of the Most Gracious and Most Merciful, I express my profound gratitude for the divine blessings that enabled me to embark on and successfully complete this research endeavor.

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TABLE OF CONTENTS

DECLARATION	2
ACKNOWLEDGMENT	3
LIST OF ABBREVIATIONS	8
ABSTRACT	1
CHAPTER-1	3
OVERVIEW	4
1.1 INTRODUCTION	4
1.2 STUDY PURPOSE	5
1.3 SIGNIFICANCE OF STUDY	6
1.4 RESEARCH QUESTIONS	6
1.5 RESEARCH OBJECTIVES	7
1.6STRUCTURE OF THE STUDY	7
CHAPTER-2	9
LITERATURE REVIEW	10
2.1 INTRODUCTION	10
2.2 PHARMACEUTICAL PACKAGING FOR TABLETS:	12
2.3TRENDS IN ECO-FRIENDLY PHARMACEUTICAL PACKAGING:	14
2.4 CHALLENGES OF ADOPTING SUSTAIANBLE BLISTER PACKAGING:	16
2.5 DISPOSAL AND SUPPLY PROCESS OF SUSTAIANBLE BLISTER PACKAGING IN PHARMACIES	17
2.6 DIGITALIZATION AND SMART PACKAGING:	18
2.7 SUSTAINBILITY IN COMMUNITY PHARMACIES	21
2.8 CONCLUSION:	23
2.9 RESEARCH GAP:	23
CHAPTER-3	24
RESEARCH METHODOLOGY	25
3.1 OVERVIEW	25
3.2 RESEARCH APPROACH:	26
3.3 RESEARCH PHILOSOPHY:	27
3.4 RESEARCH STRATEGY:	29
3.5 RESEARCH STRUCTURE:	30
3.6 TIME-HORIZON:	31

3.7 PARTICIPANTS:	32
3.7.1 SELECTION OF PARTICIPANTS:	32
3.7.2. INCLUSION CRITERIA:	32
3.7.3. EXCLUSION CRITERIA:	33
3.7.4 SAMPLE SIZE:	33
3.7.5 ETHICAL ISSUES:	33
3.8 DATA ANALYSIS:	33
3.8.1 QUANTITATIVE ANALYSIS	33
3.8.2 QUANLITATIVE ANALYSIS	34
3.9 CONCEPTUAL FRAMEWORK	34
3.9.1 CONCLUSION	35
CHAPTER-4	37
FINDINGS AND ANALYSIS	38
4.1 QUANTITATIVE ANALYSIS AND QUALITATIVE ANALYSIS	38
CONCLUSION:	59
CHAPTER-5	61
CONCLUSION AND RECOMMENDATIONS	62
5.1 CONCLUSION	62
5.2 RECOMMENDATION FROM THE STUDY	68
5.3 LIMITATIONS OF THE RESEARCH	68
5.4 CONTRIBUTION OF THE RESEARCH	69
REFERENCES	70
APPENDICES	74

LIST OF FIGURES

Figure 1: Research Onion(Saunders et al., 2019)	26
Figure 2: Research Timeline.....	29
Figure 3: Conceptual framework of current study	35
Figure 4: Pie chart representation with percentage of survey respondent's experience in the pharmacy in Ireland	39
Figure 5:Pie chart representation with percentage of respondent's familiarity with Sustainable blister packaging	40
Figure 6:Comparison between the most common experience of study participants and their familiarity with sustainable blister packaging.	41
Figure 7: Frequency of responses regarding the education on sustainable blister packaging.....	42
Figure 8: Bar Graph represents the frequency of responses on whether the sustainable blister packaging shows environmental conservation	43
Figure 9: Pie Chart represents the responses on the need for additional training on sustainable blister packaging practices.	45
Figure 10: Bar Graph representation of respondents most common using sustainable blister packaging options.	46
Figure 11: Bar Graph represents the frequency of responses on different challenges of adopting sustainable blister packaging.	48
Figure 12: Pie Chart represents the response frequency on the shelf-life period of sustainable blister packaging.	49
Figure 13: Bar Graph Representing the Frequency of responses showing the challenges affecting the pharmacies during adopting the sustainable blister packaging	51
Figure 14: Pie Chart Represents Frequency of responses on the benefits of adopting sustainable blister packaging.	52
Figure 15: Pie Chart Represent Frequency of responses on reduction of plastic waste in pharmacy sector	53
Figure 16: Bar Graph represents the frequency of responses for various packaging in pharmaceutical sector.	54
Figure 17: Pie Chart Represents the frequency of responses on yes or no for recommendation on sustainable practices.	56
Figure 18: Bar Graph Represents Frequency of responses on the willingness on adopting the sustainable blister packaging in pharmacy.	58

LIST OF TABLES

Table 1: Overview of Research Methodology.....	25
Table 2: Research philosophy and definition(Saunders et al., 2019)	28
Table 3: Summary of Questionnaire Structure.....	30
Table 4: Familiarity with sustainable blister packaging	39
Table 5: Comparison between the most common experience of study participants and their familiarity with sustainable blister packaging.	40
Table 6: Frequency of responses regarding the education on sustainable blister packaging	42
Table 7: Responses showing the importance of sustainable blister packaging for environment.....	43
Table 8: Responses obtained from participants regarding additional training on sustainable blister packaging practices	44
Table 9: Frequency of respondents using sustainable packaging options.....	45
Table 10: Frequency of responses on mostly using sustainable blister packaging options in pharmacies.	46
Table 11: Frequency of responses on different challenges faced during the adoption of sustainable blister packaging.	47
Table 12: Frequency of responses about the shelf-life period of sustainable blister packaging.....	49
Table 13: Frequency of responses showing the challenges affecting the pharmacies during adopting the sustainable blister packaging.	50
Table 14: Frequency of responses on the benefits of adopting sustainable blister packaging.	51
Table 15: Frequency of responses on reduction of plastic waste in pharmacy sector	53
Table 16: Reasoning given by participants for promoting the sustainable blister packaging.	56
Table 17: Frequency of responses on the willingness on adopting the sustainable blister packaging in pharmacy	57
Table 18: Recommendations provided by the participants	59

LIST OF ABBREVIATIONS

➤ FOOD & DRUG ADMINISTRATION	-	FDA
➤ POLYVINYL CHLORIDE	-	PVC
➤ LIFE CYCLE IMPACT ASSESSMENT	-	LCA
➤ PHARMACEUTICAL SUPPLY CHAIN	-	PSC
➤ RADIO FREQUENCY IDENTIFICATION	-	RFID
➤ NEAR-FIELD COMMUNICATION	-	NFC
➤ A CROSS BOUNDRY GREEN PSC	-	XGPSC

ABSTRACT

The pharmaceutical industry's commitment to sustainable practices has prompted a paradigm shift in packaging solutions, with a specific focus on sustainable blister packaging. This dissertation scrutinizes the multifaceted landscape of sustainable blister packaging practices within the context of pharmacies in Ireland, aligning its findings with the predefined objectives.

The central objectives of this study encompass the exploration of pharmacists' familiarity with sustainable blister packaging, the identification of challenges hindering its adoption, the assessment of perceived benefits, and the formulation of recommendations to enhance sustainable packaging practices. By leveraging a combination of quantitative and qualitative methodologies, this study offers a comprehensive analysis of the subject matter.

The research commences by profiling the demographics of surveyed pharmacists, unveiling their experience levels and familiarity with sustainable blister packaging. These insights inform the understanding of the pharmacist's perspective within the broader context of sustainable packaging practices. Furthermore, the study explores into the challenges encountered during the adoption of sustainable blister packaging, highlighting storage constraints, regulatory guidelines, cost considerations, and availability of suitable options. The analysis of these challenges contributes to the formulation of targeted strategies to overcome barriers to sustainable practices.

A fundamental aspect of this dissertation lies in the assessment of perceived benefits associated with the adoption of sustainable blister packaging. The research underscores a notable consensus on the environmental advantages, reduction of plastic waste, and improved sustainability brought forth by sustainable packaging. These findings underscore the alignment between participants' perspectives and the overarching goals of sustainable packaging initiatives.

Aligning with the defined objectives, the study culminates by offering recommendations and best practices to foster the adoption of sustainable blister packaging within pharmacies. These recommendations encompass the need for widespread awareness campaigns, education initiatives, and training programs to facilitate informed decision-making and responsible choices. By addressing each objective, this study provides a comprehensive framework for enhancing sustainable packaging practices in the pharmacy sector.

In conclusion, this dissertation sheds light on the intricate dynamics of sustainable blister packaging practices within Irish pharmacies. Through an insightful analysis of findings, the study contributes valuable insights on sustainable packaging, offering practical implications for the industry's shift towards more environmentally responsible practices.

CHAPTER-1

OVERVIEW

1.1 INTRODUCTION

The sustainable packaging has noticed in recent years as a part of environmental concerns. Over the years, there is realization of the adverse environmental issues due to traditional packaging materials such as plastics, which are commonly used in pharmaceutical industries. Thus, the use of excess plastics caused major pollutions. Thus, in order to minimize the waste accumulation which are non-recyclable most of the industries started to do research on sustainable packaging alternative to minimize environment harm.

The packaging requirement are complex for pharmaceutical products than other non-edible products. The main importance of packaging comes during storage, transportation and at the time of utilization. Packaging must be user-friendly and should provide long-shelf life(Kumar and Gupta, 2012a). This study mainly concentrates the sustainable blister packaging of tablets and how much is convenient for pharmacists to supply, storage and dispose. In addition, the sustainable blister packaging are eco-friendly materials which reduce environmental impact.

Thus, understanding the impact and awareness of sustainable blister packaging are very much crucial. Because, the pharmacists are the ones who act as an intermediate among the patients and medications. Hence, their awareness and understanding has importance on patient education, environmental sustainability in pharmaceutical sector. And they have direct contact with the patients so they can promote the usage of sustainable alternatives, its disposal and storage. At the same time, by knowing the challenges and barriers of keeping the sustainable packaging in pharmacies, so in future companies can make changes accordingly.

The pharmaceutical industry's rapid growth significantly impacts people's lives, contributing to well-being and the global economy. However, an emerging concern pertains to product sustainability, particularly related to environmental harm and human toxicity caused by pharmaceuticals and their packaging(Commissioner, 2023). The prevalent use of non-biodegradable materials in packaging generates substantial waste and pollution(Akala, 2008).

A recent report by the IQVIA Institute predicts that medicine consumption will reach 4.4 billion doses in 2023, with emerging markets like China and Brazil leading the demand. Brazil, for

instance, has a considerable market for blister-packed medicines, which are estimated to reach a market value of \$7.6 billion by 2026, with North America and Europe being significant contributors(Pedrosa de Oliveira *et al.*, 2021).

Considering sustainability as meeting present needs without compromising the future, pharmaceutical blisters raise significant environmental concerns across their life cycle. From raw material extraction to post-use disposal, blisters contribute to water consumption, CO2 emissions, and resource depletion. This emphasizes the need to address sustainability issues in pharmaceutical packaging(Pedrosa de Oliveira *et al.*, 2021).

To establish a more environmentally friendly production process for tablet packaging, various strategies are available(Poudel and Nissen, 2018). These include:

1. Reducing commercialization through campaigns promoting rational medicine use and adjusting prescription durations.
2. Minimizing waste by unitizing prescriptions to prevent selling extra tablets, and extending medicine shelf-life.
3. Directly reducing packaging materials by eliminating unnecessary secondary packaging, digitizing package inserts, and using fewer raw materials per unit.
4. Opting for sustainable materials and packaging designs.

The reduction in commercialization through rational consumption has been explored in-depth by previous studies. Extending shelf-life could be influenced by pharmaceutical properties or packaging quality(Poudel and Nissen, 2018). Surprisingly, the U.S. Food and Drug Administration (FDA) found that many drugs remain intact beyond their official expiration date, suggesting that waste reduction is feasible without formulation or packaging changes(Commissioner, 2023).

1.2 STUDY PURPOSE

The purpose of this dissertation is to investigate and analyze the adoption and implications of sustainable blister packaging practices within the pharmaceutical sector, specifically focusing on pharmacies in Ireland. The study aims to gain a comprehensive understanding of the perceptions, challenges, benefits, and potential solutions associated with the adoption of sustainable packaging solutions for solid dosage forms. The dissertation intends to provide valuable insights into the feasibility, challenges, and benefits of incorporating sustainable blister packaging practices within

the pharmacy sector. The research contributes to the broader discourse on sustainable packaging and offers actionable recommendations to guide pharmacies toward more environmentally responsible packaging choices.

1.3 SIGNIFICANCE OF STUDY

The study "Impact and Analysis of Adopting Sustainable Blister Packaging for Oral Solid Dosage Form in Irish Pharmacies" holds significant importance for various stakeholders in the pharmaceutical industry and the broader sustainability landscape. The adoption of sustainable blister packaging has the potential to significantly reduce plastic waste and environmental impact. As the global concern for environmental sustainability grows, understanding the impact of sustainable packaging practices in pharmacies is crucial in contributing to waste reduction and conservation efforts. The pharmaceutical industry's commitment to sustainable practices enhances its reputation and aligns with evolving consumer preferences for eco-friendly products. By analyzing the impact of adopting sustainable blister packaging, the study provides insights into how the industry can improve its environmental stewardship. As regulatory bodies worldwide introduce stricter regulations related to packaging waste and environmental impact, understanding the potential implications of adopting sustainable packaging options is essential for pharmacies to align with evolving regulations and avoid potential legal issues. Consumers are becoming increasingly conscious of their purchasing decisions' environmental implications. Pharmacies that adopt sustainable blister packaging practices can enhance their brand image and engage environmentally conscious customers effectively. While sustainable packaging may involve initial investment, it can lead to long-term cost savings through reduced waste disposal expenses and improved operational efficiency. The study's analysis of the economic impact can guide pharmacies in making informed decisions. By shedding light on the impact of sustainable blister packaging adoption, the study raises awareness about the broader environmental implications of packaging choices. It encourages individuals and organizations to take responsibility for their choices and contribute to a more sustainable future.

1.4 RESEARCH QUESTIONS

1. What factors pose as challenges of implementing sustainable packaging in pharmaceutical industry?
2. How much each Pharmacists are aware about the importance of packaging and its sustainability?

1.5 RESEARCH OBJECTIVES

1. To evaluate the knowledge level and awareness of sustainable blister packaging among pharmacists.
2. To identify the challenges of adopting sustainable blister packaging in solid dosage forms in pharmacies such as storage, supply process, and disposal practices.
3. To identify the benefits of adopting sustainable blister packaging in pharmacies in Ireland.
4. To suggest recommendations and advice for more sustainable packaging practices in the pharmacies.

1.6 STRUCTURE OF THE STUDY

This work “The analysis and impact of adopting sustainable blister packaging on solid dosage form in pharmacies in Ireland.” The dissertation is systematically arranged into 5 chapters which are listed below.

Chapter 1: Introduction

In this chapter, provide an introduction to the chosen topic. Explain the main objectives, and significance of conducting this research. And also describe the purpose of the study and why it is important in today's context.

Chapter 2: Literature Review

In this part, investigate into a comprehensive examination of previously published articles related to the subject of our research. Organize the information into different headings and based on the research objectives. The literature review assists in improving our comprehension of the research questions and objectives. It also aids in identifying any gaps or areas that need further investigation within the chosen research field.

Chapter 3: Methodology and Research Design

In this chapter, provide a comprehensive overview of how the study was conducted. Explain the underlying philosophical approach that guided our research. This includes information about the

sample size, the ways researcher gathered data, and how it analyzed. Additionally, researcher outline the conceptual framework that forms the basis of our study.

Chapter 4: Discussion and Analysis

In this chapter, discuss the data collected from our research. It is presented the information using visual aids like graphs, and tables. Through our analysis, findings and interpret the data gathered. And provide clear explanations for each research questions, making sure to cover all aspects.

Chapter 5: Conclusion and Recommendations

This chapter will be mainly focus on explaining the conclusion of the results obtained from the research. The limitation of the study will be included in this section. Recommendations will be made and future research for this study.

