GRIFFITH COLLEGE DUBLIN

Assignment Cover Sheet

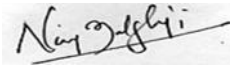
Learner name(s):	**Nicymol Shaji**		
Learner number(s):			
Assignment Type:	**Individual: Yes**	**Group:**	**Cohort 4**
Course:	**MSc. Digital Transformation (Life Science)**	**Stage/year:**	**2025**
Module:	**Dissertation Thesis**		
Study Mode:	Full time **Yes**	Part-time	
Supervisor Name:	**Dr. Dinesh Reddy**		
Assignment Title:	**A Data-Driven Approach to mRNA Vaccine Acceptance in Ireland: Leveraging Big Data for Public Health Strategy**		
No. of pages:	**97**		
Uploaded to Moodle:	Yes ✓	No	
Additional Info:			
Date due:	**08/06/2025**		
Date submitted:	**28/05/2025**		

Plagiarism disclaimer:

I understand that plagiarism is a serious offence and have read and understood the college policy on plagiarism. I also understand that I may receive a mark of zero if I have not identified and properly attributed sources which have been used, referred to, or have in any way influenced the preparation of this assignment, or if I have knowingly plagiarised my work or allowed others to plagiarise my work.

I hereby certify that this assignment is my own original work, based on my personal study and/or research, it is all written in my own words and I have acknowledged all references and sources used in its preparation. I also certify that the assignment has not previously been submitted for assessment and that I have not copied in part or whole or otherwise plagiarised the work of anyone else, including other students.

I have also not used any third parties, AI tools or websites to generate any parts of my assignment.

Signed & dated: 

28/05/2025

1. **Please note: Students MUST retain a hard / soft copy of ALL assignments as well as a receipt issued as proof of submission.**

A Data-Driven Approach to mRNA Vaccine Acceptance in Ireland: Leveraging Big Data for Public Health Strategy

By

NICYMOL SHAJI

A thesis submitted in partial fulfilment of the requirements for MSc in Digital Transformation (Life Science)

Innopharma Faculty of Pharmaceutical Sciences

Griffith College Dublin

May 2025

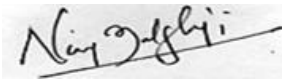
GRIFFITH COLLEGE

DECLARATION

Candidate Name: Nicymol Shaji

I hereby confirm that the dissertation entitled *"A Data-Driven Approach to mRNA Vaccine Acceptance in Ireland: Leveraging Big Data for Public Health Strategy"* submitted for the degree of MSc in Digital Transformation (Life Science) is a research work carried out by me, and that all sources used have been acknowledged by means of complete references.

Candidate signature:



Date: 06-05-2025

Supervisor Name: Dr. Dinesh Reddy

Supervisor signature:

Date: 06-05-2025

ACKNOWLEDGEMENT

I would like to express my sincere gratitude to my supervisor, Dr. Dinesh Reddy, for his invaluable support, encouragement, and guidance throughout the course of this dissertation. His insightful feedback and unwavering patience were instrumental in shaping the direction and completion of this work.

I am also deeply thankful to all the lecturers at Innopharma and Griffith College for their dedication and commitment to our academic journey. My heartfelt appreciation goes to my coursemates for their collaboration and motivation, and to all the survey respondents who took the time to contribute to this study. Their input was crucial in making this research possible.

Lastly, I would like to extend my deepest appreciation to my family and friends for their endless love, understanding, and support throughout this process. Their belief in me has been a constant source of strength, and I will remain forever grateful.

I submit this work to the grace of God Almighty, for blessing me with health, confidence, and knowledge to carry out the whole work successfully.

Nicymol Shaji

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

mRNA	Messenger Ribonucleic Acid
COVID-19	Coronavirus Disease 2019
SARS-CoV-2	Severe Acute Respiratory Syndrome Coronavirus 2
WHO	World Health Organization
HSE	Health Service Executive (Ireland)
HCW	Healthcare Worker
SAGE	Strategic Advisory Group of Experts (on Immunization)
CDC	Centers for Disease Control and Prevention (U.S.)
AI	Artificial Intelligence
N/A	Not Applicable

ABSTRACT

"A Data-Driven Approach to mRNA Vaccine Acceptance in Ireland: Leveraging Big Data for Public Health Strategy"

Nicymol Shaji

In this study, it was revealed that uptake of mRNA vaccines in Ireland is shaped by a complex interplay of demographic, social, and informational determinants. In the context of the COVID-19 pandemic, a data-driven approach was employed to establish the determinants of vaccine uptake, to inform public health policy. A cross-sectional quantitative survey was conducted among students, parents, healthcare workers, and the general population. Information was captured on the history of vaccination among respondents, willingness to receive future mRNA vaccines, familiarity with vaccine technology, perceived adverse effects, and trust in various sources of information. The results showed that overall mRNA vaccine acceptance was high but with persistent hesitancy among some subgroups due to safety concerns, apprehensions over long-term adverse effects, and a lack of understanding about how mRNA works. Participants who relied on health professionals and official health bodies as primary sources of information had the highest levels of acceptance. On the other hand, participants exposed primarily to vaccine-related information on social media or through word of mouth were more likely to be sceptical or hesitant. Misinformation, especially on social media, emerged as a significant stimulant for scepticism and confusion. The findings underscore the need for clear, open, and accessible public health communication in supporting vaccine confidence. The health institution and professional trust greatly boosted willingness to get mRNA vaccines, and hence the value of bringing in trusted individuals as part of future outreach efforts. Targeted communication that addresses directly held concerns, particularly in high-hesitancy populations such as those in rural or underserved settings, is essential. Equipping healthcare professionals with tools and training to address misinformation and encourage informed decision-making is advised by the research. While the study provided valuable quantitative findings, additional research employing qualitative or longitudinal study designs is suggested to determine shifting public opinion and underlying psychological reasons for vaccine hesitancy. The findings provide pragmatic recommendations for designing effective communication programs and enhancing public trust in vaccine programs in Ireland and other regions.

CHAPTER 1

INTRODUCTION

1. **INTRODUCTION**

Although vaccination is considered one of the greatest public health achievements, vaccine hesitancy remains a challenge due to delays in acceptance or refusal of vaccines despite their availability. Vaccine hesitancy is a complex issue that is influenced by a variety of factors that change over time and across different populations. A bibliometric analysis of research on the topic indicated key trends, including the primary causes and impacts of hesitancy, particularly in the context of COVID-19. The study also highlighted the growing role of social media and misinformation, as well as cultural and linguistic barriers, in shaping public perceptions of vaccines (Chen *et al.*, 2023). COVID-19 vaccine hesitancy remains a major public health challenge, driven by low confidence and complacency. Concerns about safety, side effects, and perceived risks influence refusal or delay. Effective health communication through trusted sources is essential to addressing cognitive factors and encouraging vaccine acceptance (Pourrazavi *et al.*, 2023). Italy's adoption of the COVID-19 and flu vaccines in the early months of the pandemic emphasised how risk perception plays a significant role in vaccination choices. Future health communication plans and infection control initiatives might benefit from an understanding of how risk perception changes, particularly during consecutive infectious illness waves (Caserotti *et al.*, 2021).

According to the World Health Organisation, vaccine hesitancy poses the greatest danger to public health safety worldwide, especially in low- and middle-income nations. Lack of understanding, wrong religious convictions, or disinformation about vaccines can all contribute to vaccination hesitation. Despite all anti-vaccine campaigns and COVID-19-related misconceptions and conspiracy theories, it raises the question of whether people would trust and embrace the new COVID-19 vaccinations.

The World Health Organisation (WHO) suggests that policies promoting voluntary vaccination, like public information campaigns, should be prioritised over mandatory vaccination policies (WHO, 2022). As vaccinations reduce the spread of infectious illnesses and save millions of lives every year, they have long been a pillar of public health. With its exceptional speed and effectiveness in vaccine creation, the introduction of mRNA vaccine technology, especially during the COVID-19 pandemic, has completely transformed the field of vaccination (Pardi *et al*., 2018; Verbeke *et al*., 2021). However, the public's acceptance of

mRNA vaccines is just as important to their success as their scientific imagination. A major obstacle to attaining broad immunisation is vaccine reluctance, which is driven by variables including false information, mistrust of institutions, and socioeconomic inequality (Larson *et al.*, 2015; MacDonald, 2015a). This study seeks to address this challenge by exploring the factors influencing mRNA vaccine acceptance in Ireland through a survey-based approach, to propose data-driven strategies to improve public health outcomes.

Figure 1. '4Cs' Model of Covid-19 Vaccine Hesitancy (Ingram et al., 2023)

Figure 1 illustrates Ingram *et al*. (2023)'s '4Cs' model of COVID-19 vaccine hesitancy where Confidence, Complacency, Convenience, and COVID-19 Communications are labelled as the principal drivers of vaccine uptake. Confidence is linked with fear of side effects, distrust in health authorities, and lack of information. Complacency is a felt low risk of COVID-19, and Convenience addresses logistical challenges such as transport, financial issues, and limited literacy skills. Covid-19 Communications is engaged in capturing the impact of varied messaging, anticipation of vaccine ineffectiveness not fulfilled, and pandemic fatigue.