CHAPTER-2

LITERATURE REVIEW

2.1 INTRODUCTION

Pharmaceutical packaging is crucial for keeping medicines safe and effective. It prevents them from being affected by the surroundings and helps maintain their quality. The packaging material must safeguard the product, provide necessary information, and prevent any damage or loss. Choosing the right packaging material is essential for stability testing of medications. Nowadays, biodegradable polymers are used to make packaging, which helps reduce pollution and environmental impact. Packaging is an arrangement of medications according to their therapeutic effectiveness from the time of packaged till the time of consumption. Packaging mainly made of variety of materials from manufacturer till it reaches the customers(Patel *et al.*, n.d.).

Packaging serves multiple purposes, including presenting, protecting, and identifying products throughout their lifecycle. It ensures the product remains safe until it is consumed. Factors such as the required level of protection, compatibility with the contents, filling method, cost, and user convenience influence the choice of primary and secondary packaging materials. Containers can be categorized as primary or secondary, depending on whether they are used immediately or after the product is produced. There are single-dose and multi-dose container options available(Patel and Patel, 2019).

The ideal container or package should have certain qualities to ensure the protection and quality of its contents. It should shield the contents from environmental hazards such as moisture, light, and temperature variations. Additionally, it should safeguard the contents from mechanical hazards like impact, vibration, and compression. The package should not allow any loss or alteration of the product. It should also have an attractive appearance that is suitable for pharmaceutical use(Bairagi *et al.*, n.d.).

When selecting packaging materials, it is important to consider specific properties. The materials should effectively protect the product from environmental conditions. They should not react with the product or introduce any unwanted tastes or odors. Furthermore, the materials should be non-toxic and approved by the FDA (Food & Drug Administration). They should meet tamper-resistance requirements and be compatible with commonly used high-speed packaging equipment.

Lastly, the cost of the packaging material should be reasonable in relation to the product's cost(Bairagi *et al.*, n.d.).

The solid dosage forms are mainly packed by tamper resistant packaging such as film packages, blister package, strip packages, bottle seals, tape seals, breakable caps and so on. A strip package is commonly used for the medications such as tablets and capsules and it is made of heat-sealable flexible film. Mainly different materials are used for this strip packaging in terms of barrier applications such as paper, polyethylene, foil laminations(Bairagi *et al.*, n.d.)

Moreover, due to the environmental issues most pharmaceutical companies are giving priority to eco-friendly packaging. However, there are lot of challenges for implementing these types of packaging in the market(Kumar and Gupta, 2012b).

Socially sustainable supply chain practices encompass various initiatives such as preventing child and slave labor, implementing employee health and safety programs, engaging with communities, and upholding human rights. Companies have embraced these practices to decrease their carbon footprints and enhance their social reputation. Adopting sustainable practices in supply chain processes gives organizations a competitive edge in terms of stock market performance and financial metrics (Shashi and College of Management, n.d.).

The main job of pharmaceutical packaging is to protect the medicine from the environment, keeping it safe and effective for a long time. But it's also essential to consider the environment when developing packaging materials. Many countries prioritize protecting the environment, and there are factors to think about to be environmentally conscious. This includes using sustainable materials and following relevant recycling laws. Recycling and proper disposal of packaging waste are gaining more attention in many places. While pharmaceutical packaging waste is a small part of overall waste, it can still harm the environment if not handled properly. So, efforts are being made to introduce more environmentally friendly packaging materials to reduce environmental impact(Deore *et al.*, 2023).

On the other hand, there are lot of evolutions evolved in the pharmaceutical packaging from glass to blisters and now most of the pharmaceutical companies are developing the packaging materials which causes less environmental pollution and sustainable and recyclable. So, in this following research will discuss more about the pharmaceutical packaging, its trends in packaging,

sustainability and the challenges such as disposal, supply of implementing these sustainable blister packaging in pharmacies and smart technology of packaging in pharmacies.

2.2 PHARMACEUTICAL PACKAGING FOR TABLETS:

Eco-friendly pharmaceutical packaging refers to the use of packaging materials that are environmentally safe and do not harm the planet. Many companies are switching to biodegradable or green materials for their packaging to reduce their impact on the environment and enhance their brand image. This type of packaging is becoming increasingly popular and is marked with eco-labels. Researchers are working on developing biodegradable and eco-friendly packaging materials to replace or complement existing packaging options. Eco-friendly pharmaceutical packaging materials can be classified in various ways based on their environmental friendliness and production methods(Aminabhavi *et al.*, 1990; Singh *et al.*, 2011).

Eco-friendly pharmaceutical packaging materials offer several functional parameters that contribute to their effectiveness and desirability in the industry. The primary function of eco-friendly pharmaceutical packaging is to provide a barrier against various external factors such as moisture, light, oxygen, and temperature variations(Singh *et al.*, 2011). This protection helps maintain the integrity and stability of the pharmaceutical products, ensuring their quality and effectiveness. Eco-friendly packaging materials also offer protection against biological contaminants, such as bacteria or other microorganisms. This is crucial to prevent contamination and maintain the safety and efficacy of the pharmaceutical products throughout their shelf life. Another important function of eco-friendly packaging is to safeguard the pharmaceutical products against physical damage during transportation, handling, and storage. It ensures that the products remain intact and undamaged until they reach the end consumers(Singh *et al.*, 2011).

Eco-friendly packaging plays a crucial role in conveying essential information about the pharmaceutical products to the consumers. This includes instructions on the correct usage of dosage forms, details about the contents of the product, its origin, potential side effects, and any necessary warnings. Clear and accurate communication helps consumers use the products safely and effectively. Eco-friendly packaging materials allow for easy identification of the pharmaceutical products. Clear labeling and appropriate packaging designs help consumers

quickly recognize the specific product they need, facilitating convenience and efficient use(Singh *et al.*, 2011). The security of pharmaceutical products. This includes measures to prevent unauthorized access, especially by small children, and protection against counterfeiting or tampering, safeguarding the integrity and safety of the products(Singh *et al.*, 2011).

Enhance consumer access to pharmaceutical products and improve their overall convenience(Singh *et al.*, 2011). This includes considerations for easy distribution, handling, selling, and usage of the products, making them more user-friendly and accessible to a wider range of consumers. Thus, eco-friendly pharmaceutical packaging materials offer functional parameters that encompass barrier protection, biological protection, physical protection, information communication, identification, security, convenience, and marketing. These parameters collectively contribute to the effectiveness, safety, accessibility, and marketability of pharmaceutical products while minimizing their environmental impact (Singh *et al.*, 2011).

The primary packaging is the material that directly encloses and protects the product. It's the part that comes into direct contact with the product, such as ampoules, vials, or prefilled syringes. This packaging is essential because it can influence the product's shelf life and ensure its safety and quality. Moving on to the secondary packaging, it is the outer layer that holds together multiple primary packages. Its main purpose is to group and protect the individual product units during storage and transportation. Examples of secondary packaging include cartons, boxes, shipping containers, and injection trays. Lastly, we have the tertiary packaging, which is designed for bulk handling and shipping. It provides a larger level of protection and convenience when transporting a large number of secondary packages. Common examples of tertiary packaging are barrels, containers, and edge protectors(Zadbuke *et al.*, 2013).

Pharmaceutical packaging companies are currently exploring the use of materials that are made from renewable sources. One recent development involves using ethylene, which is derived from sugarcane. This process is carbon-negative, meaning it actually helps remove carbon dioxide (CO₂) from the atmosphere and releases oxygen when the sugarcane is grown (Rich Quelch, n.d.). Paper-based push-through blister packaging is a suitable option for nutraceuticals (health supplements). It consists of a paper blister with a barrier and a heat-sealable layer, which provides similar protection as traditional blister packaging made of PVC or aluminum. Both the base and the top layer of the packaging can be recycled (Torsten Sauer, 2022).

2.3 TRENDS IN ECO-FRIENDLY PHARMACEUTICAL PACKAGING:

In the (2016) a comparative study conducted by Raju et.al on two types of blisters which is made up of PVC and Aluminum. For the study authors used a life cycle impact assessment (LCA) method for analyzing these two blisters. And the assessment carried out from the initial to final stage such as from manufacturing, transportation of packaging materials to drug plant, and packaging of tablet. From the study they reached a conclusion that PVC blisters are much better than the Aluminum ones(Raju *et al.*, 2016). However, in 2021 (Pedrosa de Oliveira *et al.*, 2021) conducted a study on the sustainability of blisters which is used in tablet forms. In that study, it shows the characteristics of blister packaging and its sustainability compared to Raju's study. Moreover, the blister packs are made by heat-softening sheet of thermoplastic resin and vacuum into a mold. The packaging material used are peelable type heat-sealed-aluminum foil. And the coating on the foil must be harmonious with blister pack to make the product protection and tamper-resistance. The commonly used materials are thermo-formable blister are poly vinyl chloride (PVC), PVC/Polyethylene combinations, polystyrene and polypropylene (Bairagi *et al.*, n.d.).

Moreover, the blister packaging evolved by complex of different layers to enhance the protection, flexibility and other attributes. However, the blister packaging has great environment impact during their life cycle from their raw-materials extraction till the post-use destination such as landfills, recycling. Thus, these will cause damage to environment such as high-water consumption, global warming due to carbon dioxide emission, cause of depletion of natural resources as well as fossil resources(Pedrosa de Oliveira *et al.*, 2021).

Pedrosa de Oliveira also highlights the strategies for the sustainable packaging production chain such as reduction of commercialization due to least consumption can be done by campaign of rational use of medicines, reduction of commercialization by waste reduction by avoiding the selling of extra tablets of blisters and by extended shelf-life of medicines, direct reduction of secondary or unnecessary packaging materials, digitalizing the package inserts or reducing the raw-materials as per unit, and change of packaging designs and raw-materials favoring sustainable options(Pedrosa de Oliveira *et al.*, 2021). However, in the comparative study conducted by Raju

et al. reveals that PVC blisters are more environmentally friendly than Aluminum but according to the Pedrosa de Oliveira the more recyclable and environment friendly packaging are paper based blister than Aluminum or PVC blisters.

A disadvantage of aluminum blisters is their environmental impact. A study from Raju, Sarkar, Sharma, Singh, and Singla (2016) showed that an aluminum blister has a 70% higher global warming potential compared to PVC blisters. Some trends have shown that environmental friendliness of pharmaceutical packaging will increase in importance in the future(Raju *et al.*, 2016).

The alternatives for blister packaging are paper blister which is made of waterproofed materials such as nano clay, starch, binder polymer and surfactants. This blister is 30 percent cheaper than regular blister which is composed of PVC and Aluminum and it is fully recyclable. It is an FDA approved product, so here the aluminum layer and plastic part PVC is replaced by both paper blisters with same moisture barrier. the blister-eco which is consist of tissue paper with less thickness and laminated with small layer of aluminum which is lighter and cheaper than normal blister and it also maintain moisture barrier. Finally, the one company developed a biodegradable polymer which can be disposed easily because it will break down in anerobic conditions easily. But still, it leaves some micro-plastics that hinder the flow and clog the valves (Pedrosa de Oliveira *et al.*, 2021).

The use of biodegradable polymers in packaging materials is becoming more popular due to their environmentally friendly nature. Biodegradable packaging materials, such as cellulose, xylan, chitin, protein, gluten, zein, soy, casein, whey, gelatin, collagen, keratin, polylactic acid, pullulan, and others, decompose naturally and even act as soil fertilizers (Patel *et al.*, n.d.). The chitosan, starch and other biodegradable materials can be used as an effective packaging material because of its availability and can be easily chemically modifiable. And these type of packaging extend its shelf-life and also its biodegradation conserve future generation (Kumar and Gupta, 2012b).

The advancement in packaging such as compliance packaging and anti-counterfeit measure which enhance drug safety and user-friendliness (Raja *et al.*, 2012). The chitosan, starch, and other biodegradable materials are suitable for creating films for packaging due to their natural availability these films have got long shelf-life and it preserve ecology for future generations.

Therefore, this type of packaging offers alternative waste management routes and controls pollution for the long term(Kumar and Gupta, 2012a).

2.4 CHALLENGES OF ADOPTING SUSTAINABLE BLISTER PACKAGING:

There are three ways to handle blister packaging when it reaches the end of its life: throwing it in the landfill, recycling it directly, or burning it. The choice depends on policies and how people behave. When blister packaging is thrown in the landfill, the plastic and aluminum parts can make the soil more acidic. Moreover, if the packaging is not recycled, more primary aluminum needs to be produced, and this process consumes a lot of energy. The waste that is not recycled also harms the environment by causing pollution in the air and water(Pikoń *et al.*, 2021). And also now a days blister packages are considered as plastic waste because it has got high plastic content and the metal cannot be recovered from it(Klejnowska *et al.*, 2020).

The major challenges faced by sustainable blister packaging are commercialization of these packages has got many challenges, however there are many options are possible. It has found that starch, chitosan and other biodegradable packaging are the best materials for packaging. Moreover, these materials are much more useful for extending the shelf-life of pharmaceutical as well as food products(Kumar and Gupta, 2012b).The challenges such as limited resources, lack of infrastructure and resistance to change. These are the barriers that faced due to the sustainable practices in pharmacies (Do and Novakowski, n.d.).

In 2023, Hallie Forcinio conducted a study on new blister options in that study the author found out that currently, there are no specific rules or instructions for using eco-friendly blister packaging in the pharmaceutical industry. However, people are becoming more aware of the need to be sustainable in this industry. Many companies are taking their own steps to reduce their impact on the environment. They are using materials that are better for the Earth and finding ways to create less waste from packaging. The World Health Organization also understands the importance of being sustainable in healthcare and wants to create systems that are better for the environment. Although there are no exact rules for eco-friendly blister packaging yet, there are rules for pharmaceutical packaging in general. These rules make sure the packaging is safe for children, keeps the medicine stable, and protects the patients. As more and more people want sustainable

packaging, it is likely that specific rules for eco-friendly blister packaging will be made in the future(Hallie Forcinio, n.d.).

2.5 DISPOSAL AND SUPPLY PROCESS OF SUSTAINABLE BLISTER PACKAGING IN PHARMACIES

The study conducted by Pedrosa de Oliveira in 2021 the author mentioned about the the recycling of blister will be easier without medicines in it rather than with unused medicine blisters and also with monolayered blisters but the blisters we use are multilayered to ensure the medication safety and properties. Hence, it cannot be fully recycled and cannot be guaranteed for sustainability. One significant aspect shows in this article is the recycling difficulty of blister packaging such as separation difficulty(Pedrosa de Oliveira *et al.*, 2021). According to the study by Louise in 2016 the environmental health and pharmacy practice may not seem related. However, with increasing awareness about climate change, resource depletion, and environmental issues, it's important to examine how our profession is connected to these topics. Traditional pharmacy practice is not typically considered environmentally friendly, and there is a belief that healthcare providers must prioritize patient safety over environmental concerns. For example, reusing certain items in pharmacies is often not allowed due to safety regulations. However, it's possible to find a balance between providing safe care for patients and being environmentally conscious(Lau, 2016)

In 2016, Louise examined the disposal of wastes in pharmacies and most plastic waste, especially from packaging, is a significant environmental problem as it takes a long time to break down and causes harm to the environment. The excessive use of plastic packaging in community pharmacies contributes greatly to the overall waste generated. Pharmacists can help tackle this issue by being environmentally aware when ordering supplies(Lau, 2016).

The green logistics, sustainable procurement and effective transportation for minimizing the carbon emissions and generation of waste. The role of stakeholders in promoting the sustainable blister packaging and also about the providers to implement the sustainable practice. Improper disposal of medications has negative environmental consequences, economic losses, and safety issues due to expired or hazardous drugs. Proper medication waste management is essential in the healthcare system. This study focuses on community pharmacies in the UK, where patients frequently participate. To achieve effective pharmaceutical waste management, all stakeholders in

the supply chain, including manufacturers, wholesalers, GPs, community pharmacies, and customers, need to be involved. This will reduce preventable waste and improve recycling and disposal practices(Xie and Breen, 2012).

A network is designed to enable community pharmacies and customers to recycle expired or unwanted medications. Additionally, a far-reaching approach called XGPSC is proposed to integrate environmental practices into the business strategy and promote collaboration among companies in the supply chain. Four recommended environmental practices include top management commitment, supplier certification and cooperation, customer cooperation, and eco-design. Specific actions are suggested for manufacturers, wholesalers, GPs, community pharmacies, and customers(Xie and Breen, 2012).