1.1 Background of the Study

The COVID-19 pandemic highlighted the need for vaccinations for world health, and because of their quick creation and great effectiveness, mRNA vaccines have emerged as a game-changer (Verbeke *et al.*, 2021). The introduction of mRNA vaccines was received with both excitement and doubt in Ireland, as it was in many other nations. Although a sizable section of the population supported vaccination, some were hesitant because of worries about its efficacy, safety, and novelty (Breslin *et al.*, 2021, p.19). Factors such as rural-urban differences, socioeconomic status, and availability of healthcare have also been shown to impact vaccination uptake (Begum *et al.*, 2024). Addressing vaccination hesitancy has also become more challenging due to the quick dissemination of false information on social media, which has hindered public health communication efforts (Larson *et al.*, 2015). In considering this, the purpose of this study is to investigate, using a survey-based methodology, the factors that influence the acceptability of mRNA vaccines in Ireland to offer insightful information for creating focused interventions.

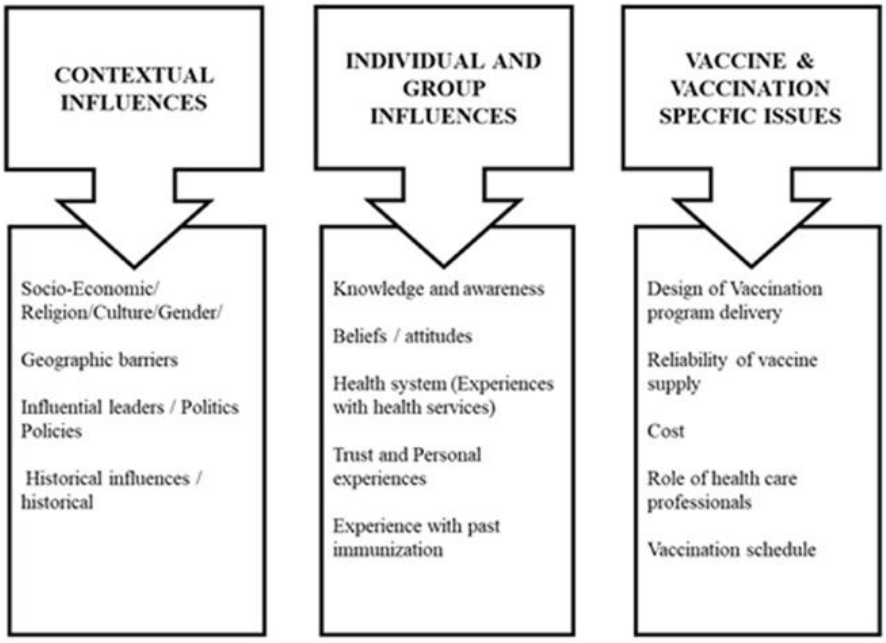


Figure 2. SAGE Vaccine hesitancy model (Dubé et al., 2014)

Figure 2. SAGE Vaccine Hesitancy Model from Dubé *et al.,* 2014 illustrates determinants of vaccine hesitancy to be classified in three broad categories: contextual influences, individual

and group influences, and vaccine/vaccination-related issues. Contextual influences consist of socio-economic status, religious beliefs, cultural practices, and political policies, while individual and group influences draw from knowledge, attitude, and belief in healthcare systems. Vaccine-specific issues address the implementation and design of vaccination programs, the trustworthiness of vaccines, and the role of healthcare professionals.

1.2 Hypothesis

The following hypothesis serves as the study's direction: "In Ireland, a mix of demographic, socioeconomic, and psychological variables, together with exposure to false information, impact public acceptance of mRNA vaccinations. These issues may be successfully addressed and vaccination uptake increased with targeted, data-driven public health initiatives". A survey-based methodology will be used to test this hypothesis, gathering information from various stakeholder groups to spot trends and patterns in vaccination uptake.

1.3 Purpose of the Study

This study aims to investigate the factors affecting mRNA vaccine acceptance in Ireland and develop data-driven strategies to enhance public health outcomes. By conducting surveys among healthcare professionals, parents, students, and the general public, this research aims to provide a comprehensive understanding of vaccine hesitancy and inform the development of targeted interventions.

1.4 Context of the Study

The study is set against the context of worldwide immunisation campaigns against infectious illnesses, with a particular emphasis on Ireland. Although the COVID-19 pandemic brought to light the vital role that mRNA vaccines play in public health, it also exposed notable differences in vaccination adoption across various demographic groups (Marron *et al.*, 2024). In Ireland, factors such as rural-urban divides, socio-economic status, and access to healthcare have been shown to influence vaccine uptake. Public health communication initiatives have also become more challenging due to the quick dissemination of false information on social media (Larson

et al., 2015). By using a survey-based method to examine these characteristics in the Irish setting, this study aims to expand on previous research by offering practical insights to increase vaccination acceptability.

1.5 Significance and Justification of the Study

This study is important because it might help guide public health initiatives to combat vaccine hesitancy and raise Ireland's vaccination rates. Even though mRNA are effective, hesitation still stands in the way of developing herd immunity and stopping further outbreaks (Breslin *et al.*, 2021). This study intends to offer a thorough knowledge of the variables influencing vaccination hesitancy and to suggest evidence-based solutions by utilising survey data from various stakeholder groups. Policymakers, medical professionals, and public health organisations will find value in the study's conclusions, which give useful information for creating focused campaigns and enhancing communication tactics.

1.6 Aims and Objectives:

1. **To determine the current rate of mRNA vaccine acceptance in Ireland** by analysing survey responses on vaccination status and willingness to take future mRNA vaccines.
2. **To identify key factors influencing mRNA vaccine hesitancy in Ireland** by analysing concerns such as side effects, misinformation, and trust issues reported in the survey.
3. **To evaluate the impact of knowledge and information sources on mRNA vaccine acceptance** by comparing respondents' understanding of mRNA vaccines with their willingness to receive them.
4. **To evaluate the impact of information sources on vaccine acceptance** by examining how reliance on different media (healthcare professionals, social media, news, etc.) influences vaccination decisions.

1.7 Research Questions

The following research questions are anticipated to be addressed at the study's conclusion to offer a solution and a path forward for achieving these objectives:

- What is the current rate of mRNA vaccine acceptance in Ireland, as measured by vaccination status and willingness to receive future mRNA vaccines?
- What are the primary factors contributing to mRNA vaccine hesitancy in Ireland, including concerns about side effects, exposure to misinformation, and trust in healthcare institutions?
- How does respondents' knowledge and understanding of mRNA vaccines influence their willingness to accept or reject vaccination?
- How do different sources of information (e.g., healthcare professionals, social media, news outlets) impact individuals' decisions to accept or reject mRNA vaccines?

1.8 Overview of the Dissertation Structure

The study includes five distinct chapters: the introduction, the literature review, the research methods, the findings and discussion, and, lastly, the recommendations and conclusion. The backdrop, goal, and importance of the study are described in Chapter 1: Introduction, along with the research questions and hypothesis, which set the scene.

Chapter 2: Literature Review identifies important arguments and gaps in the literature by reviewing the body of research on mRNA vaccines, vaccination hesitancy, and public health tactics.

Chapter 3: The survey-based study design is described in depth in the Methodology section, which also covers participant selection, data gathering strategies, and analytic approaches.

Chapter 4: Findings and Discussions explains the survey's findings, emphasising significant trends and patterns in vaccination acceptance. It also analyses the results, contrasts them with previous research, and talks about how they could affect public health policy.

Chapter 5: Conclusions and Recommendations highlights the main findings, offers helpful advice for decision-makers and medical professionals, and identifies potential research topics.

This framework guarantees a rational progression from theory to practice, resulting in practical insights to enhance the adoption of mRNA vaccines in Ireland.

1.9 Definition of Key Terms

To ensure clarity, the following key terms are defined:

- **mRNA Vaccines:** Vaccines that use messenger RNA to instruct cells to produce a protein that triggers an immune response (Pardi *et al.,* 2018).
- **Vaccine Hesitancy:** The delay in acceptance or refusal of vaccines despite the availability of vaccination services (MacDonald, 2015).
- **Big Data:** Large and complex datasets that can be analysed to reveal patterns, trends, and associations, particularly concerning human behaviour and interactions (Raghupathi & Raghupathi, 2014).

CHAPTER 2

LITERATURE REVIEW

2. LITERATURE REVIEW

This chapter presents a comprehensive review of existing literature, focusing on key themes related to mRNA vaccine acceptance and hesitancy. It explores the factors influencing public perceptions, including misinformation, trust in healthcare systems, and the effectiveness of public health communication. Additionally, the review examines trends and challenges in vaccine adoption, identifying gaps in research and areas that require further study. By analysing previous findings, this chapter establishes a foundation for understanding vaccine hesitancy and informing strategies to improve public confidence in vaccination efforts. Finally, the chapter identifies gaps in existing research and presents the conceptual framework, addressing challenges such as misinformation, trust in healthcare institutions, and public health communication strategies.

2.1 mRNA Vaccine Technology and Public Perception

A key success in vaccination began with the creation of mRNA vaccines, which were brought to light during the COVID-19 pandemic. Clinical investigations have shown that mRNA vaccines, including those made by Moderna and Pfizer-BioNTech, are highly effective and safe (Pardi *et al.*, 2018; Verbeke *et al.*, 2021). Public opinion of this technology is still dispersed, though; some are concerned about the novelty and long-term implications of mRNA vaccines, while others see them as a revolutionary scientific breakthrough (Wróblewski *et al.*, 2022).