The far-reaching approach provides valuable knowledge on environmental practices in pharmaceutical waste management. It can guide waste producers and serve as a reference for professional bodies and government regulations. Implementing the approach requires commitment from all participants to reduce and recycle medication waste, transforming the supply chain into a greener system. However, weak cooperation from some parties may hinder progress, and improving collaboration among stakeholders is crucial(Xie and Breen, 2012).

The cost aspect of the far-reaching approach raises concerns about who should bear the expenses. Future investigations will explore whether the cost of proper medication disposal should be included in the medication price or become part of mandatory taxes. Recycling medications is necessary for environmental risk reduction, safety improvement, and economic benefits. The proposed far-reaching approach promotes proactive action to minimize medication accumulation and the need for disposal(Xie and Breen, 2012).

2.6 DIGITALIZATION AND SMART PACKAGING:

Digitalization plays a crucial role in improving sustainability across environmental, social, and economic aspects. According to Gartner's research, supply chain leaders who neglect investing in digital strategies and enablers supporting sustainability goals may face negative consequences in terms of brand reputation, company image, and consumer perception of value (Shashi and College of Management, n.d.).

There is different innovative packaging such as self-administration drugs and talk pack wipac which provide spoken dosage instructions. And also shows robotic packaging processes which help with speedy packaging, efficiency, and accuracy(Raja *et al.*, 2012). Therefore, these packaging technologies enhance the efficiency of the supply chain (Raja *et al.*, 2012). According to the study done in 2018 by Ding, it mainly shows the importance of pharma 4.0 in the supply chain process of pharmaceutical medications to pharmacies(Ding, 2018). The author discusses artificial intelligence and digital technologies. Additionally, the study discusses the potential benefits such as eco-friendly, waste reduction, and energy efficiency to reduce the environmental impact (Ding, 2018). The pharmaceutical supply chain (PSC) mainly of primary manufacturers, secondary manufacturers, logistics service providers, healthcare providers and retail outlets (Savage *et al.*, 2006). Moreover, the advanced technologies such as blockchain, real-time monitoring system, radio frequency identification technology (RFID). And these type of monitoring makes the pharma product quality more robust and also it promotes sustainable pharmaceutical supply chain designs and assist the companies to remain competitive (Stock and Seliger, 2016). Moreover, the 3D printing improved the productivity and flexibility of manufacturing process and reduced the waste products throughout the process cycle which enabled more sustainable environment and energy efficient manufacturing. The transparent and real-time information helped collaborations and communications among the suppliers, manufacturers, hospitals, distributors and end-users (Ding, 2018). Thus, doing cross-company symbiosis for the speedy response for the drug recalls. Moreover, providing the agile logistics by considering sustainability. The sustainable PSC practices such as lots of time and money consuming on infrastructure and supporting system construction, poor support from the seniors, lack of expertise to conduct the training on the sustainability practices, lack of law and regulations for the sustainability development, insufficient communication and collaboration and inadequate education about the awareness of PSC sustainability among the public(Ding, 2018).

Smart packaging is a rapidly growing technology expected to be worth around \$26.7 billion by 2024. It is being used in various industries, such as food, medicine, and other products. The benefits of smart packaging are significant for patients and managing the supply chain of pharmaceuticals. One advantage is that it can improve patient compliance, meaning it helps patients stick to their prescribed treatment plans. Smart packaging also plays a vital role in confirming the authenticity of products, ensuring that they are genuine and safe for consumers. It

enables tracking, allowing companies to monitor the movement of products through the supply chain(Gahtori, 2022).

A crucial function of smart packaging is its role in anti-counterfeiting efforts. It helps prevent fake products from entering the market, protecting both consumers and manufacturers. Furthermore, smart packaging can support addiction prevention efforts by limiting access to certain medications or products. Another essential benefit is that it helps extend the shelf life of products. By providing valuable information on the quality of the product and the conditions inside the packaging, it ensures that the product remains safe and effective for a more extended period(Gahtori, 2022).

There are two main types of smart packaging: active packaging and intelligent packaging. Active packaging is used in pharmaceuticals and displays information on quality and safety. It can sense the product's condition, the atmosphere inside the package, or the shipping environment. Examples of active packaging technologies include oxygen scavengers, desiccants (which remove moisture), color-changing inks, and odor absorbers or emitters. For instance, tamper freeze ink changes color when exposed to extremely cold temperatures, and tamper heat ink changes color when exposed to high heat(Gahtori, 2022).

On the other hand, intelligent packaging is more interactive and allows for the exchange of information. It includes technologies like QR codes, Near-Field Communication (NFC), Radio Frequency Identification (RFID), printed electronics, smartphones, smartphone apps, the Cloud, and the Internet. A pharmaceutical package with an NFC tag, for instance, can deliver interactive information to a patient's smartphone, providing videos about dosing instructions. Moreover, some smart packaging contains sensors or microchips to record data accurately. For instance, when a patient removes a pill from the packaging, a built-in sensor records this data and uploads it to a cloud-based system. This allows doctors to monitor when and how often the pills are taken, ensuring proper medication adherence. Additionally, there are metered dosing systems that track and count pills, sending the data to a smartphone. So, smart packaging is an advanced and beneficial technology that enhances patient compliance, prevents counterfeiting, supports tracking, and extends the shelf life of products. It comes in two main types: active packaging, which senses product quality, and intelligent packaging, which allows for interactive information exchange and data recording. Its applications in the pharmaceutical industry are promising and offer significant advantages for patients and supply chain management(Gahtori, 2022).

2.7 SUSTAINABILITY IN COMMUNITY PHARMACIES

The goal of the sustainable practices adopted by pharmacists in this study was to achieve cost savings, waste reduction, and improved efficiency (Derqui *et al.*, 2021). Schaper provides a list of ways that environmentally conscious firms can make a positive impact on the environment. These include participating in recycling activities, joining environmental advocacy groups, providing eco-friendly packaging to consumers, using sustainable equipment, purchasing environmentally friendly products, and training staff. In the case of community pharmacies, they can contribute to reducing the pharmaceutical industry's environmental impact by promoting proper disposal of expired or unused medications, minimizing drug release, preventing household sewage contamination with excess drugs, and sourcing products with minimal negative effects on the environment and society (Schaper, 2002).

Pharmacists are well-positioned to communicate with patients and provide information about medicinal products, including their environmental impact. During counseling sessions, pharmacists should educate patients about the correct disposal of unused or expired medicines and encourage them to return these medications to a community pharmacy. It is also important for pharmacists to advise patients on how to package the medicines appropriately when returning them to the pharmacy. Providing written instructions about the proper disposal of unused or expired medicines is crucial (TOMA and CRIŞAN, 2018, p.). There is a lack of comprehensive research on the social aspects of sustainability specifically related to community pharmacies. There is an urgent need for empirical studies to evaluate both the internal and external dimensions of pharmacy work in terms of social sustainability. Currently, the available research on this topic is limited. To gain a better understanding of social sustainability in community pharmacies, it is essential to conduct in-depth studies that explore various aspects of their operations and impact on society. These studies should focus on evaluating how community pharmacies contribute to social sustainability within their own organizations (internal aspects) as well as in the wider community (external aspects). This may involve examining the working conditions, employee well-being, and the overall social impact of pharmacy practices. Research should also investigate how community pharmacies engage with their local communities and contribute to social development. This could

involve analyzing their involvement in community outreach programs, health education initiatives, and support for vulnerable populations(Nazar *et al.*, 2019)

Nowadays, most of the pharmacies are moving towards the sustainability practices by considering the legal requirements, economic considerations and with safety and efficacy of medications. Electronic prescribing method and computerized documentations are now most of pharmacies are implementing(Do and Novakowski, n.d.). The plastic composing medication stocked bottles can be recycled and reused. On other hand, this article shows the patient outcomes as a part of sustainable practices. It shows that the medical adherence has improved, reduction medication waste. Thus, this shows the different from previous literature because it shows the benefits of sustainability practices. The article highlights the challenges such as limited resources, lack of infrastructure and resistance to change. These are the barriers that faced due to the sustainable practices(Do and Novakowski, n.d.).

During Covid 19, the study conducted by Lyons in 2020 highlights the challenges and opportunities faced by pharmacy education program during pandemic. The authors emphasize the education program such as environmental stewardship and ethical responsibilities and also highlights the environmental conscious decision-making. It also raises possibilities of using technology to enhance pharmacists' knowledge and awareness on sustainable packaging alternatives(Lyons *et al.*, 2020). Moreover, according to the reviewed study conducted among community pharmacists in Australia by Crespo-Gonzalez in 2021 highlights that sustainability factors were grouped into social, economic and environmental domains. In the social domain it mainly highlights about the pharmacists' services. In the economic domain most of them argue about the remunerations concerns. Because economic support is crucial for sustainability practices. In the environmental domain, the government recognition of pharmacist role as new key drivers for sustainability (Crespo-Gonzalez *et al.*, 2021).

Cavicchi and Vagnoni (2020) suggest that the economic aspect of sustainability in community pharmacies can be understood by considering their managerial approach and focus on health. Pharmacy owners and managers, despite working in a heavily regulated industry, now encounter growing competition and shrinking profits. As a result, they must prioritize tasks like marketing, innovation, human resources, and building strong relationships with customers (Cavicchi and Vagnoni, 2020). Sustainability in healthcare includes environmental, social and economic aspects,

which aims to minimize the ecological footprint, improves patient care and enhance financial growth for future. The sustainability that rather than well-being of environment it is about well-being of community. Moreover, the authors categorized to focus on three areas for discussion: Dimensions of sustainability practices, drivers for sustainability practices and strategies to implement the sustainability effectively (Marimuthu and Paulose, 2016).

2.8 CONCLUSION:

In conclusion, the literature review sheds light on the multifaceted landscape of sustainable blister packaging, highlighting the ongoing efforts and advancements in addressing the environmental concerns posed by traditional packaging methods. The synthesis of various studies underscores the significance of adopting sustainable alternatives to minimize the adverse ecological impacts associated with blister packaging. From the exploration of biodegradable materials and innovative design approaches to the integration of recycling initiatives and life cycle assessments, it is evident that the packaging industry is gradually moving towards more environmentally responsible practices.

The analysis of adopting the sustainable blister packaging in pharmacies in specific region ie, Ireland mainly needs to focus on the knowledge and awareness of pharmacist about the sustainability and eco-friendly packaging and how much it is useful for customers and perspectives of pharmacist about the challenges, benefits and disposal of adopting paper, eco-blister in pharmacies. Thus, this study helps to identify the main advantages and disadvantage and the level of awareness of sustainability of packaging among the pharmacists in Ireland.

2.9 RESEARCH GAP:

When an extensive literature review was done, it was observed that there are no recent studies were conducted in terms of this topic in Ireland. This research is being conducted to fill this gap. There were no research studies were conducted on analysis of adopting sustainable blister packaging of tablets in pharmacies in Ireland. Hence, this research will focus on the challenges of adopting this sustainable blister packaging in pharmacies, and level of knowledge and awareness among pharmacist in Ireland.

CHAPTER-3

RESEARCH METHODOLOGY

3.1 OVERVIEW

Section No.	Primary Data	Details
3.2	Approach	Inductive Approach
3.3	Philosophy	Pragmatism
3.4	Strategy/ Source	Online Questionnaire- Created and distributed through Google Forms
3.5	Structure	Seven Sections comprising of 18 questions.
3.6	Time-Horizon	Cross-Sectional
3.7	Participants	Pharmacists working Pharmacies in Ireland.

Table 1: Overview of Research Methodology

This chapter mainly give importance on how the study was conducted, including the methods, philosophy, and steps taken to get the results. The reliability and validity of research depends on the chosen methodology (Morse *et al.*, 2002).

The research methodology mainly planned, implemented and analyzed to gather the data. The methodology process is very important part of the whole research process, because it includes the determining the reasons, outcomes, recommendations and help to draw conclusion from the results. To conduct effective research, researchers must grasp the basic principles behind different methods and determine which techniques are suitable for specific problems. This understanding allows them to design a methodology tailored to their specific research problem, as different problems require different approaches(Patel and Patel, 2019).

Each research methodology has its own strengths and weaknesses, so researchers must thoughtfully assess which approach aligns best with their specific research question and context. The research methodology plays a vital role in determining the quality and credibility of the findings, making it a crucial aspect of any research. Creating valuable insights and knowledge, which can be used to enhance business practices and inform decision-making, heavily relies on a well-planned and skillfully executed research methodology (Saunders *et al.*, 2019).

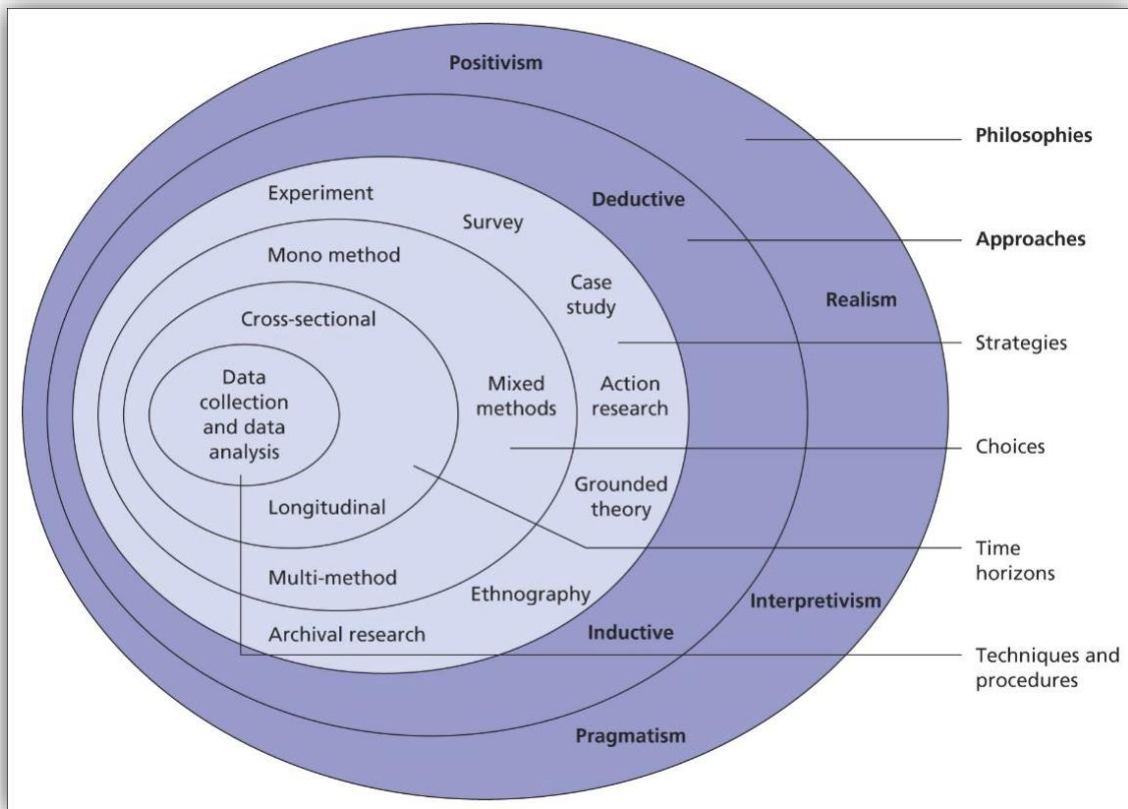


Figure 1: Research Onion(Saunders et al., 2019)

3.2 RESEARCH APPROACH:

The deductive approach focuses on developing a hypothesis based on existing theories. Researchers start with a theory, create a new hypothesis from it, and then test it to see if it holds true. If any weaknesses are found, they try to fix them before confirming or rejecting the new hypothesis. On the other hand, the inductive approach involves observing a situation or problem to generate and test beliefs. Researchers gather information directly from their observations and use it to develop theories (Burney and Saleem, 2008). Inductive research begins by observing a situation or problem and then forms and tests beliefs based on those observations(Kothari and Garg, 2019).

Based on the primary research methodology, an inductive approach was more suitable for this research as the inductive approach in research methodology is a method that starts with collecting specific observations and data, which are then used to generate broader theories or general

principles. Inductive approach allows researchers to explore new areas of study, discover patterns or trends in the data, and develop novel theories based on empirical evidence. By starting with observations rather than preconceived theories, the inductive approach enables researchers to be more open-minded, flexible, and responsive to the complexities and nuances of the real world. It is particularly valuable when studying topics where little prior research exists or when trying to uncover unexpected relationships between variables. The inductive approach fosters creativity and innovation, as it encourages researchers to think outside the box and consider perspectives that may have been overlooked. Additionally, it can serve as a stepping stone for further research and hypothesis testing, laying the foundation for more rigorous investigations in the future(Saunders *et al.*, 2019).

The introduction of sustainable packaging practices is a relatively new and evolving field, where established theories and frameworks might be limited. Therefore, an inductive approach, which involves deriving general principles from specific observations and real-world practical applications, allows researchers to gather insights from practical activities, feedback, and real-world examples. As sustainable blister packaging is still emerging and lacks well-defined theoretical foundations, an inductive approach enables researchers to build a more comprehensive understanding by analyzing concrete instances and experiences, thus contributing to the overall knowledge base in this evolving domain.

3.3 RESEARCH PHILOSOPHY:

The term "research philosophy" refers to a person's basic beliefs about the world. These beliefs shape how they view the purpose of research and the best methods to achieve that purpose. Different research philosophies may have varying ideas, but the choice of which philosophy to use depends on the specific focus of the research project(Thesismind, 2019).

Different varieties of philosophy are listed below:

Research Philosophy	Definitions
Pragmatism	Pragmatism, in simple words, means focusing on what works and taking practical actions to solve problems. It values real-life results and being flexible to adapt to different situations.

	Pragmatism prioritizes effectiveness over sticking strictly to abstract theories or ideals.
Interpretivism	According to interpretivism, it is essential to understand how people view things, what drives them, and how they think within a social context. This approach interprets the data collected about a phenomenon to gain insights into human experiences and perspectives.
Positivism	Positivism relies on gathering factual knowledge through observations and measurements, considering them to be reliable sources of information. In this approach, researchers aim to collect and analyze data objectively, without any personal bias, to ensure the accuracy and validity of their findings.
Realism	Realism is based on the idea that the human mind can think independently. It relies on scientific assumptions to build knowledge and understand the world.

Table 2: Research philosophy and definition (Saunders et al., 2019)

In this research, the researcher adopted the pragmatism philosophical approach.

Where, pragmatism which mainly support actions. Pragmatism mainly focused on the real-world consequences and practical outcomes of implementing this sustainable blister packaging in Ireland (Saunders *et al.*, 2019). In this research, the pragmatic analysis will focus on assessing the practical implications of adopting the sustainable blister packaging. And also consider the perspectives of pharmacists to understand the practical implications of this packaging approach.

Using qualitative and quantitative approach, the pragmatic approach was used to collect the data from online survey. The data gained from the online survey helps to identify the perspectives of

pharmacists based on their experience and level of knowledge on the subjects and their suggestions.

3.4 RESEARCH STRATEGY:

A timeline for the research plan was created using the Gantt Chart to assist in scheduling the dissertation activities

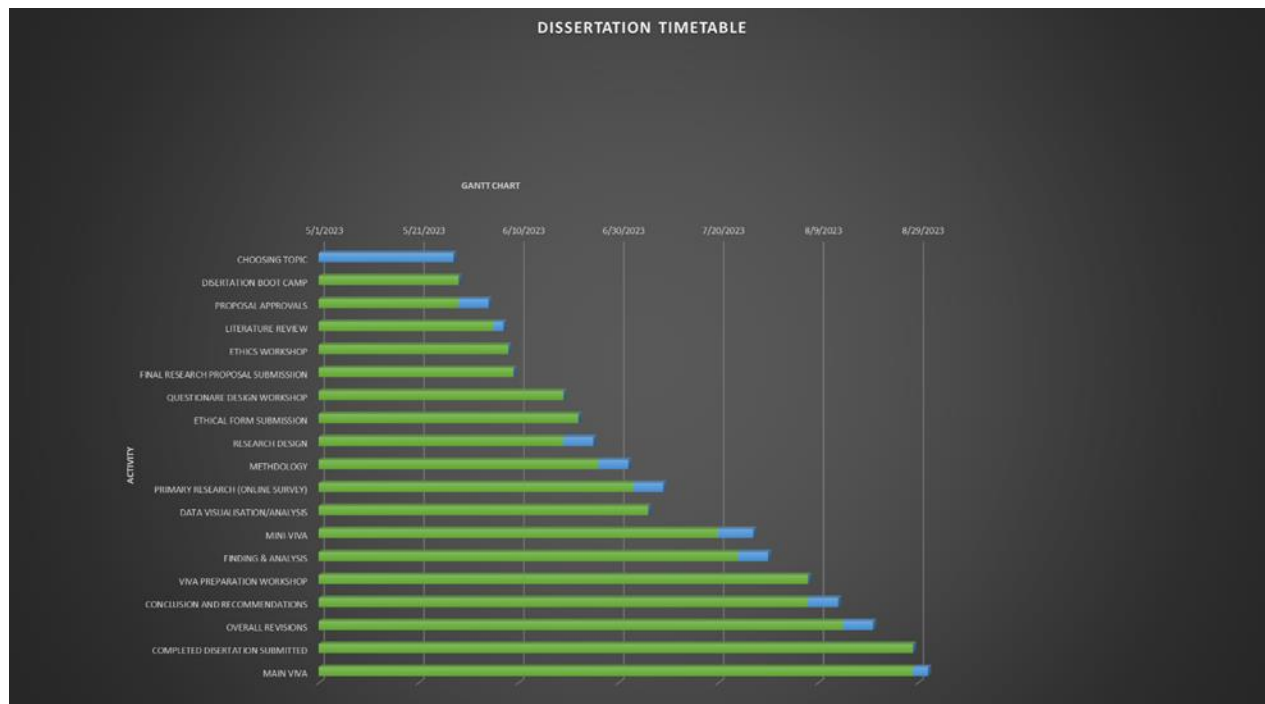


Figure 2: Research Timeline

The strategy of this research was to identify the level of awareness and knowledge of pharmacists and to identify the barriers, impact of adopting the sustainable blister packaging in Irish pharmacies. It is evident that there are have been not much studies that have explored the concept of sustainable blister packaging among pharmacists which provide a scope for this research.

The participants were informed about the purpose of this study and the language of this questionnaire was easy to understand. Majority consists of closed-end with some open-ended questions in order to get the facts and opinions of this topics. It was given to nearly 200 people currently working pharmacists in Ireland.

The questionnaire was divided into seven sections and consisting of 18 questions. It included a participation consent in the beginning of the survey, here author can use their response for this

study. This agreement is mandate to filled by participants before proceeding the survey. The participant assured the anonymity and confidentiality and the data was handled by current general data protection regulation (GDPR).

3.5 RESEARCH STRUCTURE:

The main tool used for data collection is the online survey questionnaire which contain close-end and open-end questions. It was distributed to the pharmacist in Ireland. The questionnaire was made into a structure which meet the information needed for the objectives of this study.

Number		Per Section
Participant consent and Introductory part		
1	Demographic	1
2	The knowledge level and awareness of sustainable blister packaging among pharmacists.	6
3	Challenges of adopting sustainable blister packaging .in solid dosage forms in pharmacies such as storage, supply process, and disposal practices.	3
4	The benefits of adopting sustainable blister packaging in pharmacies in Ireland.	2
5	Types of packaging.	2
6	Recommendations and advice for more sustainable packaging practices in pharmacies.	4

Table 3: Summary of Questionnaire Structure.

Section 1 - Demographics:

This section aims to gather information about the participants' experience as pharmacists. It asks how many years of experience they have in the field, which helps in understanding their background and level of expertise.

Section 2 - The knowledge level and awareness of sustainable blister packaging among pharmacists:

This section focuses on assessing the participants' awareness and knowledge regarding sustainable blister packaging. It includes questions about their familiarity with the concept, whether they received any training or education related to it, and whether they consider it important for environmental conservation.

Section 3 - Challenges of adopting sustainable blister packaging in solid dosage forms in pharmacies:

In this section, participants are asked about the challenges they face when adopting sustainable blister packaging for solid dosage forms in their pharmacies. The questions address issues related to storage, supply process, availability of sustainable packaging options, cost, and regulatory guidelines.

Section 4 - The benefits of adopting sustainable blister packaging in pharmacies in Ireland:

Here, participants are asked about their perception of the benefits of adopting sustainable blister packaging in pharmacies. The questions explore various advantages, such as reduction in plastic waste, improved environmental sustainability, positive brand image, enhanced patient perception, and potential cost savings.

Section 5 - Types of packaging:

This section inquires about the types of pharmaceutical product packaging commonly supplied and sold in participants' pharmacies. It includes options like bottles, blister packs, tubes, jars, pouches, vials, sachets, and provides space for other packaging types.

Section 6 - Recommendations and advice for more sustainable packaging practices in pharmacies:

Participants are asked whether they have specific recommendations or best practices to promote more sustainable packaging in pharmacies. The survey provides an opportunity for participants to share their insights on sustainable packaging initiatives.

3.6 TIME-HORIZON:

The time horizon is mainly divided into two types:

- Cross-Sectional: In the cross-sectional studies, the time period will be less time frame, which will limit the data gathering and analysis.
- Longitudinal: This is a long-term observation study. Which will last for considerable time period.

This research adopted a cross-sectional study because of less time frame for the research. So the data will be collected and analyzed in a certain time limit (Saunders *et al.*, 2019).

3.7 PARTICIPANTS:

Certain criteria had to be used for primary data collection:

3.7.1 SELECTION OF PARTICIPANTS:

The author used social media platforms like LinkedIn and Facebook to contact potential participants. They explained the study's goal and invited interested individuals to take part. Some people responded positively and were chosen to participate. Additionally, the author received assistance from friends and former colleagues who are currently working as pharmacists in Irish pharmacies. The method used by the author to assess the data is the Microsoft Excel and represented the results in the forms of pie graphs, bar graphs. The elaborated responses were used for recommendations for adopting the sustainable blister packaging in Irish Pharmacies.

The data was collected with the questionnaire containing sections with both open-end and closed-end questions. The author mainly considered the pharmacists experience with minimum one year experience. The survey was distributed electronically and was filled out by the participants without the presence of author and to ensure that the responses are not biased or influenced by the author. Around 200 participants were assumed to be taken in the online survey through the sample size calculation obtained through survey monkey app.

3.7.2. INCLUSION CRITERIA:

The only requirement for participants in the study was to have knowledge, understanding, and experience in pharmacies about the sustainable practices. The author did not set any other specific criteria for people to take part in the research.

3.7.3. EXCLUSION CRITERIA:

People who chose not to participate in the survey were not included in the study. If participants lost interest and didn't complete the questionnaire after receiving it, they were encouraged to ignore the survey link.

3.7.4 SAMPLE SIZE:

According to the list of pharmacists of Ireland, there are 7067 pharmacists according to the pharmacists annual list in 2022(PSI,2022, n.d.). And the population size was calculated in the site of survey monkey by putting 95 percent confidence level and 7 percent marginal error got a sample size of 191 participants. And the data collection was continued until reaching a saturation point to generate proper result.

3.7.5 ETHICAL ISSUES:

All participants were given a clear explanation of the research's aim and purpose. They were informed about their right to choose whether to take part in the study or withdraw if they wish. The survey questions were carefully designed to protect the participants' privacy, ensuring that they didn't have to disclose personal or organizational information, including details about their clients or current projects. The questions were relevant to the study's objectives. Participants were aware that their involvement was entirely voluntary, and they could leave the study without facing any consequences.

3.8 DATA ANALYSIS:

3.8.1 QUANTITATIVE ANALYSIS

The responses from all participants were collected and recorded in a spreadsheet. The data received from the survey was then analyzed using Microsoft Excel, and graphical representations such as bar charts or pie charts were created to present the findings visually. And the data obtained from the closed-end questions through statistical tool called descriptive statistics, here nominal data were analyzed. Here, frequency distribution will be obtained accordingly. Descriptive statistics mainly summarize and organize data according to its characteristics.

3.8.2 QUANLITATIVE ANALYSIS

The data analyzed using the descriptive method which were used to understand the opinion of the participants. Thematic analysis for open-ended survey questions involves systematically identifying and analyzing themes or patterns in the responses provided by participants and conclusion will be made. The context of our research on sustainable packaging, the researcher employed Thematic Analysis as a robust qualitative method to analyze the data obtained from a survey conducted among the pharmacists in Ireland. Thematic Analysis proved invaluable in unraveling patterns and themes within the collected data, facilitating a comprehensive exploration of the participants' perspectives. By perceptive patterns and recurrent themes in the pharmacists' perspectives, the researcher was able to develop and refine key themes that contributed significantly to the advancement of our research on sustainable packaging. The question number 13 and 15 analyzed using thematic analysis by assigning codes to each responses with labels which help to organize them into categories or themes.

3.9 CONCEPTUAL FRAMEWORK

The conceptual framework for the study on sustainable blister packaging in Ireland's pharmacies the literature review on packaging types and the investigation of pharmacist knowledge, impact, and recommendations related to sustainable blister packaging. The literature review will explore existing studies on various packaging types used in the pharmaceutical sector, including bottles, blister packs, tubes, jars, pouches, vials, and sachets. This review will help provide a comprehensive understanding of the current packaging landscape in pharmacies and its environmental implications.

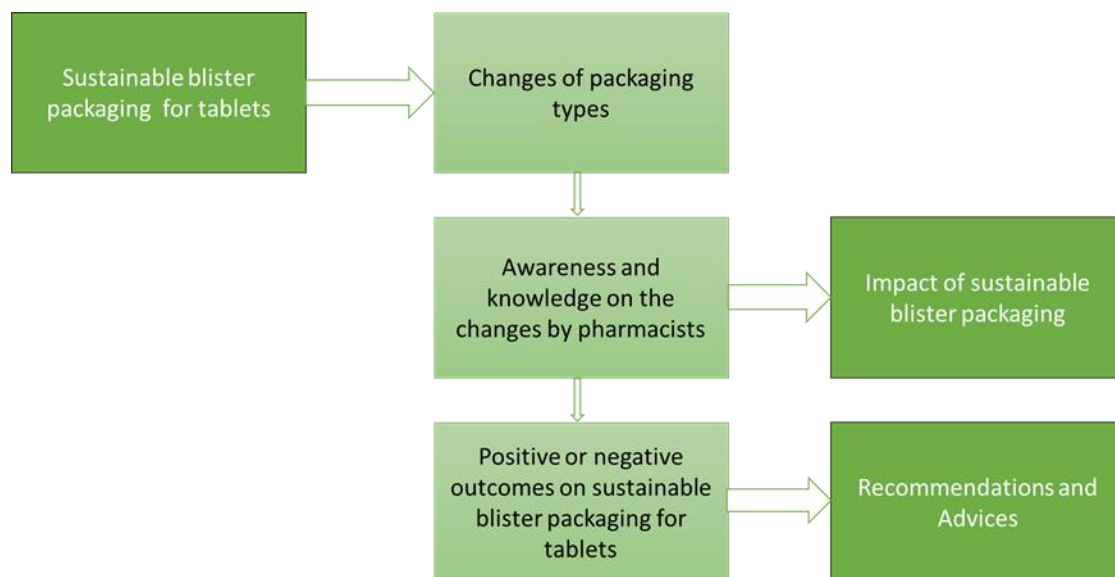


Figure 3: Conceptual framework of current study

The study's primary objective is to assess pharmacists' knowledge and awareness of sustainable blister packaging and its potential impact on the environment. The survey will gather data from pharmacists in Ireland, ensuring their informed consent to participate. The questionnaire will be carefully crafted to protect participants' privacy, ensuring they do not need to disclose personal or organizational details. The analysis will be conducted qualitatively, using thematic analysis to identify common themes and patterns in the responses.