According to a Murphy *et al.* (2021) survey, 65% of Irish respondents were in favour of the COVID-19 vaccination, compared to 26% who were apprehensive and 9% who were against it. These numbers are consistent with those seen throughout Europe, where around 26% of individuals reported being reluctant or resistant to the COVID-19 vaccine. For example, myths regarding vaccinations changing human DNA have been extensively rejected, yet continue to be discussed in public (Verbeke *et al.*, 2021). According to a survey done in 2022, vaccination acceptance rates have somewhat improved. Based on the survey, 67.1% of participants stated they would accept a COVID-19 vaccination, followed by 21.1% who leaned yes, 6.2% who leaned no, and 4.9% who answered no. This points to a slow but steady rise in vaccination

acceptability over time, maybe as a result of more public knowledge and educational initiatives (Robertson *et al.*, 2021).

The little examination of how public trust in mRNA vaccines changes over time, especially in the setting of non-pandemic situations, is a significant gap in the research. This offers a chance to investigate how educational initiatives might alleviate remaining hesitancy and enhance public knowledge of mRNA technology. Although mRNA vaccines were a breakthrough when they were introduced during COVID-19, there was public resistance (Xu *et al.*, 2024). Significant public reluctance, however, brought to light the possibility that future mRNA-based medical developments may encounter poor acceptance rates. The development of mRNA-based medicines in the future and the readiness for health emergencies depend on enhancing public confidence through focused communication (Xu *et al.*, 2024).

A wide range of intricate variables contribute to vaccine hesitancy, which is a significant worldwide health challenge. These dynamics were illustrated by a study conducted in Israel during the COVID-19 pandemic, which found that while the general public preferred vaccines manufactured in the USA or UK with high efficacy (>90%) over those from China or Russia, doctors and life science graduates were less likely to accept mRNA vaccines (Dror *et al.*, 2021). Hesitancy is significantly shaped by sociodemographic characteristics, including age, education, and socioeconomic position as well as cognitive aspects like mistrust of vaccination safety and quick growth timeframes. Israel's high vaccination rates, despite early forecasts of lesser acceptance, highlight the value of focused public health initiatives that target particular issues and use reliable sources to boost vaccine confidence (Dror *et al.*, 2021).

2.1.1 Efficacy and Safety

The safety and efficacy of COVID-19 mRNA vaccines have been strongly debated since their introduction. Later investigations raised concerns regarding major side effects, such as neurological illnesses, immunological disorders, and cardiac problems, despite initial trials suggesting a decrease in symptoms (Mead *et al.*, 2024). Scepticism continues to be fuelled by concerns about insufficient safety testing, quality control, and regulatory openness. Experts stress the necessity of comprehensive studies to evaluate long-term safety in light of the

possible hazards. Sustaining public confidence in immunisation programs requires thorough assessments and open reporting (Mead *et al.*, 2024).

Although mRNA vaccines, including Moderna's mRNA-1273, are effective and safe in the fight against COVID-19, vaccination hesitancy is still a major obstacle. No severe instances were identified among vaccinated subjects in the COVE study, which showed a 94.1% effectiveness rate for mRNA-1273 in avoiding symptomatic COVID-19. Nevertheless, vaccination safety worries specifically, reactogenicity and long-term adverse effects continue to be major sources of reluctance (Baden *et al.*, 2021). Research indicates that the novelty of mRNA technology increases scepticism because people doubt its quick creation and apparent lack of testing. Acceptance rates are further lowered by the widespread fear of adverse effects, which is particularly strong among younger populations, women, and those with underlying medical or allergy issues. Furthermore, even in cases when faith in health authorities is still strong, reluctance is made worse by suspicion of pharmaceutical corporations because of alleged economic reasons. One mitigating aspect is social conformity; as community adoption rates of mRNA vaccines grow, so does willingness to receive them (Baden *et al.*, 2021). Transparent communication on vaccine safety and effectiveness, messaging catered to certain demographics, and utilising early adopters to increase public trust in mRNA vaccines are all necessary to allay these worries. These tactics are crucial for getting beyond reluctance and guaranteeing that vaccines are widely used (Baden *et al.*, 2021).

2.1.2 Misconceptions in mRNA Vaccine Hesitancy

Defending against changing SARS-CoV-2 variants has required the creation and distribution of variant-adapted mRNA vaccines, such as those that target the Omicron and XBB sub-lineages. Misconceptions about these vaccinations persist in exacerbating vaccine weariness and hesitation despite their proven safety and effectiveness. Key issues influencing hesitation are highlighted in studies, such as those conducted by Kassianos *et al.* (2024). These include mistrust of pharmaceutical corporations, worries about inadequate testing, and the apparent novelty of variant-adapted vaccinations. Despite strong neutralising antibody responses against current variations as indicated by clinical and preclinical data, hesitation endures because of false information regarding safety issues such as myocarditis or ischaemic stroke, which are

exceedingly rare or unsupported by evidence. Moreover, vaccination tiredness is exacerbated by the need for booster doses due to declining immunity over time, which some people find inconvenient or excessive (Kassianos *et al.*, 2024). Clear information on the stringent regulatory procedures enabling variant-adapted vaccines and their compatibility with earlier mRNA platforms is necessary to dispel these myths. Rebuilding confidence and increasing vaccination acceptability in the face of continuous SARS-CoV-2 development requires targeted educational efforts that highlight the advantages of updated immunisations for certain populations, such as children, pregnant women, and those with a history of infections (Kassianos *et al.*, 2024).

2.2 Factors Influencing mRNA Vaccine Hesitancy

The topic of vaccine hesitancy is complex and impacted by a variety of socioeconomic, psychological, and demographic variables. Research has consistently shown that opinions on vaccines are strongly influenced by factors such as age, income, education level, and geographic region. (MacDonald, 2015b; Ingram *et al.*, 2023). For instance, studies in Ireland have shown that socioeconomic inequality and rural-urban divisions are important factors influencing vaccination uptake (Breslin *et al.*, 2021). Another important component is faith in the government and healthcare system, with increased reluctance being correlated with lower levels of trust (Quinn *et al.*, 2019). It has been demonstrated that being exposed to false information, especially on social media, makes refusal higher.

According to Darbandi *et al.*, (2024) numerous factors, such as age, gender, and numerous socioeconomic variables, affect vaccination acceptability. Examining the underlying determinants is essential due to the intricate and multidimensional nature of vaccine hesitancy. Policymakers can better grasp the elements that improve community-based interventions with the use of systematic reviews. Although some insights exist, there is limited research on how cultural and religious beliefs influence vaccine attitudes in Ireland. Additionally, the role of social media in vaccine hesitancy within the Irish context is not well understood, highlighting the need for further studies to guide more effective, targeted interventions.

Despite being trusted professionals on immunisation, healthcare workers' (HCWs') vaccine reluctance presents a serious obstacle to public health initiatives. HCWs themselves frequently have concerns about vaccination, especially with regard to more recent vaccinations, according to a qualitative survey of 65 vaccine providers in Croatia, France, Greece, and Romania. Fear of side effects was the main cause of reluctance, which was increased by mistrust of pharmaceutical corporations because of their alleged financial interests and lack of disclosure of side effects. HCWs felt a significant professional need to address patient reluctance, even though they typically trusted health authorities (Karafillakis *et al.*, 2016). At present, vaccine hesitancy is a major public health problem, which is driven by worries about side effects, safety, conspiracy theories, and false information spread on social media. It needs comprehensive immunisation campaigns, educational programs, and high-quality information to overcome hesitation. To improve vaccination uptake and attain herd immunity, governments and medical practitioners need to take cognitive, behavioural, and emotional variables into account (Romate *et al.*, 2022).

According to a study by Salerno *et al.* (2021), a complex web of interrelated variables influences Italian college students' vaccination hesitation towards mRNA vaccines. There are still worries about the safety, effectiveness, and quick development of vaccines, and doubt gets worse with false information and conspiracy theories. Sociodemographic variables like gender and academic discipline also matter; women and non-scientific students exhibit greater reluctance because of concerns about side effects and mistrust of pharmaceutical businesses. Students in low-vaccination regions or those exposed to anti-vaccine ideas are more likely to be cautious, and attitudes are further shaped by peer pressure and regional differences in vaccine uptake. Targeted tactics are needed to overcome these obstacles, such as open communication on vaccine safety, customised educational initiatives, and using reliable resources like university health services to dispel myths and improve acceptance among young adults (Salerno *et al.*, 2021).

Vaccine uptake can also be influenced by multiple factors, including awareness of the need for vaccination, accessibility of vaccines, and the availability of vaccination services. Thomson et al. introduced the 5 A's model, which provides a framework for understanding the structural, organisational, sociocultural, and individual factors that impact vaccination rates (Thomson *et*

al., 2016). While access, affordability, and awareness are crucial in addressing vaccine hesitancy and examining how both vaccine recipients and healthcare providers perceive and engage with immunisation efforts. The detailed description of the 5 A's model is given (Table 1).

The 5 A's	**Description**
Access	The ability of individuals to be reached by, or to reach, recommended vaccines
Affordability	The ability of individuals to afford vaccination, in terms of both financial and nonfinancial costs
Awareness	The degree to which individuals know the need for, and availability of, recommended vaccines and their objective benefits and risks
Acceptance	The degree to which individuals accept, question, or refuse vaccination
Activation	The degree to which individuals are nudged toward vaccination uptake

Table 1. The 5 A's model (Dubé et al., 2021)

Similarly, to identify important criteria influencing adoption, a study has been conducted by examining 28 papers on vaccination reluctance during previous pandemics, such as H1N1 and Ebola. This study includes accessibility, risk perception, safety concerns, disinformation, alternative safeguards, demographics (race, age, and education), and faith in health authorities (Truong *et al.*, 2022). These observations are still applicable to managing COVID-19 vaccination reluctance, even if they vary according to the pandemic. The study emphasises the necessity of focused actions using reliable sources, such as medical experts, to lessen inequities, increase transparency, and counteract false information. Gaining an understanding of these elements can aid in developing successful public health initiatives to boost vaccination rates (Truong *et al.*, 2022).

2.3 The Role of Big Data in Public Health Strategy

The introduction of big data analytics has transformed public health by making it possible to gather and examine enormous volumes of data from a variety of sources, including social media, electronic medical records, and mobile devices (Wang *et al.*, 2018). Big data may offer real-time insights into public attitudes, spot new patterns, and guide focused efforts in the context of vaccination reluctance (Salathé, 2018). Social media analytics, for instance, may be used to monitor the dissemination of false information and determine how the public responds to news about vaccines (Vayena *et al*., 2018). According to (Adenyi *et al.*, 2024) using enormous information from sensors, social media, and electronic health records, big data analytics has revolutionised public health. Personalised medicine and illness prediction are made possible by cutting-edge methods like machine learning. However, issues like ethics, interoperability, and data privacy continue to exist. AI and teamwork developments in the future can improve public health decision-making. Vaccine hesitancy, driven by social media misinformation, remains a global challenge. Deep learning models, especially Long Short-Term Memory and Recurrent Neural Network models, effectively detect hesitant tweets, achieving 86% accuracy during COVID-19 (Nyawa *et al.*, 2022).

Big data is essential to precision public health because it improves risk assessment, illness tracking, and focused treatments. Even while it allows for more thorough demographic analysis, problems still exist. Big data is anticipated to continue to be a key component in the development of precision public health initiatives as data availability and computing techniques improve (Dolley, 2018). Utilising the 4Vs—volume, variety, velocity, and veracity—as criteria, the study provides an extensive analysis of big data applications in environmental health and health services. While admitting limits in depth and statistical analysis, it tries to enhance the quality of future research, highlights the appropriate use of big data technology, and exposes methodological inadequacies (Tang *et al.*, 2022). Big data and AI have significantly impacted COVID-19 prevention, diagnosis, and management in China. It emphasises how these technologies helped track infections, identify high-risk groups, and enhance vaccine development. AI improved clinical decisions by analysing medical images and predicting

disease progression, while big data integrated diverse sources like travel history and health records to optimise resource allocation (Dong *et al.*, 2021).

Big data is crucial for contemporary public health plans, especially when it comes to handling crises like the COVID-19 epidemic. In China, Wang *et al.* (2023) created the "DSA" model, a big data preventive and control model that combines internet, government, healthcare, and epidemic data into a single framework. The three levels of this model—data gathering, stakeholder needs, and practical application—allow for accurate risk assessment, real-time monitoring, and efficient decision-making at various epidemic phases. Predicting epidemic patterns, tracking patients and close relationships, improving early warning systems, and allocating resources as efficiently as possible have all benefited from the use of big data. For example, big data was used by China's joint preventative mechanism during COVID-19 to accelerate the distribution of medical resources and case tracking. Yet, issues like guaranteeing data quality, safeguarding privacy, and dismantling information silos continue to exist. According to Wang *et al.* (2023), customised rules are required to match technology capabilities with real-world requirements, promote stakeholder participation, and manage privacy issues through regulatory frameworks. This study emphasises big data as a foundation for creating robust public health systems that can successfully handle future crises, in addition to being a tool for crisis response (Wang *et al.*, 2023).

The study by Mao *et al*. shows how important big data is to improving public health tactics, especially when it comes to handling the COVID-19 outbreak. The paper demonstrates how big data technology was incorporated into the mitigation, readiness, response, and recovery phases of emergency management using Hainan Province as a case study. The authors provide a flexible and effective application architecture that makes use of big data to provide accurate risk assessment, real-time monitoring, and efficient decision-making at various phases of an outbreak. Predicting epidemic patterns, tracking confirmed cases and close relationships, and allocating medical resources as efficiently as possible were among the main uses. Coordinating data gathering from many sources, such as medical data, mobile phone signalling data, and epidemic investigations, was a major responsibility of the Hainan Provincial Big Data Administration. Rapid analysis and reaction were made possible by this centralised method, confirming the viability and worth of the suggested big data structure. The study highlights the

potential of big data to improve the flexibility and accuracy of epidemic control measures and offers empirical support for local governments throughout the world to adopt data-driven, all-encompassing approaches for handling public health catastrophes (Mao *et al.*, 2021).

To manage significant events like the COVID-19 pandemic, public health initiatives now must use big data analytics. Jia *et al.* (2020) offer a thorough framework that prioritises the application of big data in three crucial domains: reaction, recovery, and epidemic prevention. Through the use of visual analysis, deep learning, and predictive modelling approaches, governments may improve early warning systems by utilising big data technologies to gather information in real time from sources including social media, navigation systems, IoT devices, and genetic databases. During epidemics, this facilitates prompt decision-making, disaster identification, and coordination. In addition, big data facilitates the tracking of infected persons and the investigation of viral origins through the use of graph database analysis and geographic information systems, both of which are essential for resource allocation and containment. Big data also helps recovery efforts by encouraging cross-regional data exchange, dispelling myths to calm people, and evaluating the socioeconomic effects of epidemics to guide policy changes. Notwithstanding its revolutionary potential, the study admits its limits, including the difficulty of forecasting novel viruses in the absence of historical data, privacy issues, and administrative limitations. Jia *et al.* (2020) emphasise that big data is a helpful tool that has to be combined with strong governance structures to guarantee its functionality while striking a balance between the interests of public health and individual privacy. This paradigm emphasises how crucial big data is to developing flexible and successful public health initiatives (Jia *et al.*, 2020).

2.3.1 Patient Data Ownership and Its Implications

Big data's incorporation into public health initiatives has transformed the way diseases are managed, but it also brings up important issues about patient data ownership. The conflict between personal ownership of health data and the larger public health requirement for open access to such data is brought to light by Mirchev *et al*. (2020). Although patient data ownership gives people authority over their health information, it may be in opposition to the overall

advantages of leveraging big data for scientific research and epidemic prevention, among other public health projects. The paper argues for alternative legal frameworks that strike a compromise between individual rights and public health concerns, highlighting the shortcomings of standard property and privacy rules in handling the intricacies of big data (Mirchev *et al.*, 2020). Since big data is becoming more and more important to predictive analytics, resource allocation, and personalised treatment, transparent governance frameworks are crucial to ensuring equitable access to data while lowering ethical hazards. Big data may reach its full potential to enhance population health outcomes while preserving privacy and trust by coordinating patient-centric data governance with public health goals (Mirchev *et al.*, 2020).

The ownership of patient data is essential to the acceptability of mRNA vaccines. Trust in immunisation efforts rises when people feel in charge of their health information. By resolving privacy concerns and strengthening public trust in health authorities and systems, transparent data practices, particularly under laws like GDPR, can reduce reluctance. But there are also ethical concerns raised by the application of big data in public health, especially about algorithmic bias and data privacy (Batko and Ślęzak, 2022). This disparity offers a chance to combine big data and conventional public health statistics to create more thorough and adaptable vaccination uptake tactics.

2.4 Public Health Communication Strategies

Successful public health campaigns are built on excellent communication, yet there is continuous discussion on the best ways to deal with vaccine reluctance. Misinformation spreads through conventional and social media and has a substantial impact on healthcare decisions, mental health, and vaccination reluctance. Vulnerable groups are disproportionately affected by misconceptions about the causes, therapies, and public health initiatives of viruses. Health literacy, digital technologies, authoritative communication, fact-checking, and community participation are all necessary to combat disinformation, build public trust, and guarantee successful health treatments (Kisa and Kisa, 2024).

By creating long-lasting resources to counteract health misinformation, the WHO is promoting infodemiology. Through collaborations, fact-checking initiatives, and social listening is improved and digital literacy is fortified. AI-driven monitoring tools, research agendas, network analytics, and infodemic observatories are some of the major advances. The goal of these initiatives is to provide communities and health authorities with trustworthy information (WHO, 2020).

The study by Glenton *et al,* (2021)identifies important variables that affect how healthcare professionals and senior citizens communicate about vaccinations. It highlights the need for clear communication objectives, training for healthcare workers, and access to trustworthy vaccination information. To successfully improve vaccination tactics, future studies should examine demographic influences, low-income settings, and pandemic-related vaccine communication. There is potential for boosting vaccination uptake through customised messaging that speaks to the particular worries of reluctant groups (Quinn *et al.*, 2019).

For example, in certain situations, campaigns that highlight the effectiveness and safety of vaccinations while dispelling prevalent myths have been successful (Betsch *et al.*, 2015). In a study conducted by Evers *et al.* (2023) it was found that when it came to creating communication plans to increase the adoption of the mpox vaccine among at-risk groups, intervention mapping worked well. Policymakers and medical experts may optimise vaccination efforts with the help of this methodical technique. Future responses to infectious disease outbreaks, in which vaccination is a crucial preventative tool, can also be guided by this approach.

Nowak and Cacciatore (2025) have shown that mRNA vaccination reluctance must be addressed by effective public health communication tactics. The research emphasises how crucial it is to adjust communication strategies to political beliefs, information source choices, and demographic characteristics. To foster trust and combat disinformation, public health initiatives must place a high priority on coherence, openness, and trustworthiness in their communications. People with different political views, for instance, frequently react differently to different communication methods; Democrats could be more receptive to arguments based on science, while Republicans would need communications that emphasise individual liberty

and the good of society. The study also emphasises how vaccination views are shaped by reliable information sources, such as medical professionals, local authorities, or certain media outlets. Social media sites are also essential for spreading correct information and quickly thwarting false information (Nowak and Cacciatore, 2025).