The conceptual framework also includes investigating the perceived benefits and challenges of adopting sustainable blister packaging in Irish pharmacies. By gathering insights on the advantages, such as reduced plastic waste and improved environmental sustainability, as well as the obstacles faced, such as storage constraints and supply process difficulties, the study aims to provide valuable information to guide future sustainable packaging practices.

Finally, the research will elicit recommendations and advice from pharmacists on promoting more sustainable blister packaging practices. Participants will have the opportunity to share their insights on the subject, helping identify potential strategies to overcome challenges and enhance the adoption of eco-friendly packaging solutions.

3.9.1 CONCLUSION

The study used a combination of qualitative and quantitative methods to gather data. The researcher conducted surveys with open-end and close-end questions to record participants' ideas

for analysis. The collected data were carefully analyzed, and conclusions were drawn based on the findings. The results were presented visually using diagrams. The researcher compared the conclusions with the key findings from the literature review conducted earlier. The subsequent chapters provide a detailed explanation of the main findings and analyses.

CHAPTER-4

FINDINGS AND ANALYSIS

This chapter will concentrate on the data finding from the participants and analyzing the data findings to reach conclusion of the study. The quantitative data were analyzed through descriptive statistics using Microsoft Excel. The data obtained is grouped frequency according to the number of responses. Moreover, the qualitative data is analyzed through thematic analysis through common pattern of responses or familiarizing the common responses obtained from the open-ended questions.

4.1 QUANTITATIVE ANALYSIS AND QUALITATIVE ANALYSIS

PART-1

Before starting the survey, two introductory questions were included to ensure agreement with the study's purpose. A brief description of the research's goals was provided in the survey introduction. Participants were informed that they could reach out to the author if they had any concerns or questions. It was emphasized that participation in the survey was entirely voluntary, and they had the freedom to opt out at any time.

In this short period of time, the total number of responses obtained from the survey is 102 pharmacists from Ireland from the sample size of 191.

- **Demographics:**

1.How many years of experience do you have as a pharmacist?

The majority of respondents (91.18%) have less than 5 years of experience as pharmacists. This suggests that the survey audience might consist of relatively new or early-career pharmacists. A small percentage of respondents (5.88%) have been practicing for 5-10 years.

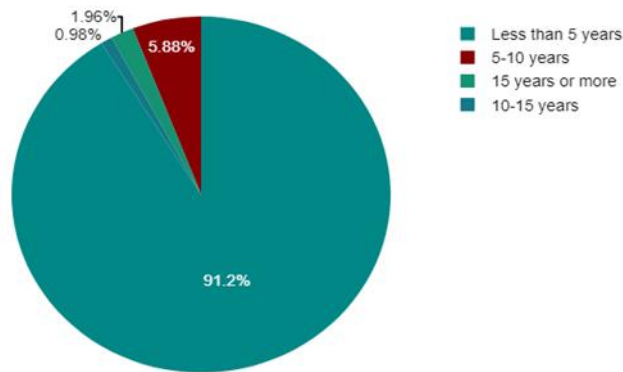


Figure 4: Pie chart representation with percentage of survey respondent's experience in the pharmacy in Ireland

This could indicate a group of pharmacists who are in the mid-stages of their careers. Only a few respondents (1.96%) have 15 years or more of experience. This suggests a smaller representation of pharmacists with extensive experience. The data includes a single respondent (0.98%) with experience between 10 and 15 years. This category has the lowest representation.

- **The knowledge level and awareness of sustainable blister packaging among pharmacists.**

2. Are you familiar with the concept of sustainable blister packaging?

Table 4: Familiarity with sustainable blister packaging

Responses	Frequency	% Frequency
Yes	56	54.9%
No	46	45.1%
Total	102	100%

Using descriptive statistics, we analyzed the familiarity of 102 participants with the concept of sustainable blister packaging. Among these participants, 56 individuals, or 54.9%, reported being familiar with sustainable blister packaging. On the other hand, 46 participants, or 45.1%, indicated that they were not familiar with the concept. In total, all 102 participants were accounted for in the analysis. This simple breakdown helps us understand the distribution of familiarity with sustainable blister packaging among the participants.

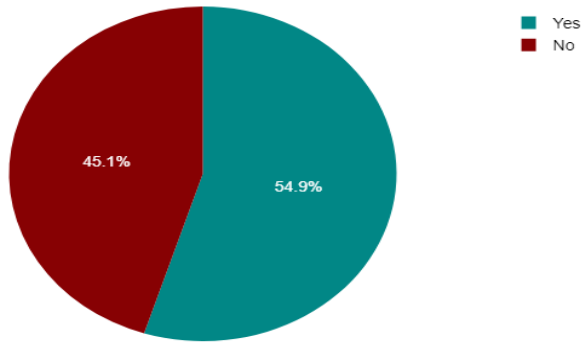


Figure 5: Pie chart representation with percentage of respondent's familiarity with Sustainable blister packaging

2.1 Comparison between the experience of study participants and familiarity with sustainable blister packaging.

		1. How many years of experience do you have as a pharmacist?									
		15 years or more		Less than 5 years		5-10 years		10-15 years		Total	
		n	%	n	%	n	%	n	%	n	%
2. Are you familiar with the concept of sustainable blister packaging?	Yes	2	1.96%	50	49.02%	6	5.88%	1	0.98%	59	57.84%
	No	0	0%	43	42.16%	0	0%	0	0%	43	42.16%
Total		2	1.96%	93	91.18%	6	5.88%	1	0.98%	102	100%

Table 5: Comparison between the most common experience of study participants and their familiarity with sustainable blister packaging.

The research examined the connection between pharmacists' years of experience and their familiarity with the concept of sustainable blister packaging. A total of 102 pharmacists participated in the survey, with responses categorized based on experience and familiarity. Among those with 15 years or more of experience, 2 pharmacists (1.96% of total respondents) are familiar with sustainable blister packaging. Among pharmacists with less than 5 years of experience, 50 (49.02%) are familiar, and 43 (42.16% of total respondents) are not. In the 5-10 years experience range, 6 pharmacists (5.88% of total respondents) are familiar. In the 10-15 years experience range, 1 pharmacist (0.98% of total respondents) is familiar.

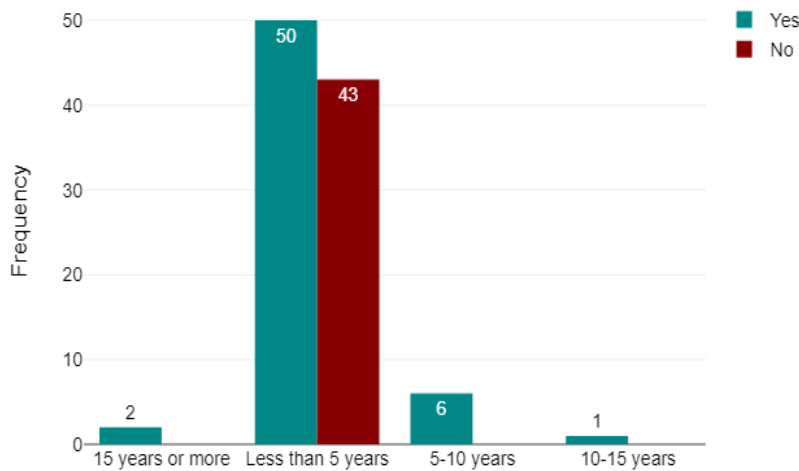


Figure 6: Comparison between the most common experience of study participants and their familiarity with sustainable blister packaging.

Pharmacists with less than 5 years of experience show the highest level of familiarity with sustainable blister packaging. Almost half (49.02%) of respondents in this group are familiar with the concept. The familiarity rate remains moderate (5.88%) among pharmacists with 5-10 years of experience. Among pharmacists with 15 years or more of experience, the familiarity rate drops to 1.96%. This suggests that, irrespective of experience level, a significant proportion of pharmacists were acquainted with this packaging concept.

In conclusion, using descriptive statistics, we observed that a higher percentage of participants with less experience were familiar with sustainable blister packaging compared to those with 5-10 years of experience. However, recent graduates might receive more exposure to sustainability concepts during their education, contributing to their higher familiarity. Nevertheless, Pharmacists with more experience might not have encountered sustainability concepts in the same way as newer graduates due to evolving industry trends.

3. Have you received any training or education regarding sustainable blister packaging?

In this research, we inquired about participants' training or education on sustainable blister packaging. Out of the 102 participants, 83.33% responded that they had not received any training or education on this topic, while 16.67% indicated that they had. The data showed that a significant majority of participants had not been exposed to training or education in sustainable blister packaging.

Responses	Frequency	% Frequency
No	85	83.33%
Yes	17	16.67%

Table 6: Frequency of responses regarding the education on sustainable blister packaging

This finding suggests that there might be an opportunity for educational interventions to increase awareness and knowledge about sustainable blister packaging within the pharmacy profession. The low percentage of participants who reported having received training could imply a potential gap in the current curriculum or training programs in addressing environmentally friendly packaging practices. Among those with less than 5 years of experience, a majority (49.02% of total respondents) are familiar with sustainable blister packaging, and a similar portion (42.16%) have not received training. The patterns in less-experienced pharmacists could indicate that recent graduates, who are likely to have received more up-to-date training, are more familiar with sustainability concepts. This alignment highlights a potential correlation between familiarity, training, and the early years of professional practice.

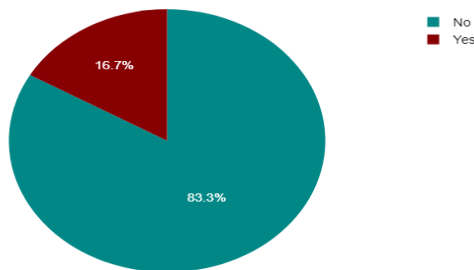


Figure 7: Frequency of responses regarding the education on sustainable blister packaging

4. Do you consider sustainable blister packaging to be important for environmental conservation?

In this study, we explored participants' perceptions of the importance of sustainable blister packaging for environmental conservation. Out of the 102 participants, a significant majority of 87.25% expressed the view that sustainable blister packaging is indeed important for environmental conservation. Additionally, 11.76% were uncertain about its importance, and only a small percentage of 0.98% indicated that they do not consider it important.

Responses	Frequency	%Frequency
Yes	89	87.25%
Unsure	12	11.76%
No	1	0.98%

Table 7: Responses showing the importance of sustainable blister packaging for environment.

These findings underscore a positive sentiment towards sustainable blister packaging among the participants. Eventhough, 45% respondents shows infamiliarity in term of sustainable blister packaging. However, 87.25% respondents shows that sustainable packaging promotes environmental conservation this is mainly because of participants having diverse perspectives and assumptions. Moreover, they propose that this discrepancy may be a result of a broader awareness of sustainability's importance, despite a lack of familiarity with the specific terminology.

The overwhelming agreement on its importance implies a general recognition of the role that environmentally friendly packaging can play in conservation efforts. The relatively small percentage of uncertainty suggests that some participants might require more information or education to form a definitive opinion on the matter.

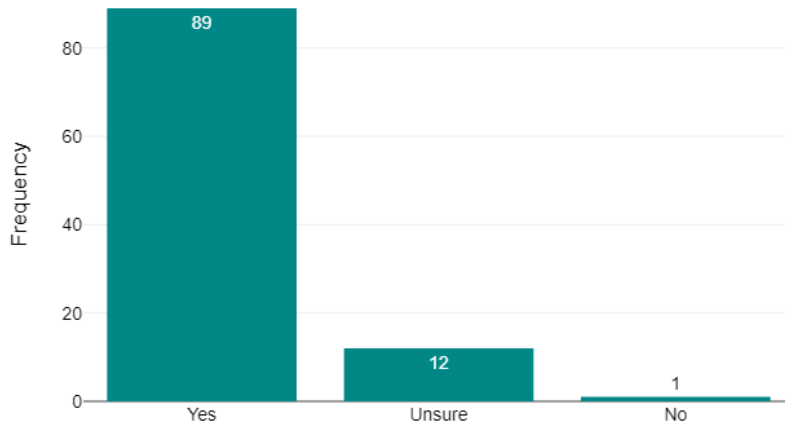


Figure 8: Bar Graph represents the frequency of responses on whether the sustainable blister packaging shows environmental conservation

The solitary participant who expressed that sustainable blister packaging is not important represents an outlier in the data, and its significance should be interpreted cautiously given its low prevalence. And from the study conducted by Deore et al shows that qualities of eco-friendly sustainable packaging such as reduction of packaging waste, improvement in shipping effectiveness. These type of eco-friendly packaging can be recycled and made into another packaging and it can be re-used and can be repurposed (Deore *et al.*, 2023). Moreover, this data support that study conducted by the Pedrosa de Oliveira, the use of biodegradable packaging for tablet forms will ensure environmental friendliness (Pedrosa de Oliveira *et al.*, 2021).

These results highlight a positive inclination towards sustainability within the pharmacy community, and they align with broader efforts to promote environmentally responsible practices.

5. Do you believe there is a need for additional training or educational programs to enhance awareness and knowledge about sustainable blister packaging among pharmacists?

In this study, we investigated participants' perspectives on the necessity of additional training or educational programs to enhance awareness and knowledge about sustainable blister packaging among pharmacists. Out of the total 102 participants, an overwhelming 98.04% responded affirmatively, indicating that they believe there is a need for such training. Only a very small percentage of 1.96% expressed that they do not perceive a need for additional education in this area.

Responses	Frequency	%Frequency
Yes	100	98.04%
No	2	1.96%

Table 8: Responses obtained from participants regarding additional training on sustainable blister packaging practices

The data demonstrates a strong consensus among participants regarding the requirement for enhanced awareness and knowledge about sustainable blister packaging. The large number of

positive responses shows that many people agree there's a lack of understanding and that focused educational programs could help pharmacists learn more about sustainable blister packaging. And also, around 83 % participants still have not received any educational programs or training to enhance their education level about sustainable blister packaging.

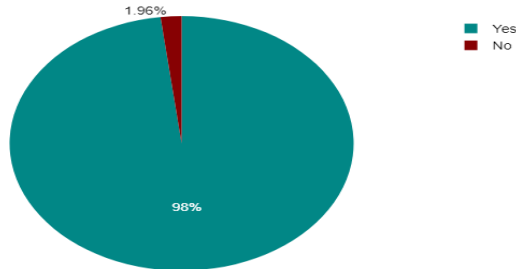


Figure 9: Pie Chart represents the responses on the need for additional training on sustainable blister packaging practices.

**6. Are you currently using any sustainable blister packaging options in your pharmacy?
And if yes, which sustainable blister packaging is used?**

Responses	Frequency	%Frequency
No	63	61.76%
Yes	39	38.24%

Table 9: Frequency of respondents using sustainable packaging options

Out of the 102 participants, 61.76% reported that they are not currently using any sustainable blister packaging options, while 38.24% indicated that they are implementing such options.

This breakdown of responses provides insights into the adoption of sustainable blister packaging practices within pharmacies.

		Are you currently using any sustainable blister packaging options in your pharmacy?		Total
		No	Yes	
If you answered 'Yes' to the previous question, please describe the sustainable blister packaging options you are currently using.	Recycled Plastics	0	8	8
	Bio-Based Plastics	0	32	32

	Compostable materials	0	2	2
	Total	0	42	42

Table 10: Frequency of responses on mostly using sustainable blister packaging options in pharmacies.

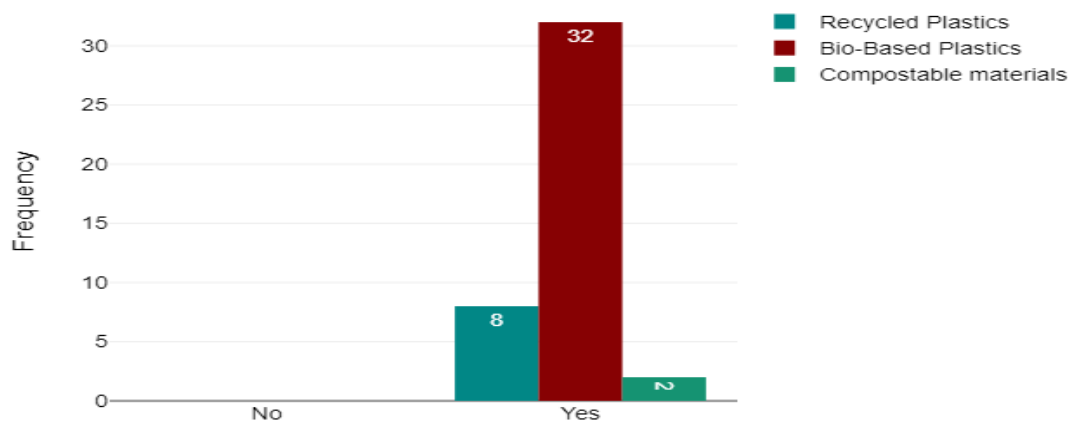


Figure 10: Bar Graph representation of respondents most common using sustainable blister packaging options.