Public health communication strategies for mRNA vaccines can draw insights from approaches used in RNA-based cancer immunotherapies. To overcome scepticism, Chehelgerdi *et al.* (2023) stress the significance of clear communication regarding mRNA processes. Adapting communications to different groups, using reliable intermediaries like medical professionals, and preventing false information using fact-checking and real-time monitoring are all examples of successful tactics. Public awareness and acceptability can be increased by highlighting the adaptability of mRNA technology in both therapeutic and preventative applications. Public health initiatives may successfully encourage the uptake of mRNA vaccines by embracing the concepts of openness, trust-building, and flexible messaging (Chehelgerdi and Chehelgerdi, 2023).

Important ideas relevant to mRNA vaccine communication tactics are highlighted in Montero *et al.*'s (2024) historical examination of vaccination. The significance of establishing public confidence through accurate and honest information distribution is emphasised in the study. Historical achievements like the elimination of smallpox show how successful community involvement and extensive education efforts can be. The authors advise resolving public concerns about new technology while utilising contemporary communication strategies for mRNA vaccines. They emphasise the need to convey unambiguous information on the safety, effectiveness, and scientific methodology of mRNA platforms in vaccines. The research also emphasises how important healthcare professionals are as communicators and how important it is that they receive in-depth training on mRNA technology to successfully handle patient concerns and counter false information (Montero *et al.*, 2024).

2.5 Research Gap

There are still several unresolved concerns regarding the Irish public's perceptions of mRNA vaccinations, despite lots of research on vaccine reluctance. Although previous research has

concentrated on vaccine acceptance during the COVID-19 pandemic (Murphy *et al.*, 2021; Lazarus *et al.*, 2021), little is known about how public trust changes after the pandemic and the long-term tactics required to maintain high immunisation rates. Furthermore, little research has been done on how cultural and religious beliefs affect attitudes towards vaccines in Ireland, which leaves a knowledge gap (Figueiredo *et al.*, 2020). The impact of social media in disseminating false information and influencing vaccination reluctance is another crucial gap (Wilson and Wiysonge, 2020) especially in the Irish context where online forums are heavily used in public conversation. Although big data analytics are being used more and more to examine vaccination hesitancy (Wang *et al.*, 2019), little research has been done on how to combine it with conventional public health techniques to create focused treatments. Filling up these gaps will yield important information for creating data-driven, more successful public health initiatives that target certain Irish demographic and cultural characteristics.

2.6 Summary

Identifying important issues such as public perception, disinformation, faith in healthcare systems, and the efficacy of public health communication, this chapter offers a thorough analysis of the body of research on mRNA vaccination uptake and hesitation. The success of mRNA vaccine technology is examined first, with an emphasis on both its scientific accomplishments and the persistent reservations over its novelty and long-term impacts. The analysis then explores the variables that affect vaccination reluctance, such as socioeconomic inequality, confidence in the government and medical establishments, and the impact of false information, especially on social media. It also looks at healthcare professionals' reluctance despite of their crucial role in vaccination promotion. Along with addressing issues with data privacy and governance, the chapter also covers the use of big data analytics in public health policies, highlighting its potential for managing epidemics, allocating resources, and enhancing vaccination uptake. The chapter concludes with a review of public health communication tactics, emphasising the value of focused messaging, fact-checking campaigns, and customised techniques to dispel myths and foster public confidence. This chapter lays the foundation for future research into enhancing vaccine acceptance in Ireland by highlighting gaps in the literature, including the impact of social media in the Irish context, the influence of cultural

and religious beliefs, and the integration of big data with public health interventions. Strong public health communication is essential to promoting mRNA vaccine acceptance. Clear and consistent messages from trusted sources, most importantly healthcare professionals, can overcome misinformation, build trust, and enable informed choice. Tailored campaigns to reach specific populations optimize reach and more effectively address concerns, leading to higher vaccine uptake and public confidence.

2.7 Conceptual Framework

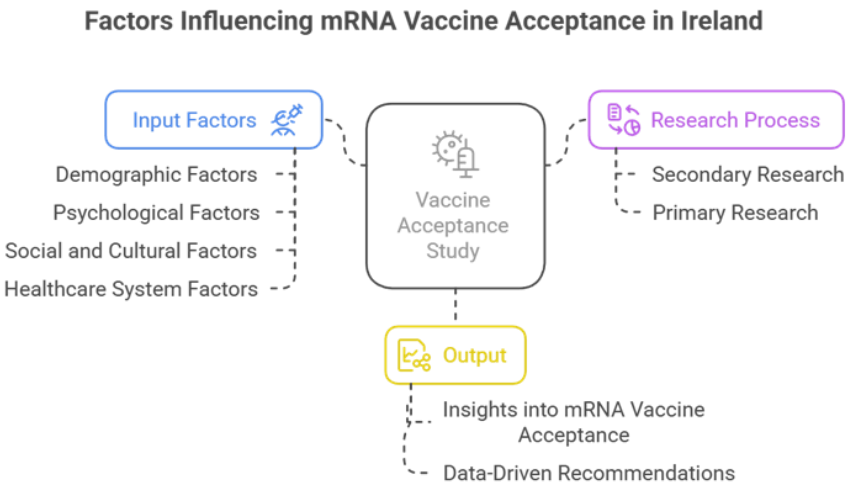


Figure 3. Conceptual Diagram Designed Using Napkin.ai

Figure 3. Conceptual Diagram Designed Using Napkin.ai presents the structure for the analysis of mRNA vaccine uptake in Ireland, dividing the study into three major components. The Input Factors—demographic, psychological, social/cultural, and healthcare system factors—are the basis of the analysis. These inputs are explored through a Research Process integrating secondary and primary research approaches. The findings, represented in the Vaccine Acceptance Study, yield public acceptance of mRNA vaccines and generate data-based conclusions to overcome hesitation. The diagram presents a quick visual recognition of the study framework, noting the interplay among causative factors, research design, and actionable findings.

CHAPTER 3

METHODOLOGY

3. RESEARCH METHODOLOGY

Research methodology refers to the systematic approach used to conduct research, encompassing the theoretical framework, data collection methods, and analysis techniques to address a research problem. It involves choosing an appropriate study design, data collecting strategies, and sample techniques. It is a methodical style that guarantees the study is reliable, repeatable, and able to provide significant findings (Saunders *et al.*, 2009).

This chapter describes the study approach used to look at the variables affecting Ireland's adoption of mRNA vaccines. It describes the study strategy, data collecting procedures, the analytical tools used to interpret the results, and the justification for the selected methodology. To gather quantifiable data from a wide range of participants, including healthcare assistants, nurses, parents, students, and the general public, the study uses a quantitative survey-based approach. The procedures followed to guarantee the study's validity and reliability, including ethical concerns and pilot testing, are also described in the methodology section. This study intends to offer data-driven insights into vaccination reluctance and acceptance by utilising statistical analysis and structured questionnaires, therefore assisting in the development of more successful public health initiatives.

A collection of driving ideas, presumptions, and methods that are part of the methodology determines the study subjects and the choice of research procedures. The first phases of setting time horizons, defining methodology, methods, and strategies, and outlining the fundamental philosophy are followed by the research design, which includes the main procedures and strategies for gathering and analysing data. The Research Onion Model, a comprehensive framework for creating a research technique, was proposed by Saunders, Thornhill, and Lewis (2009). This method describes the many levels of the research process as an onion, with each layer standing for a stage or component of the study design (Figure. 4).

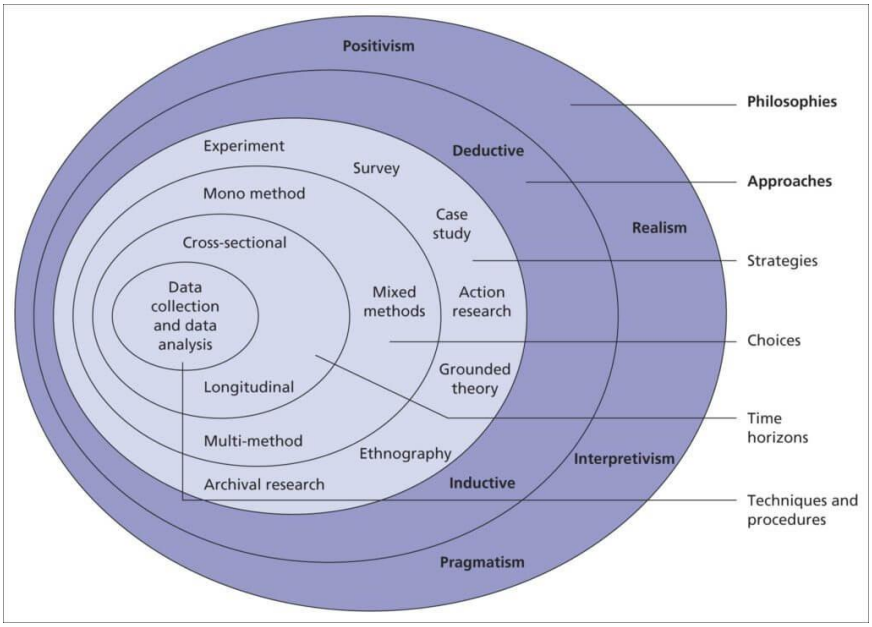


Figure 4. Research Onion model (Saunders et al., 2009)

The following provides a clear explanation of the layers in the Figure 4 Research Onion model by Saunders *et al*. (2009):

3.1 Research Philosophy

The outermost layer of this model represents research philosophy, which influences the overall approach to a study. The set of ideas about how knowledge should be created and examined is known as research philosophy. The onion model identifies four primary research philosophies: Positivism: The belief that reality is objective and accessible to quantitative, systematic measurement. This kind of idea keeps researchers independent and bases their hypothesis testing on statistical analysis.

Similar to positivism, realism recognises that reality is also influenced by interpretations and perceptions. It can be either critical realism, which acknowledges that reality is affected by underlying structures and mechanisms, or direct realism, which assumes the world is as it seems.

Interpretivism: Focusses on gaining a subjective knowledge of human behaviour, usually using

qualitative means. It focuses on the interpretations people give to events and makes the assumption that reality is socially created.

According to pragmatism, research philosophy should be adaptable, and techniques should be chosen according to how well they address the research issue. Pragmatists frequently combine quantitative and qualitative methods.

The proposed study has a positivist attitude, which is consistent with the study's quantitative design. According to Creswell and Creswell. (2018) Positivism is based on the idea that reality is objective and open to measurement and analysis using scientific procedures and empirical observation. This methodology is especially appropriate for this study as it uses quantifiable data, such as survey answers, to uncover patterns and relationships. This strategy is in line to produce empirical insights regarding the acceptability of mRNA vaccines in Ireland because it focuses on survey data and statistical analysis.

The positivist approach is appropriate as the goal of this study is to generalise data across various demographic groups and uncover quantifiable factors impacting vaccination uptake. The study may provide trustworthy and repeatable results by depending on statistical analysis and organised surveys, which are crucial for guiding evidence-based public health initiatives. This approach also ensures that the research is replicable and transparent, enhancing its credibility and reliability.

3.2 Research approach

The research approach is a critical layer that directs how a study formulates its technique. This layer specifies whether an inductive or deductive method is used in the investigation.

The deductive method starts with accepted assumptions, develops hypotheses, and then gathers evidence to support them. It is frequently linked to quantitative research, which places a strong emphasis on measurement, statistical analysis, and objectivity. The inductive method, on the other hand, begins with data collecting and looks for patterns and trends that support the development of new ideas. A flexible and exploratory study design is made possible by this approach, which is more in line with qualitative research (Saunders *et al.*, 2009).

A deductive technique is ideal for this study as it starts with well-established theories on vaccine hesitancy and uses a structured survey to assess their viability. The deductive technique is especially well-suited to studies that aim to use organised methodologies to explain correlations between variables, as noted by Saunders *et al.* (2009). The adoption of a deductive method enables objective data gathering, statistical testing, and conclusions that can be applied broadly, as the goal of this study is to determine the variables impacting the acceptability of mRNA vaccines in Ireland. The research guarantees a comprehensive analysis that may support data-driven public health policies for enhancing vaccination uptake by adhering to this organised methodology. Based on the literature, theories on vaccine acceptability are formulated, and data gathering will serve to verify these theories. This method guarantees that results are supported by empirical data by allowing for a systematic analysis of vaccination reluctance causes.

3.3 Research Design

The research design layer of the onion focuses on the overall plan for answering the research question, encompassing the methodological choices, strategies, and time horizons. A descriptive and cross-sectional research approach is used in this study to examine the variables affecting the Irish acceptability of mRNA vaccines. Quantitative information is gathered from healthcare assistants, nurses, parents, students, and the general public using a standardised survey. This methodology aids in the identification of important patterns and connections across variables, including sources of knowledge about vaccines, trust in healthcare institutions, and demographic characteristics.

Three essential components make up the research design in the Research Onion architecture. First, research that is exploratory, descriptive, or explanatory is essential. According to Saunders *et al.* (2009), a descriptive research approach is used in this study to methodically explain traits, behaviours, and patterns. Assessing vaccination acceptance levels and determining contributing factors, such as exposure to false information and faith in healthcare institutions, are the goals.

The second topic discussed is quantitative vs qualitative design. This study takes a quantitative approach, gathering numerical data for statistical analysis using organised questionnaires. Studies that need quantifiable, objective data rather than subjective interpretations are best suited for quantitative research, claim Saunders *et al*. (2009). A deeper empirical knowledge of the variables affecting vaccination acceptability is made possible by this method.

Third, the difference between cross-sectional and longitudinal designs is considered. This study has a cross-sectional design, which means that information is gathered all at once as opposed to over an extended period. Cross-sectional studies, according to Saunders *et al.* (2009), are especially helpful for examining current trends and patterns, which makes this method perfect for evaluating current sentiments towards mRNA vaccines in Ireland.

3.4 Research Strategy

To provide an accurate understanding of mRNA vaccination uptake in Ireland, both primary and secondary data sources are used in this study.

The main primary research methodology used in this study is quantitative, and data is gathered using organised questionnaires/surveys (provided in the Appendix). This approach is suitable as it makes it possible to gather quantitative data from a big sample in a methodical manner, which makes statistical analysis and result extrapolation easier. The research collects reliable and quantifiable data on demographics, opinions, and vaccination acceptability by employing structured surveys.

This project uses organised surveys to gather data on opinions, experiences, and attitudes regarding mRNA vaccines. The survey will include a mix of multiple-choice, closed-ended, open-ended and Likert-scale type questions to guarantee consistency and facilitate analysis. This method has given a formal framework for understanding the many aspects impacting vaccination acceptability in addition to clear and usable data for analysis.

In order to gather data, an internet platform such as Google Forms is used to distribute the surveys, which makes the procedure accessible, economical, and efficient throughout Ireland. This platform made it possible to quickly and conveniently reach a large audience. Before the

survey is completely implemented, a pilot test is also carried out with a small sample of my friends and colleagues to guarantee the platforms and questions' clarity and dependability. Additionally, the outcome of the pilot test did not incorporate the final test results.

The questionnaires were divided into four sections, close-ended consisting of 14 questions and 1 open-ended question. At the start of the survey, the participant was briefed about the study's objectives and asked for their consent. It is guaranteed that the General Data Protection Regulation (GDPR) manages the data's privacy and confidentiality.

Secondary strategy - To establish a fundamental knowledge of vaccination hesitancy, public health strategies, and the use of big data to address healthcare issues, a thorough literature analysis was carried out. Peer-reviewed journals, books, and scholarly publications were among the many sources that the review consulted. Official health reports from government agencies including the World Health Organisation (WHO) and the Health Service Executive (HSE), were also reviewed. Along with social media trends and news items that recorded popular opinions about mRNA vaccines, surveys and research focused on vaccine uptake and reluctance were also examined. This thorough evaluation highlighted essential theoretical frameworks that support the research of vaccination hesitancy in addition to identifying important information gaps and new trends.

Figure 5 shows the Dissertation Timeline, highlighting the key stages and deadlines of the research project—from the Draft Research Proposal (30 Jan) to the Dissertation Submission (08 Apr). The table includes specific dates and task durations to support efficient progress tracking.

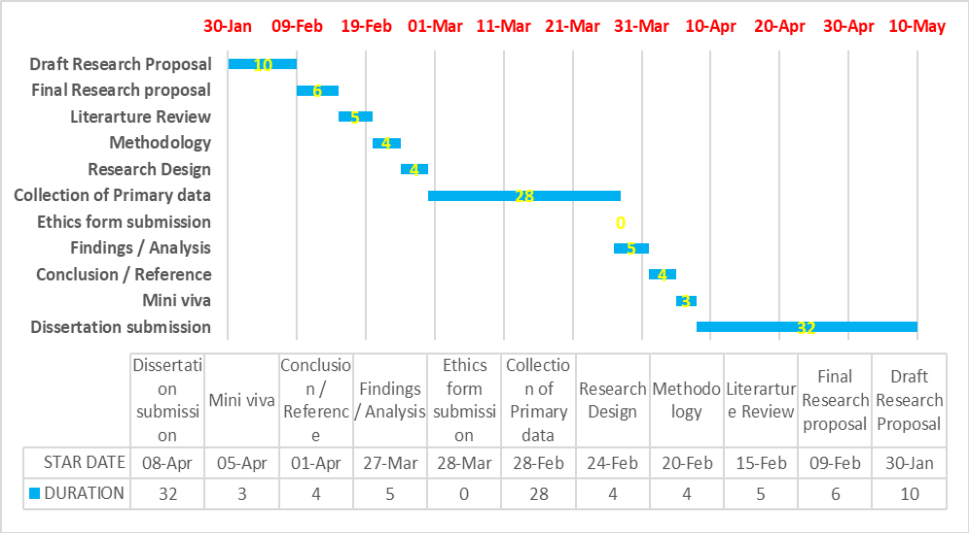


Figure 5. Dissertation timeline

3.5 Time Horizon

A crucial component of the research design that establishes the study's temporal scope is the Time Horizon. Depending on the goals of the study, it may be longitudinal or cross-sectional.

Cross-sectional research provides an idea of the phenomenon being studied by gathering data at one point in time or across a brief period. Though it doesn't examine how these characteristics evolve, this kind of research helps comprehend present situations, such as staff attitudes or consumer preferences. Longitudinal research, on the other hand, is appropriate for comprehending patterns or causal linkages as it covers a longer period and monitors changes or developments over time (Saunders *et al.*, 2009). The choice between these two-time horizons is guided by the research objectives—whether the goal is to capture a moment in time or observe changes over a period.

This study uses a cross-sectional time horizon, which means that data is gathered all at once rather than over a long period. This method is suitable for determining the reasons driving

vaccination reluctance within the chosen participant groups and comprehending present opinions regarding mRNA vaccines.