The number of participants who stated ‘Yes’ shows that among the 39 participants who stated that they are using sustainable blister packaging, they provided details about the specific options they are implementing. Notably, 8 participants mentioned using recycled plastics, 32 participants reported using bio-based plastics, and 2 participants indicated the use of compostable materials. Thus, responses shows that the bio-based materials are started being used in pharmacies in Ireland. So, according to the study conducted by the Kumar and Gupta on the pharmaceutical packaging trends this data supports that bio-degradable materials of packaging can be effectively used (Kumar and Gupta, 2012b). These insights allow us to compare the preferences for sustainable blister packaging across different options. It is evident that bio-based plastics are particularly popular among the pharmacies that are incorporating sustainability measures. Recycled plastics also have a presence, albeit to a lesser extent, while compostable materials are being used by a smaller fraction of participants.

- **Challenges of adopting sustainable blister packaging in solid dosage forms in pharmacies such as storage, supply process, and disposal practices.**

7. What are the main challenges you face in adopting sustainable blister packaging for solid dosage forms? (Select all that apply)

Responses	Frequency	%Frequency
Storage constraints	28	27.45%
Lack of regulatory guidelines	25	24.51%
Higher costs	23	22.55%
Limited availability of sustainable packaging options	22	21.57%
Supply process difficulties	4	3.92%

Table 11: Frequency of responses on different challenges faced during the adoption of sustainable blister packaging.

Through the application of descriptive statistics, we explored the main challenges encountered by participants when adopting sustainable blister packaging for solid dosage forms. A total of 102 participants provided insights into their challenges. Most frequently cited challenge was "Storage constraints," with 27.45% of participants indicating it as a hurdle. This suggests that limited space to store sustainable blister packaging materials might be a considerable concern within the pharmacy context.

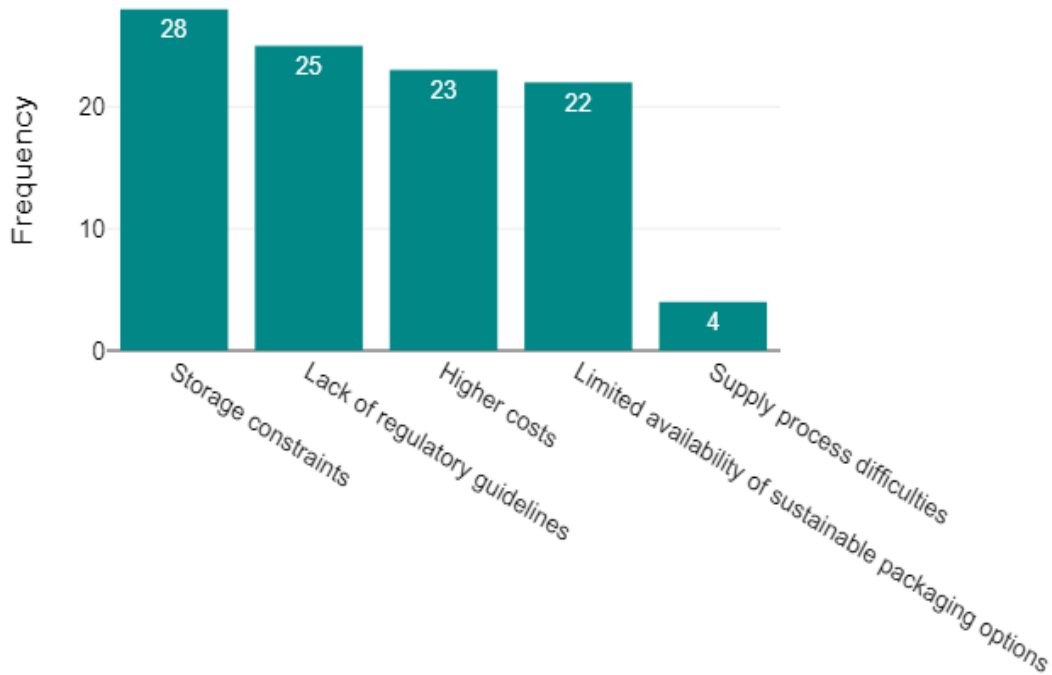


Figure 11: Bar Graph represents the frequency of responses on different challenges of adopting sustainable blister packaging.

Close in prevalence was the challenge of "Lack of regulatory guidelines," which was noted by 24.51% of participants. This highlights a potential need for clearer regulatory frameworks to guide the adoption of sustainable blister packaging practices, indicating an area where regulatory intervention might be beneficial. Another noteworthy challenge was "Higher costs," as mentioned by 22.55% of participants. This suggests that cost considerations might play a role in the decision-making process when choosing sustainable blister packaging alternatives.

"Limited availability of sustainable packaging options" was identified as a challenge by 21.57% of participants, indicating that a restricted selection of viable sustainable options might be influencing the adoption rate. In contrast, "Supply process difficulties" emerged as a less prevalent challenge, with only 3.92% of participants selecting it. This suggests that challenges related to the supply chain might be less significant compared to other obstacles.

The data's distribution showcases the complexity of challenges faced in the adoption of sustainable blister packaging for solid dosage forms. The variation in percentages indicates that different pharmacies might encounter distinct barriers based on their individual perspectives rather than their own experiences.

From the above discussion the researcher came to an understanding that storage constraints and lack of regulatory guidelines are the main challenges faced during the adoption of sustainable blister packaging in pharmacies in Ireland. And this data agreement with statement in the article on the challenges part such as lack of infrastructure and resistance to change. These are the barriers that faced due to the sustainable practices in pharmacies (Do and Novakowski, n.d.) and although there are no exact rules for eco-friendly blister packaging yet, there are rules for pharmaceutical packaging in general (Hallie Forcinio, n.d.).

8. Do you think that sustainable blister packaging ensures more shelf-life period for solid dosage form than traditional packaging?

Out of the 102 participants, 66.67% responded "No," indicating that they do not believe sustainable blister packaging ensures a longer shelf-life period. Conversely, 33.33% responded "Yes," suggesting that they do think sustainable blister packaging contributes to an extended shelf-life period. These findings reflect a division of opinions among the participants. A majority of

respondents expressed skepticism about the potential of sustainable blister packaging to significantly increase the shelf-life period for solid dosage forms.

Responses	Frequency	%Frequency
No	68	66.67%
Yes	34	33.33%

Table 12: Frequency of responses about the shelf-life period of sustainable blister packaging.

The results show that participants have different perspectives. Most of them are unsure if sustainable blister packaging can noticeably extend the shelf-life of solid medicines. This uncertainty could be because they worry that sustainable materials might not be as good at preserving medicines for a long time.

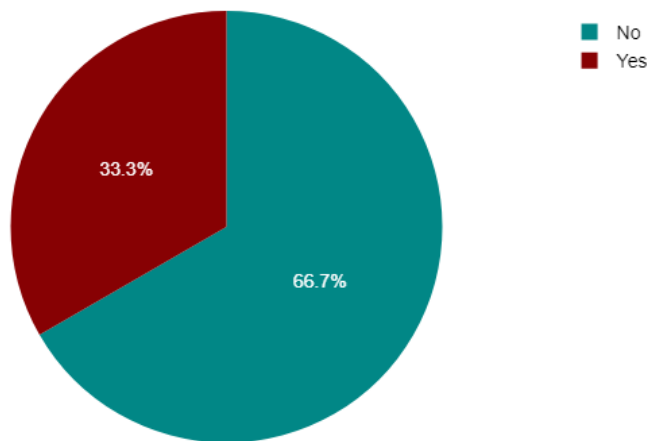


Figure 12: Pie Chart represents the response frequency on the shelf-life period of sustainable blister packaging.

From the discussion it is understood that the most respondents are concern about the shelf-life period of sustainable blister packaging. However, this statement disagree with the article which state about the long shelf-period of sustainable blister packaging that the bio-degradable, eco-friendly packaging such as packaging made by chitosan, starch and other bio-degradable materials extend their shelf-life more effectively in pharmaceutical as well as food sector (Kumar and Gupta, 2012b).

9. Which of the following challenges have affect the supply process when adopting the eco-friendly sustainable blister packaging for solid dosage form? (Select all that apply)

A significant portion, 50%, highlighted the need to adjust current systems to suit unique requirements. This indicates that accommodating sustainable blister packaging might demand changes in how pharmacies operate, reflecting a potential need for adaptability and innovation. 19.61% of participants mentioned that sustainable blister packaging comes with greater costs compared to traditional packaging.

Responses	Frequency	%Frequency
Modifying the existing systems to accommodate unique requirement.	51	50%
Higher expenses compared to traditional packaging	20	19.61%
Limited Manufacturers or suppliers	16	15.69%
Availability and sourcing of eco-friendly packaging	15	14.71%

Table 13: Frequency of responses showing the challenges affecting the pharmacies during adopting the sustainable blister packaging.

This insight reflects a concern about the financial implications of transitioning to environmentally friendly options, underscoring the importance of cost-effectiveness in sustainable practices. For 15.69% of participants, a challenge lies in the limited availability of manufacturers or suppliers for sustainable packaging materials. This constraint might hinder the adoption of sustainable practices, highlighting the need for a robust supply chain for eco-friendly packaging options. Sourcing eco-friendly packaging options was cited by 14.71% of participants. This challenge underscores the importance of having access to a variety of sustainable materials, indicating a potential area for industry expansion and development. Overall, these findings inform discussions on the practical aspects of implementing sustainability in pharmaceutical packaging and point toward potential areas for improvement.

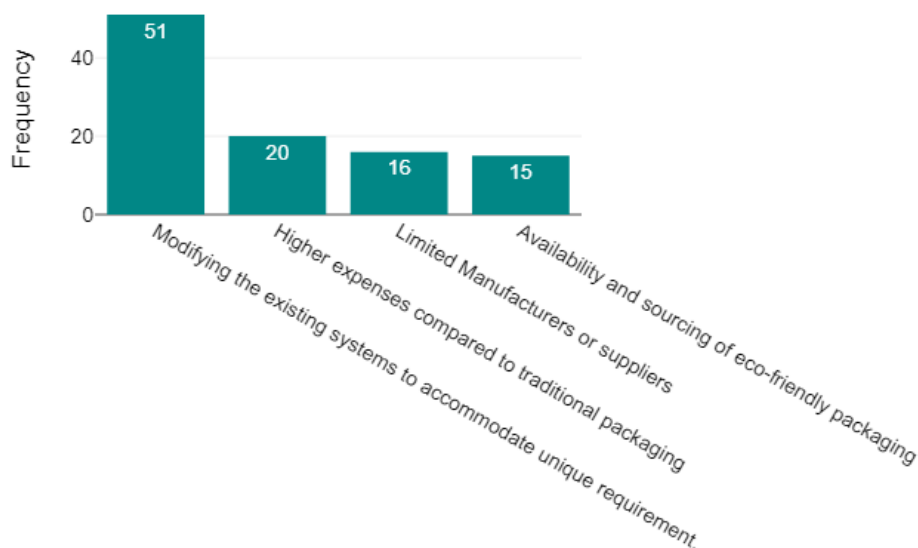


Figure 13: Bar Graph Representing the Frequency of responses showing the challenges affecting the pharmacies during adopting the sustainable blister packaging.

- **The benefits of adopting sustainable blister packaging in pharmacies in Ireland.**

10. In your opinion, what are the benefits of adopting sustainable blister packaging in pharmacies? (Select all that apply)

A substantial majority, 69.61%, identified a reduction in plastic waste as a primary benefit. This indicates a strong recognition of the environmental impact of sustainable blister packaging, with participants valuing its potential to contribute to waste reduction.

Responses	Frequency	%Frequency
Reduction in plastic waste	71	69.61%
Improved environmental sustainability	21	20.59%
Enhanced patient perception and satisfaction	5	4.9%
Positive brand image and reputation	3	2.94%
Potential cost savings in the long run	2	1.96%

Table 14: Frequency of responses on the benefits of adopting sustainable blister packaging.

For 20.59% of participants, the central benefit lies in enhanced environmental sustainability. This finding underscores the alignment between sustainable practices and broader ecological concerns,

suggesting a proactive approach towards mitigating environmental impact. A smaller group of participants (4.9%) highlighted the potential for improved patient perception and satisfaction. This insight suggests that patients may view sustainable blister packaging favorably, possibly attributing environmentally friendly practices to greater care and responsibility.

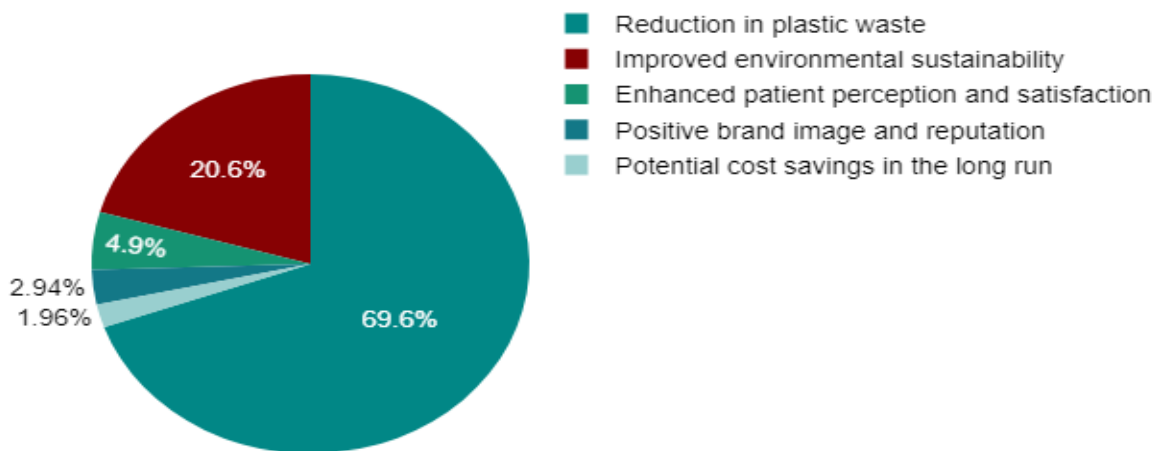


Figure 14: Pie Chart Represents Frequency of responses on the benefits of adopting sustainable blister packaging.

A few participants (2.94%) recognized the advantage of a positive brand image and reputation resulting from sustainable packaging practices. This finding points to the potential role of sustainability in shaping how pharmacies are perceived by their customers and the wider community. A couple of participants (1.96%) mentioned potential long-term cost savings as a benefit. This insight hints at the consideration of sustainable practices not only as environmentally responsible but also as financially prudent in the future.

From the discussion it is understood that these data showing agreement with the study conducted by Patel on biodegradable materials the study highlights the main benefit of sustainable packaging are its environmental friendly nature so by adopting these type of packaging will reduce the amount of plastic waste.

11. How do you think sustainable blister packaging can contribute to reducing plastic waste in the pharmacy sector?

A substantial majority, 50.98%, emphasized the role of biodegradable materials in reducing plastic waste. This finding underscores a strong belief in the potential of eco-friendly packaging materials that can break down naturally, thus minimizing the lasting environmental impact of plastic waste.

Responses	Frequency	%Frequency
Biodegradable materials	52	50.98%
Education and Awareness	36	35.29%
Bio-based plastics	14	13.73%

Table 15: Frequency of responses on reduction of plastic waste in pharmacy sector

A significant portion of participants (35.29%) identified education and awareness as key drivers in reducing plastic waste. This insight highlights the recognition that informed decision-making, coupled with raising awareness about sustainable practices, can lead to a decrease in plastic usage. A smaller yet noteworthy group (13.73%) mentioned bio-based plastics as a contributor to reducing plastic waste. This suggests a positive perception of innovative materials that are derived from renewable sources and have a potentially lower environmental footprint compared to traditional plastics.