3.6 Ethical considerations

The study ensured that participants gave their informed permission, emphasising that participation is voluntary, and that withdrawal is possible at any moment without consequences. Secure storage procedures and data anonymisation will be used to ensure confidentiality. All information will be maintained in a secured cabinet at the researcher's home on a password-protected laptop that is frequently backed up to a safe external drive. The data will be kept for at least two years after the study is finished and sent to Griffith College as part of the thesis submission. Throughout the research process, participants' health will be given priority, and every effort will be taken to reduce hazards. In order to ensure ethical compliance and integrity in study conduct, any uncertainties or challenges will be quickly addressed through proactive means.

3.7 Participants

3.7.1 Selection Criteria for Participants:

Participants will include medical experts, including pharmacists, nurses, and healthcare assistants who have knowledge or experience with mRNA vaccines and public health. The general public, parents, and students will also be enlisted to offer a variety of viewpoints on vaccination acceptability.

Participants are chosen based on their demographic variety (e.g., age, region), geographic location (Ireland), and relevance to the study's emphasis on mRNA vaccination uptake. Healthcare workers' professional duties and background in public health or vaccination administration are also taken into account.

In order to guarantee statistical significance and improve the findings' generalisability, the study seeks to enlist a minimum of 151 participants. A minimum of forty participants will be chosen from each of the four groups—medical professionals, parents, students, and the general

public—to provide a fair representation. This method guarantees a range of viewpoints on the subject of the study.

3.7.2 Sample size

According to the latest record on March 5 given by Worldometer, the general population relevant to this study includes 5,308,039 individuals in Ireland, encompassing healthcare professionals, parents, students, and the broader public (Worldometer, 2025). The sample size was calculated using a 95% confidence interval and an 8% margin of error through the SurveyMonkey sample size calculator, resulting in a required sample of 151 participants for this research.

Figure 6 presents the process used to calculate the required survey sample size through SurveyMonkey. Taking Ireland's total population of 5.3 million into account, along with a confidence level of 95% and a margin of error set at 8%, the calculator estimated that 151 participants would be needed for reliable results.

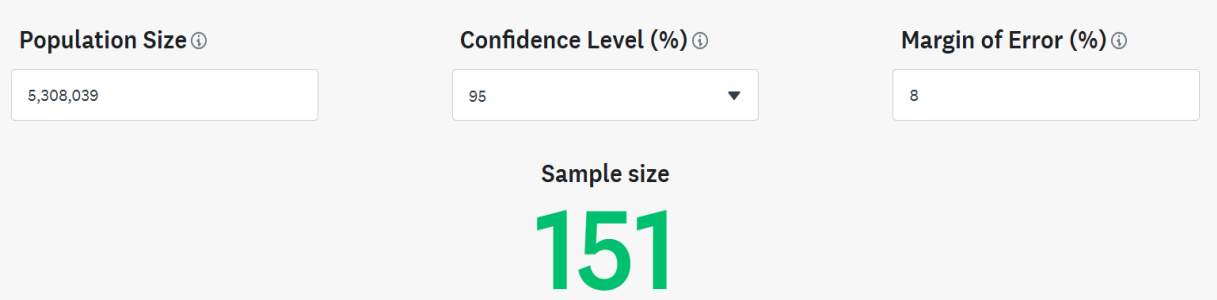


Figure 6. Sample size collection via SurveyMonkey

3.7.3 Subject Availability and Accessibility:

In order to achieve effective recruitment, as the researcher, I have taken into account each target group's accessibility. My goal is to get data from 40 individuals in each category.

Students: Students are an easy and accessible group to recruit since I easily reached them through my college campus.

Healthcare Professionals: I get to know a lot of healthcare assistants, nurses, and pharmacists personally because I work in a nursing home environment. Their availability for involvement in this survey is guaranteed from my current professional network.

Parents: Since many of the health care professionals I work with are also parents, I can easily get their thoughts and perspectives. Furthermore, I have a broad circle of parents who reside in Ireland with their families, which gives me access to a wide range of possible participants with different experiences and backgrounds.

General Population: I can recruit volunteers who are representative of the general population by utilising my extensive network of contacts from my job, college, and other personal associations.

3.8 Data Analysis

Quantitative techniques are used to examine the gathered survey data to find trends, patterns, and connections. Data analysis and visualisation are done using Microsoft Excel version 2501. The following actions listed below will be taken:

3.8.1 Data Cleaning:

Responses that are inconsistent or lacking are eliminated from the dataset through cleaning. Microsoft Excel was used for cleaning the survey data that was obtained. I went over each response by hand to make sure there were no duplicates or insufficient information.

To find mistakes or missing data, I used simple Excel functions like filtering, sorting, and basic calculations. For instance, I checked a single-choice question to see if someone chose more than one response or left a question unanswered.

To ensure that the data was correct and prepared for analysis, the majority of the cleaning was completed manually. Depending on the degree of missingness, appropriate methods, such as mean imputation or exclusion, were used to manage missing data.

3.8.2 Descriptive Statistics:

The demographic details of the participants and their answers to the survey questions are compiled using descriptive statistics (such as frequencies, percentages, averages, and standard deviations).

3.8.3 Inferential Statistics:

To investigate correlations between variables, inferential statistical tests like chi-square tests were used (e.g., to compare vaccine acceptance levels across different groups (e.g., students, healthcare professionals, parents)). In addition, a Kruskal-Wallis H test was employed to make comparisons of the levels of concern about vaccine side effects based on residential locations. Both tests were appropriate for the analysis of categorical and ordinal data, respectively.

3.8.4 Data Visualisation:

Tables, graphs, and charts are used to show the results to improve readability and ease of interpretation. The data collected in this study are mostly categorical, including information like age group, occupation, location, and opinions about mRNA vaccines. I used pie charts and bar charts to properly display the results because the data is categorised. Bar charts were used to compare the frequency of each response, while pie charts assisted in displaying the proportion of each group. The most important issues causing vaccination reluctance will be highlighted using a Pareto diagram. By prioritising the concerns according to their frequency, the Pareto chart will make it easier to identify the main causes of public hesitation. Additionally, a funnel chart was used to present the data collected from the question on what could improve public trust in mRNA vaccines. This type of chart was especially effective in illustrating the gradual narrowing of responses from the most to the least frequently chosen options. These visual tools made it easier to understand the patterns in the survey responses.

3.8.5 Analysis of the Findings:

The findings are evaluated in light of the goals of the study and the body of current literature. The study offers an in-depth understanding of the adoption of mRNA vaccines in Ireland across

various demographic groups. Targeted public health policies will be informed by the findings, which will be utilised to identify important facilitators and obstacles.

Figure 7 illustrates the sequential stages of the research process, beginning with the design and online distribution of the survey, followed by data gathering and refinement to ensure accuracy. It then progresses through data analysis, interpretation of results, and concludes with the final reporting phase, including discussion and conclusions. This flowchart reflects a consistent and organized methodology from start to finish.

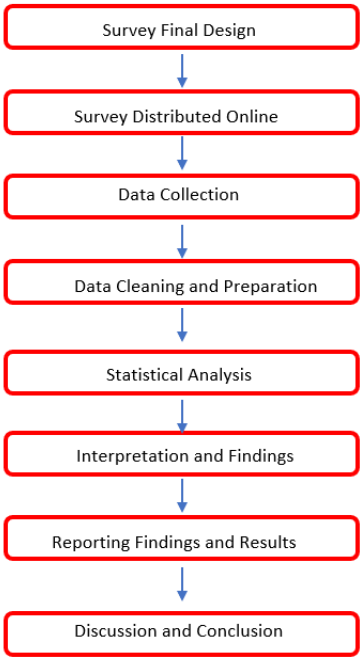


Figure 7. Flowchart: Methodology and Data Analysis

CHAPTER 4

FINDINGS AND ANALYSIS

4. FINDINGS AND ANALYSIS

This chapter presents the findings of the survey conducted to examine factors influencing mRNA vaccine acceptance in Ireland. A wide range of participants, including students, parents, members of the general public, and healthcare professionals (pharmacists, nurses, and healthcare assistants), participated in this study. A thorough understanding of vaccination acceptability and hesitation across various demographics was ensured by the selection of these groups based on their applicability to the study. Overcoming the initial predicted sample size of 151, a total of 189 responses were gathered, improving the findings' statistical reliability and generality. In order to ensure wide representation across various age groups and geographic areas, participants were gathered through connections with others, educational institutions, and professional networks. Key issues, including vaccination willingness, hesitation reasons, and the influence of information sources on decision-making are examined in connection with the outcomes. Through quantitative research, this chapter systematically examines these findings, providing clear graphical representations to support results.

4.1 DESCRIPTIVE ANALYSIS

In order to ensure that participants were aware of the purpose of the study and that their participation was voluntary, the survey started with introductory questions. The survey was designed to collect quantitative and qualitative data on vaccine acceptance, hesitancy factors, and the impact of different demographic and professional backgrounds on participants' perceptions. A total of 189 responses were obtained, exceeding the initially estimated sample size of 151, which improves the validity and reliability of the findings. The entire survey includes 15 questions under four sections.

Section 1: Demographic Information

The data for this section was gathered through four distinct questions.