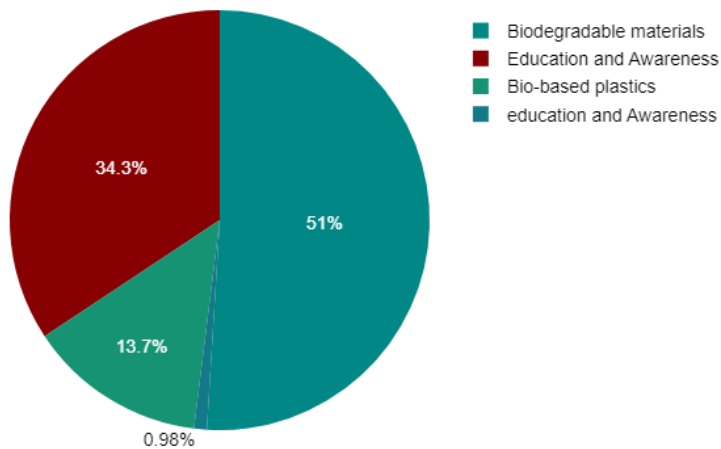


Figure 15: Pie Chart Represent Frequency of responses on reduction of plastic waste in pharmacy sector

Overall, the study's findings contribute to discussions on the pathways through which sustainable packaging choices can contribute to reducing plastic waste within pharmacies.

- **Types of packaging**

12. Comparing the types of packaging and which shows the higher protection and preservation for pharmaceutical products:

Among the various packaging types, **blister packs** emerged as the predominant choice, being commonly used by a substantial majority of **67.65%** of participants. This high percentage signifies a widespread inclination towards blister packs, portraying them as the favored packaging option within pharmacies. **Vials**, although less common, were noted by **5.88%** of participants, indicating a noteworthy utilization of this packaging type. Additionally, **bottles** gained prominence with a **12.75%** representation, highlighting their significant presence as a packaging choice in pharmacies.

Jars, pouches, sachets, and tubes exhibited varying levels of prevalence, ranging from **0.98%** to **4.9%**, indicating relatively less common usage of these options. This comprehensive analysis presents a comprehensive view of the packaging landscape within pharmacies, showcasing the dominance of blister packs while acknowledging the diverse range of packaging alternatives in use.

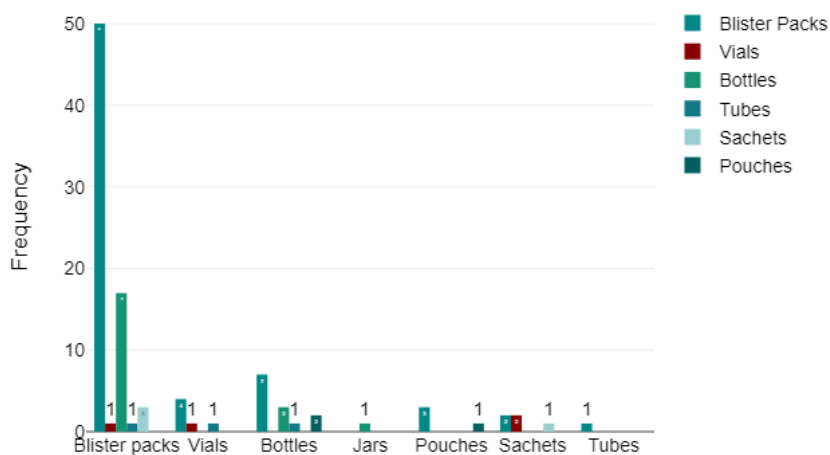


Figure 16: Bar Graph represents the frequency of responses for various packaging in pharmaceutical sector.

Turning to participants' perceptions regarding protection and preservation, the findings were equally revealing. In contrast, only a marginal **0.98%** indicated **vials** as their preferred choice in this aspect. **Bottles, tubes, sachets, and pouches** exhibited varying degrees of perceived protection and preservation benefits, ranging from **0.98%** to **3.92%**.

This comparative analysis underscores the widespread belief in **blister packs** as the superior choice for protecting and preserving pharmaceutical products. The strong alignment between participants' perceptions and the prevalence of blister packs reinforces their reputation as a favored packaging option. Such as many solid or liquid medications are stored in bottles or containers. Blister packs are often used for solid oral medications and help with dosing accuracy and patient compliance. Sachets are convenient for medications in powder or granule form, such as oral antibiotics. Liquid medications, especially injections, are often stored in sealed glass ampoules or vials. Liquid medications, especially for eye drops or ear drops, are often stored in small dropper bottles for precise dosing. Creams, ointments, and gels are often stored in tubes. These are easy to squeeze to dispense the required amount of medication.

- **Recommendations and advice for more sustainable packaging practices in pharmacies.**

13. Are there any specific recommendations or best practices you would suggest for promoting more sustainable packaging practices in pharmacies?

The majority of participants, 75.49%, indicated that they do not have specific recommendations or best practices to suggest for promoting sustainable packaging practices in pharmacies. This suggests a prevailing lack of proactive suggestions among the participants. However, a notable portion, 24.51%, did express having recommendations or best practices to offer. This minority of participants demonstrates a willingness to contribute ideas for promoting more sustainable packaging practices within the pharmacy context.

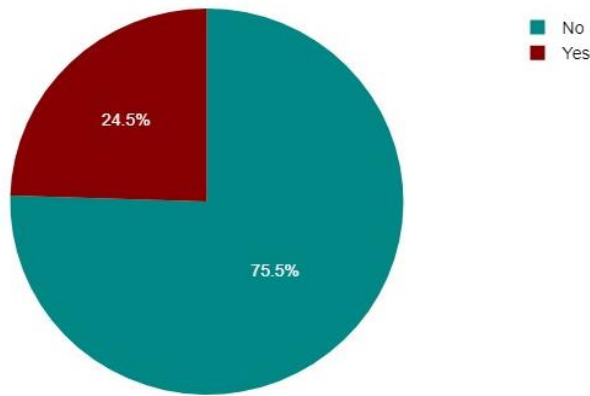


Figure 17: Pie Chart Represents the frequency of responses on yes or no for recommendation on sustainable practices.

This was followed to an open-ended question and most of the respondents who said “Yes” for further recommendations asked to conduct awareness programs and training in order to promote the usage of sustainable blister packaging in pharmacies. Participants' responses to the open-ended question revealed several recurring themes regarding recommendations for promoting more sustainable packaging practices in pharmacies:

Recommendations given by participants for promoting the sustainable blister packaging.

- Conduct awareness
- Everyone should know about the impact. How much plastic or non-degradable waste are producing per year is unknown to everyone. Give some awareness to everyone.
- Reduce single use plastics
- Conduct campaigns to aware customers. Reduce single use plastic
- Conduct awareness campaign for to educate people
- Conduct awareness campaigns to educate costumers Reduce single use plastic
Implementing recycling programs conduct staff training
- Conduct awareness campaign to educate customers
- Awareness programs for customers.

Table 16: Reasoning given by participants for promoting the sustainable blister packaging.

Many participants emphasized the need for extensive awareness campaigns and education initiatives. They stressed the importance of informing everyone about the impact of plastic waste and non-degradable materials on the environment. The consensus was that a lack of awareness contributes to the prevailing issue, and addressing this gap through campaigns and education is essential. Participants recommended conducting targeted campaigns to raise awareness among customers and the public about the adverse effects of single-use plastics on the environment. This approach seeks to encourage individuals to make conscious choices and opt for more sustainable alternatives. The concept of implementing recycling programs was mentioned by participants. This recommendation suggests an actionable approach to managing plastic waste by introducing mechanisms that allow for the proper disposal and recycling of packaging materials. Recycling programs align with the broader goal of minimizing waste and promoting responsible consumption. Some participants emphasized the importance of training pharmacy staff to be well-informed about sustainable packaging practices. By educating staff, pharmacies can play an active role in providing knowledge to customers and fostering a culture of sustainability within the pharmacy environment.

14. How willing would you be to adopt sustainable blister packaging for solid dosage forms in your pharmacy?

A significant majority of participants, 60.78%, expressed a high level of willingness to adopt sustainable blister packaging. This indicates a strong positive inclination towards embracing environmentally friendly packaging practices. 32.35% of participants indicated a moderate level of willingness to adopt sustainable blister packaging. While not as strong as the "very willing" group, this segment still shows a considerable openness to incorporating these practices.

Responses	Frequency	%Frequency
Very willing	62	60.78%
Somewhat willing	33	32.35%
Unsure	6	5.88%
Not willing	1	0.98%

Table 17: Frequency of responses on the willingness on adopting the sustainable blister packaging in pharmacy

A smaller percentage of participants, 5.88%, reported being unsure about their willingness to adopt sustainable blister packaging. This group may require further information or consideration before making a decision. A minor portion of participants, 0.98%, expressed a lack of willingness to adopt sustainable blister packaging. This segment appears resistant to the idea of implementing such practices in their pharmacies. The distribution of responses reflects a generally positive disposition towards sustainable blister packaging, with a notable majority indicating high levels of willingness. The variations in willingness levels underscore the importance of addressing potential concerns or uncertainties among participants who expressed lower levels of willingness.

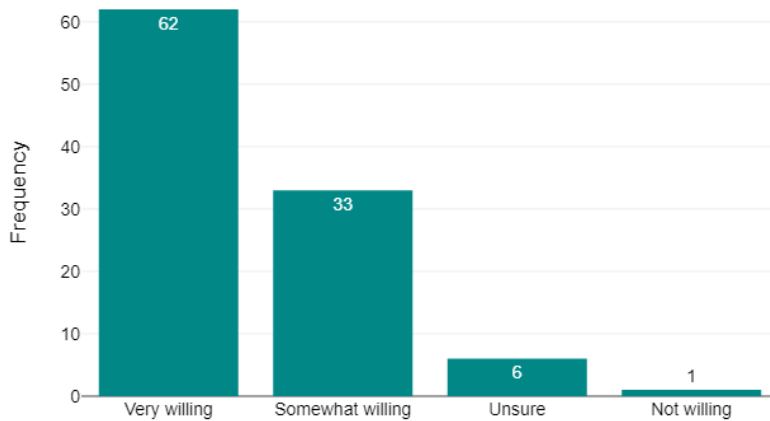


Figure 18: Bar Graph Represents Frequency of responses on the willingness on adopting the sustainable blister packaging in pharmacy.

15. Is there any additional feedback or comments you would like to provide regarding sustainable blister packaging in pharmacies?

These qualitative patterns of responses highlight a range of perspectives and concerns related to sustainable blister packaging in pharmacies. Common themes include concerns about shelf life and effectiveness, the need for education and awareness campaigns, the benefits of blister packaging, supply and shelf- life considerations, environmental responsibility, and the urgency to reduce plastic usage. The data illustrates the diversity of opinions and considerations that influence participants' perspectives on adopting sustainable packaging practices in the pharmacy sector. Only

12 participants among 102 responded to the open-end question to provide their recommendation and concerns about the sustainable blister packaging.

Recommendation provided by some participants for promoting the use of sustainable blister packaging in pharmacies.

- Not sure about the shelf life of drugs when a sustainable package is used
- Educating consumers about the usage of paper-based package
- Blister packaging is best option for protection products from damage, contamination, humidity
- Should be cost effective
- Need more suppliers and more shelf-life
- Promoting sustainable blister packaging in pharmacy
- Nothing significant
- Conduct campaigns
- Conduct staff training
- Conduct awareness campaigns to educate customers
- Go green before we all turn black
- Spread awareness Bio degradable Sustainable
- Reduce the use of plastic

Table 18: Recommendations provided by the participants

CONCLUSION:

The findings suggest a positive inclination toward sustainability within the pharmacy community in Ireland, with a strong consensus on the importance of sustainable blister packaging for environmental conservation. While a significant number of pharmacists are familiar with the concept and consider it important, there is a considerable need for additional training and education in this area. The usage of sustainable blister packaging options, especially bio-based plastics, is on the rise, indicating a gradual shift towards more environmentally friendly practices. The data highlights the potential for targeted educational interventions to bridge the gap between awareness and implementation, fostering greater sustainability within the pharmacy profession. And these

outcomes from the data mainly based on participants perceptions rather than their experience in sustainable blister packaging.

While challenges related to storage, cost, availability, and regulatory guidance exist, there is a clear interest and willingness among pharmacists to adopt more sustainable practices. The emphasis on education and awareness campaigns suggests that targeted efforts in these areas can bridge knowledge gaps and encourage the adoption of sustainable blister packaging. Overall, this research provides valuable insights into the pharmacy sector's journey towards more environmentally responsible packaging practices, paving the way for future initiatives and interventions aimed at promoting sustainability in the pharmaceutical industry.

The next chapter will discuss about further conclusion and will provide the recommendation for future research.

CHAPTER-5

CONCLUSION AND RECOMMENDATIONS

5.1 CONCLUSION

The analysis of pharmacy professionals' perspectives sheds light on the views, difficulties, and potential advantages of implementing sustainable blister packaging practices in Irish pharmacies. The fact that most respondents had less than five years of experience suggests that the survey is a representative of the opinions of pharmacists in their early careers. Although sustainable blister packaging is still in its beginning stages, participants showed a general interest in and willingness to use it. The study made clear the need of educational initiatives for raising knowledge of sustainable practices and the possibility for a decrease in plastic waste.

1. To Evaluate Knowledge Level and Awareness

In light of the comprehensive analysis conducted to evaluate the knowledge and awareness of sustainable blister packaging among pharmacists in Irish pharmacies, several key findings emerge. The study successfully achieved its objective by shedding light on the familiarity, perceptions, training, and adoption of sustainable blister packaging practices within the pharmacy community. These findings collectively contribute to a nuanced understanding of the current state of sustainable packaging awareness and practices in the context of Irish pharmacies.

Firstly, the demographics of the survey participants reveal a majority of pharmacists (91.18%) with less than 5 years of experience. This suggests that the survey primarily captured the perspectives of early-career pharmacists. Additionally, a smaller representation of pharmacists with extensive experience was observed, indicating that sustainable packaging concepts might have gained prominence more recently within the profession.

The investigation into the familiarity with sustainable blister packaging unveiled that 54.9% of the participants are familiar with the concept. This demonstrates a significant level of awareness among pharmacists. The comparison of familiarity with experience levels further emphasized that newer pharmacists, particularly those with less than 5 years of experience, exhibit a higher degree of familiarity. This aligns with the hypothesis that recent graduates might have received more exposure to sustainability concepts during their education. Interestingly, even pharmacists with over 15 years of experience demonstrated a degree of familiarity, albeit at a lower rate of 1.96%.

This indicates that regardless of experience, a noteworthy portion of pharmacists are acquainted with sustainable blister packaging.

The study also addressed the aspect of training and education. The results indicate that a substantial majority (83.33%) of participants have not received any training or education on sustainable blister packaging. This highlights a potential gap in the current curriculum or training programs, suggesting an opportunity for educational interventions to bridge this knowledge gap. Notably, a correlation was observed between familiarity and training, especially among those with less than 5 years of experience. Recent graduates who are more familiar with sustainability concepts are also more likely to have received up-to-date training.

An exploration of participants' perceptions regarding the importance of sustainable blister packaging for environmental conservation revealed a strong positive sentiment. A significant majority (87.25%) expressed that sustainable blister packaging is important for environmental conservation. This overwhelming agreement underscores a shared recognition of the role sustainable packaging can play in conservation efforts. Even participants who were not familiar with the specific terminology exhibited an understanding of sustainability's broader importance.

The study also investigated the need for additional training and educational programs. The responses overwhelmingly (98.04%) indicated a demand for enhanced awareness and knowledge about sustainable blister packaging. This demonstrates a consensus among pharmacists on the necessity for education in this area. The alignment between the demand for training and the lack of current training opportunities reinforces the idea that there is ample room for educational interventions to support sustainable packaging practices.

Finally, the study touched upon the adoption of sustainable blister packaging options. The data showed that while the majority (61.76%) of participants are not currently using such options, a significant portion (38.24%) have incorporated sustainable packaging practices. Bio-based plastics emerged as the most commonly used sustainable option, followed by recycled plastics and compostable materials. This indicates a growing trend towards adopting environmentally friendly packaging materials.

In conclusion, the study provides valuable insights into the current landscape of knowledge and awareness of sustainable blister packaging in Irish pharmacies. It identifies the levels of familiarity, perceptions, training, and adoption of sustainable practices. The findings highlight a positive inclination towards sustainability within the pharmacy community, with particular emphasis on the demand for education and training to enhance awareness. As the pharmacy profession continues to evolve, these insights can guide the development of targeted interventions to promote sustainable packaging practices and contribute to broader environmental conservation efforts. The study underscores the importance of aligning pharmaceutical practices with sustainability principles and signals the potential for positive change within the industry.

2. Identify Challenges of Adoption of adopting sustainable blister packaging in Irish Pharmacies

By carefully examining the difficulties in adopting eco-friendly blister packaging for solid medicines in Irish pharmacies, a clear picture comes into focus. This helps us understand the various complicated aspects of this shift. The study's objective to identify the challenges of adopting eco-friendly packaging practices has revealed a multifaceted landscape, characterized by various hurdles that pharmacies encounter when incorporating sustainable blister packaging solutions.

The survey results provide a clear understanding of the predominant challenges faced by pharmacists in this regard. Notably, the most commonly cited challenge is "Storage constraints," with 27.45% of participants indicating it as a significant barrier. This highlights a real-world challenge within pharmacies – the need to allocate limited space for storing sustainable packaging materials. This finding resonates with practical operational constraints that must be considered in the context of sustainable packaging adoption.

The issue of "Lack of regulatory guidelines" is another major challenge, as expressed by 24.51% of participants. This highlights the importance of having clear regulatory frameworks that can guide pharmacies in their adoption of sustainable blister packaging practices. The relatively high percentage of pharmacists citing this challenge suggests a need for greater regulatory support and clarity in the transition towards sustainable packaging.

"Higher costs" were identified as a significant challenge by 22.55% of participants. This underscores the economic considerations that pharmacies need to take into account when opting for sustainable packaging solutions. Balancing the costs associated with adopting environmentally friendly materials against the benefits they offer becomes a crucial decision-making factor for pharmacies.

The challenge of "Limited availability of sustainable packaging options" was noted by 21.57% of participants. This highlights the importance of a diverse and accessible supply of sustainable packaging materials. The lack of variety in sustainable options might deter pharmacies from fully embracing these alternatives, emphasizing the need for an expanded range of eco-friendly materials in the market.

Interestingly, "Supply process difficulties" emerged as a relatively less prevalent challenge, with only 3.92% of participants selecting it. This suggests that challenges related to the supply chain might be less significant compared to other obstacles. However, it's important to consider that even a small percentage of participants facing these difficulties could signal areas that require optimization within the supply chain process.

Moreover, when asked about the belief in whether sustainable blister packaging ensures a longer shelf-life period compared to traditional packaging, participants exhibited a divided opinion. 66.67% responded with "No," indicating skepticism about the shelf-life extension potential of sustainable packaging, while 33.33% responded with "Yes." This division suggests a need for further research and clarification regarding the actual impact of sustainable packaging on shelf-life.

Additionally, challenges affecting the supply process when adopting sustainable blister packaging were explored. The need to "Modify existing systems to accommodate unique requirements" was highlighted by 50% of participants. This underscores the necessity for adaptability within pharmacies to align with the specific demands of sustainable packaging practices. Moreover, "Higher expenses compared to traditional packaging" was mentioned by 19.61% of participants, reflecting concerns about the financial implications of adopting eco-friendly options.

In conclusion, the challenges identified in adopting sustainable blister packaging practices within Irish pharmacies underscore the intricate nature of this transition. The findings point towards the practical constraints and considerations that pharmacies encounter when attempting to incorporate environmentally friendly packaging alternatives. These challenges encompass operational, regulatory, economic, and supply-related aspects, each with its own unique implications for sustainable packaging adoption. Addressing these challenges requires a multifaceted approach that combines regulatory support, cost-effectiveness, supply chain optimization, and adaptability within pharmacy operations. The insights garnered from this study can serve as a foundation for targeted interventions and strategies that facilitate the seamless integration of sustainable blister packaging practices within the pharmaceutical industry, promoting both environmental responsibility and operational efficiency.

3. The benefits of adopting sustainable blister packaging in pharmacies in Ireland

In researching into the benefits of adopting sustainable blister packaging within Irish pharmacies, we gained valuable insights into the perceptions and preferences of pharmacy professionals. The data revealed a substantial consensus among participants, with a significant majority acknowledging reduction in plastic waste (69.61%) as the foremost benefit. This highlights a heightened environmental consciousness and a recognition of the potential positive impact that sustainable packaging can have on waste management. Additionally, participants recognized improved environmental sustainability (20.59%) as another vital advantage. This signifies a strong alignment between sustainable practices and broader ecological concerns, indicating a proactive approach towards environmental conservation.

Furthermore, the data indicated that some participants perceived potential benefits in terms of patient perception and satisfaction (4.9%), as well as positive brand image and reputation (2.94%). This suggests that patients and customers might appreciate pharmacies that embrace eco-friendly practices, attributing a sense of care and responsibility to such establishments. Moreover, the consideration of potential long-term cost savings (1.96%) highlights a holistic perspective on sustainability, where financial prudence complements environmental responsibility.

As a result, the findings collectively underscore the multifaceted advantages of adopting sustainable blister packaging in Irish pharmacies. These benefits encompass not only environmental impact but also societal perceptions and potential financial gains. By embracing eco-friendly practices, pharmacies not only contribute to waste reduction but also position themselves as conscientious stakeholders in the broader ecological narrative.

4. Recommendations for Sustainable Practices

Analyzing participants' feedback and comments regarding sustainable blister packaging practices in pharmacies provides valuable insights into the considerations, concerns, and suggestions surrounding this topic. The responses reflect a diverse range of viewpoints, revealing both enthusiasm and reservations towards the adoption of eco-friendly packaging practices.

Participants' recommendations mainly revolve around the necessity for comprehensive awareness campaigns and educational initiatives. This emphasis on education underscores the importance of disseminating accurate and relevant information to both pharmacy staff and customers. The concerns raised about the shelf life of medications in sustainable packaging indicate the need for reassurance about the efficacy and longevity of such packaging methods. This reflects a genuine need to ensure that sustainability efforts do not compromise the effectiveness of pharmaceutical products.

The participants' feedback highlights the importance of cost-effectiveness, availability of suppliers, and extended shelf life in sustainable packaging solutions. Additionally, comments advocating for the adoption of blister packaging due to its protective capabilities and minimizing damage, contamination, and humidity underline the functional advantages of this packaging type.

The recurring theme of reducing plastic usage and the urgent call to "go green" reflect a collective commitment towards more environmentally responsible practices. These recommendations and concerns collectively point towards the need for holistic approaches that address both functional requirements and sustainability goals.

The distribution of willingness levels to adopt sustainable blister packaging, with a significant majority expressing high or moderate willingness, aligns with the notion that the pharmacy sector is open to embracing eco-friendly practices. While some participants remain unsure or less willing,

the overall positive sentiment demonstrates a willingness to explore sustainable packaging alternatives.

In conclusion, participants' feedback emphasizes the significance of informed decision-making through education and awareness, the need for functional efficacy in sustainable packaging solutions, and the alignment of sustainable practices with environmental responsibility. The diversity of perspectives reflects a dynamic landscape, with the majority expressing a positive inclination towards adopting sustainable blister packaging in pharmacies while acknowledging the complexity of implementing such practices.

5.2 RECOMMENDATION FROM THE STUDY

In Ireland pharmacists are not much aware about the sustainable practices. It is recommended to develop and implement comprehensive education and training programs for pharmacists to increase their awareness and knowledge about sustainable blister packaging. These programs should include the benefits, challenges, and practical implementation of sustainable practices, enabling pharmacists to make informed decisions. Moreover, launch focused awareness initiatives that target both customers and pharmacists. The environmental harm caused by plastic waste and the benefits of switching to sustainable packaging should be emphasized in these ads. Use a variety of channels, such as seminars, workshops, social media, and educative pamphlets, to effectively communicate the message.

On the other hand, there is regulatory hurdles that pointed out as a drawback in the case of sustainable packaging. So, establishing a clear guidelines and standards for the sustainable practices will help the pharmacists to get a solid framework for adopting sustainable blister packaging practices. And collaborating with the manufacturers and suppliers help to expand the availability of sustainable packaging materials.

5.3 LIMITATIONS OF THE RESEARCH

This research, although valuable, has some limitations that need to be considered. Firstly, the study design was cross-sectional, meaning it captured a less information at a short period of time. This limits our ability to understand changes over time. Additionally, the majority of participants had less than five years of experience as pharmacists. This could influence the findings, as less

experienced professionals might have different perspectives compared to those with more experience.

Furthermore, the study focused solely on pharmacists in Ireland, which might not fully represent the global diversity of perspectives on sustainable blister packaging. Including participants from different countries and cultures could provide a broader understanding of the topic. Moreover, the research only surveyed pharmacists and not employees from the wider pharmaceutical industry. Including a variety of industry professionals, such as pharmaceutical manufacturers and distributors, could offer more comprehensive insights into sustainable packaging practices and trends.

One of the limitations of this research lies in its scope, which primarily focuses on sustainable blister packaging without a direct comparison to traditional materials such as PVC or aluminum blister packaging. While the study offers valuable insights into the perceptions, challenges, and benefits of sustainable blister packaging within Irish pharmacies, the absence of a comparative analysis with conventional packaging materials restricts a comprehensive understanding of the relative advantages and disadvantages.

5.4 CONTRIBUTION OF THE RESEARCH

Even though, there are limitations the researcher could conclude the study effectively. The researcher found a gap in literature part that most of the study based on the trends on packaging materials and not on adopting it in pharmacies. Furthermore, the investigation revealed that these studies explored more on to the perspectives of the pharmacist on adopting this new packaging practices in pharmacies. Hence, their perspectives highlighted through the study and highlighted the need of awareness and training programs which promote the environmentally friendly packaging practices and contributing to a greener future.

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APPENDICES

➤ Appendix- Survey Questions

Available at :

https://docs.google.com/forms/d/e/1FAIpQLScgbuieR4qAl_8o_BkMsKoqV6AcDUxytTb5nUi-u0B6x6L2w/viewform?usp=sf_link

The analysis and impact of adopting sustainable blister packaging on solid dosage form in pharmacies in Ireland.

Dear Respondent,

I am Reshma Antony, a post-graduate student at Griffith College Dublin, Ireland. For my dissertation in Master's in Pharmaceutical Business and Technology, I am carrying out this research on the analysis and impact of adopting sustainable blister packaging on solid dosage form in pharmacies in Ireland. I am asking pharmacists of Ireland to complete this survey in order to get pharmacists perspectives and awareness.

The purpose of this research is to know the awareness and knowledge level of pharmacists regarding the eco-friendly blister packaging. Moreover, most of the pharmaceutical companies has started exploring alternative packaging solution to mitigate the environmental impact. Sustainable blister packaging refers to eco-friendly alternatives to traditional packaging materials like PVC. These alternatives are mainly made of materials such as bio-based plastics, paper or compostable materials. The use of these type of eco-friendly packaging helps to reduce carbon footprint than currently using PVC blisters and increase the recycling rates. Thus, by evaluating the pharmacists' knowledge level, identifying the challenges and benefits, and providing recommendation, this research seeks to contribute to the development of more sustainable packaging practices in pharmaceutical sectors.

The survey is divided into four sections, of which first two sections mainly aimed to gather information on the respondents' demographics, awareness and knowledge regarding the adoption of sustainable blister packaging for oral dosage form. The third and fourth section focused on the challenges faced on adoption of sustainable blister packaging and recommendations on promoting sustainable blister packaging, respectively.

Participants privacy is highly assured and the collected data will be anonymous, kept highly confidential and handled in compliance with the current General Data Protection Regulations (GDPR).

The survey will take only 7-8 minutes to be completed.

Thank you for your participation.

*Required.

Participant Consent *

- I understand the purpose of this research. I voluntarily agree to participate in this survey and have my responses used for the purpose of this research titled “The analysis and impact of adopting sustainable blister packaging on solid dosage form in pharmacies in Ireland”.

- **Demographics:**

1. How many years of experience do you have as a pharmacist?

- a) Less than 5 years
- b) 5-10 years
- c) 10-15 years
- d) 15 years or more

- **The knowledge level and awareness of sustainable blister packaging among pharmacists.**

2. Are you familiar with the concept of sustainable blister packaging?

- a) Yes
- b) No

3. Have you received any training or education regarding sustainable blister packaging?

- a) Yes
- b) No

4. Do you consider sustainable blister packaging to be important for environmental conservation?

- a) Yes
- b) No
- c) Unsure

5. Do you believe there is a need for additional training or educational programs to enhance awareness and knowledge about sustainable blister packaging among pharmacists?

- a) Yes
- b) No

6. Are you currently using any sustainable blister packaging options in your pharmacy?

- a) Yes
- b) No

7. If you answered 'Yes' to the previous question, please describe the sustainable blister packaging options you are currently using.

- a) Bio-Based Plastics
- b) Recycled Plastics
- c) Compostable materials
- d) Other (Please Specify): _____

- **Challenges of adopting sustainable blister packaging in solid dosage forms in pharmacies such as storage, supply process, and disposal practices.**

8. What are the main challenges you face in adopting sustainable blister packaging for solid dosage forms? (Select all that apply)

- a) Storage constraints
- b) Supply process difficulties
- c) Limited availability of sustainable packaging options
- d) Higher costs
- e) Lack of regulatory guidelines

f) Other (please specify): _____

9. Do you think that sustainable blister packaging ensures more shelf-life period for solid dosage form than traditional packaging?

- a) Yes
- b) No

10. Which of the following challenges have affect the supply process when adopting the eco-friendly sustainable blister packaging for solid dosage form? (Select all that apply)

- a) Availability and sourcing of eco-friendly packaging
- b) Modifying the existing systems to accommodate unique requirement of eco-friendly sustainable packaging.
- c) Higher expenses compared to traditional packaging
- d) Limited Manufacturers or suppliers

• **The benefits of adopting sustainable blister packaging in pharmacies in Ireland.**

11. In your opinion, what are the benefits of adopting sustainable blister packaging in pharmacies? (Select all that apply)

- a) Reduction in plastic waste
- b) Improved environmental sustainability
- c) Positive brand image and reputation
- d) Enhanced patient perception and satisfaction
- e) Potential cost savings in the long run
- f) Other (please specify): _____

12. How do you think sustainable blister packaging can contribute to reducing plastic waste in the pharmacy sector?

- a) Biodegradable materials
- b) Bio-based Plastics
- c) Education and awareness
- d) Other (please specify): _____

- **Types of packaging:**

13. Which types of pharmaceutical product packaging do you commonly supply and sell in your pharmacy? (Select all that apply)

- a) Bottles
- b) Blister packs
- c) Tubes
- d) Jars
- e) Pouches
- f) Vials
- g) Sachets
- h) Other (please specify): _____

14. In your opinion, which type of packaging offers the best protection and preservation for pharmaceutical products?

- a) Bottles
- b) Blister packs
- c) Tubes
- d) Jars
- e) Pouches
- f) Vials
- g) Sachets
- h) Other (please specify): _____

- **Recommendations and advice for more sustainable packaging practices in pharmacies.**

15. Are there any specific recommendations or best practices you would suggest for promoting more sustainable packaging practices in pharmacies?

a) Yes

b) No

16. Please provide your recommendations and advice for promoting more sustainable packaging practices in pharmacies.

17. How willing would you be to adopt sustainable blister packaging for solid dosage forms in your pharmacy?

a) Very willing

b) Somewhat willing

c) Not willing

d) Unsure

18. Is there any additional feedback or comments you would like to provide regarding sustainable blister packaging in pharmacies?