Age Groups:

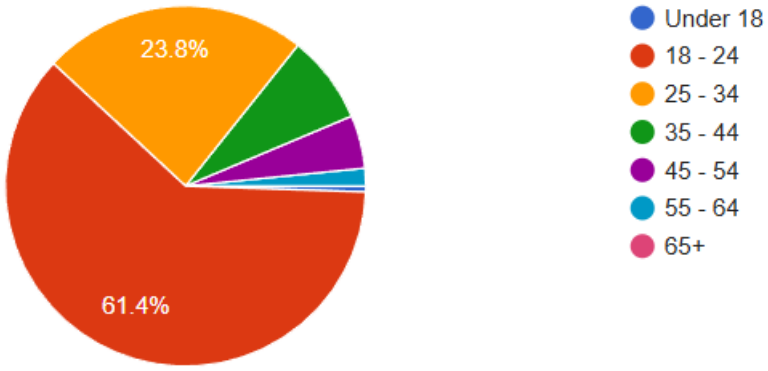


Figure 8. Age group of participants

Figure 8 shows the survey responses from 189 individuals, with a majority (61.4%) falling within the 18-24 age group, followed by 23.8% in the 25-34 category. This suggests that the majority of responders were young adults, which is indicative of their enthusiastic involvement in the research. Older age groups, such as 35-44, 45-54, 55-64, and 65+, accounted for the remaining replies, but their representation was noticeably smaller. The majority of younger participants could indicate that this group is more interested in conversations around mRNA vaccines or is more engaged with digital surveys. Given that younger people may have different worries, levels of trust, and information sources than older groups, this age distribution is crucial to understanding vaccination attitudes.

RESPONSES	FREQUENCY	FREQUENCY PERCENTAGE
18-24	116	61.4
25-34	45	23.8
35-44	15	7.9
45-54	9	4.8
55-64	3	1.6
Under 18	1	0.5

Table 2. Age distribution of participants

It is clear from Table 2 that the proportion of participants steadily decreases across the older age groups. The 35-44 age category comprises 7.9% (15 respondents), followed by the 45-54 age group at 4.8% (9 respondents). Representation further declines in the 55-64 age group, which accounts for 1.6% (3 participants), while the "Under 18" category has the lowest participation at 0.5% (1 respondent) (Table 2). However, the smaller percentage of older persons (45+) may suggest a lower response rate from this group, which might be brought on by problems with accessibility, a lack of digital literacy, or varying degrees of interest in the subject.

The study's emphasis on mRNA vaccine acceptability suggests that the majority of participants are younger, which may be a reflection of their active participation in public health debates and vaccination-related choices. However, when evaluating the generalisability of the findings, it is essential to consider the under-representation of older age groups, which could be a key focus for future research. Given more time, the study could have explored these age groups in greater depth, particularly those who may have been less engaged with social media platforms.

Occupation:

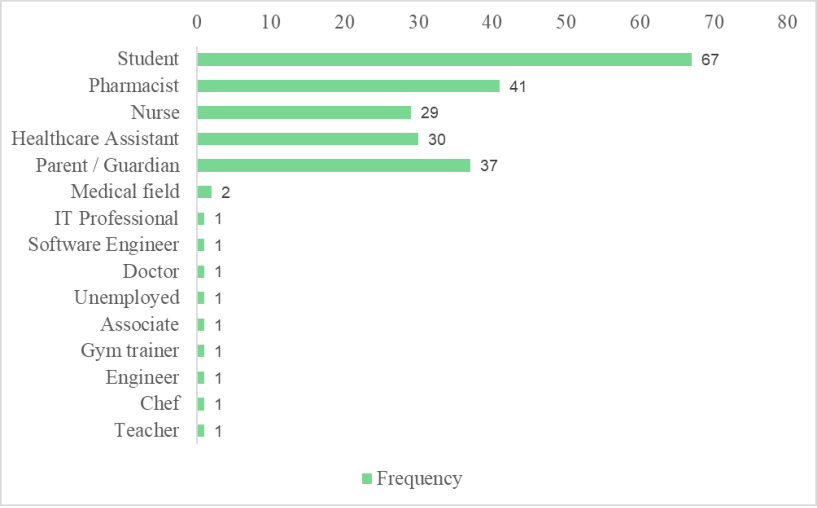


Figure 9. Participants occupation

The frequency of the participants' occupations was assessed using descriptive statistics. From Figure 9 and Table 3, it can be observed that students constituted the largest category, accounting for 35.4% (67 participants) of the total responses. Pharmacists came in second with 21.7% (41 participants). Healthcare assistants made up 15.9% (30 individuals), while parents or guardians made up 19.8% (37 participants). There were a significant number of healthcare workers in the poll, with nurses making up 15.3% of the total (29 participants).

The percentage of respondents who chose "Other," which included a variety of occupations like doctors, IT specialists, software engineers, medical field professionals, unemployed people, and other professions, was 5.3% (10 participants), which accounted for 0.5% to 1.1% of all responses.

The involvement of parents and people from various areas guarantees a wider view on public attitudes towards vaccination, while the significant presence of medical professionals supports the legitimacy of replies of mRNA vaccine acceptability. My intended participants, who included parents, students, medical professionals, and the general public, made a significant contribution, assuring a representative and well-rounded dataset for analysis.

RESPONSES	FREQUENCY	FREQUENCY PERCENTAGE
Healthcare Assistant	30	15.9
Nurse	29	15.3
Pharmacist	41	21.7
Student	67	35.4
Parent / Guardian	37	19.6
other	22	11.6

Table 3. Occupation distribution of Participants

With a combined 53% of the replies, the results show that a significant proportion of participants are employed in healthcare-related fields (pharmacists, nurses, and healthcare assistants). This implies that an adequate number of respondents had personal knowledge of public health and vaccinations, which may have an impact on their opinions regarding the acceptability of mRNA vaccines. Furthermore, the high percentage of students (35.4%) suggests that younger populations are interested in the subject, which may be related to their exposure to scientific discoveries at school. From a family-oriented standpoint, the

participation of parents and guardians (19.8%) guarantees important insights about vaccination acceptability. These results imply that the data gathered offers a fair combination of expert knowledge and popular opinion, enhancing the study's validity.

Residence:

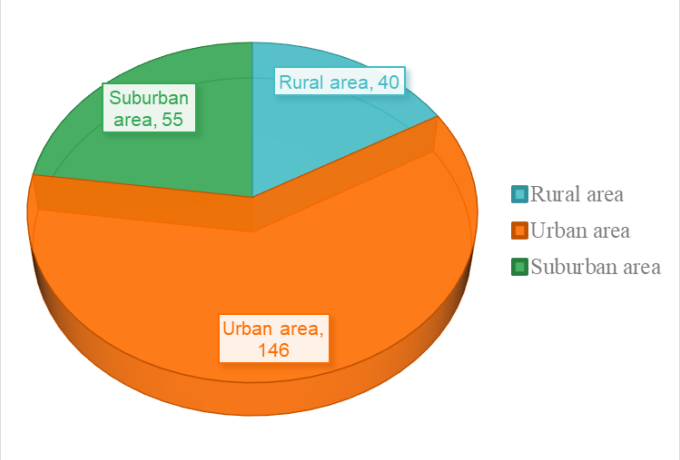


Figure 10. Distribution of Participants

The frequency of participants' living locations was evaluated from the responses and analysed using descriptive statistics. Figure 10 indicates that nearly half of the respondents reside in densely populated urban centres' where there is access to healthcare and information regarding vaccines. This is also evidenced by the fact that 48.9% of the respondents reside in urban settlements. Suburban people, who reside in moderately populated regions that frequently act as a link between urban and rural environments, made up 29.6% of all replies. The survey's smallest group of respondents the remaining 21.5%, came from rural regions.

The distribution presented in Table 4 offers insight into the geographic diversity of the study sample. Given that the survey was done online, the notable presence of urban residents may indicate more involvement from those with better access to digital technology. The significant number of respondents from suburban and rural areas guarantees that viewpoints from areas with lower population densities are also represented in the results.

RESPONSES	FREQUENCY	FREQUENCY PERCENTAGE
Rural area	40	21.2
Urban area	146	77.2
Suburban area	55	29.1

Table 4. Distribution of Participants by Residential Area

Another reason for the majority of responders (more than 78%) from urban and suburban regions, according to the data, may be that they have had more exposure to vaccination programs and public health campaigns. Rural participants' lower participation rate (21.5%) raises the possibility of survey reach or engagement issues, which may be a reflection of actual obstacles like the lack of adequate healthcare infrastructure and vaccine accessibility in these regions. By ensuring that perspectives from various geographic locations are recorded, this data helps to provide a more thorough knowledge of the patterns in vaccination acceptability.

COVID 19 Vaccine Status:

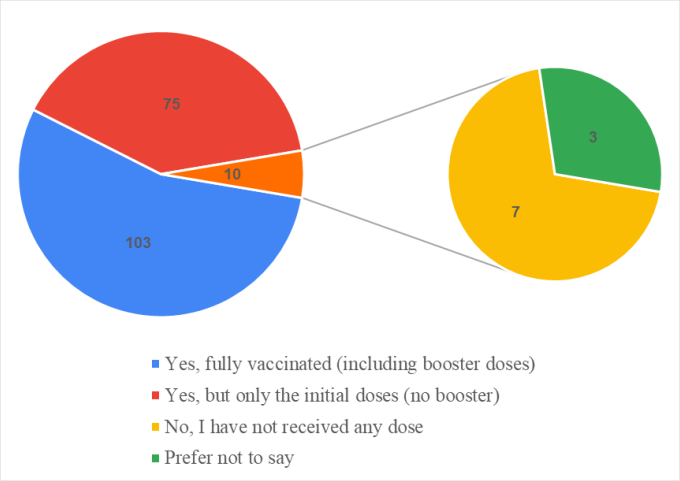


Figure 11. Vaccination Status of Participants

Participants' level of immunisation against COVID-19 was assessed by evaluating their vaccination status using descriptive statistics. Figure 11 and Table 5 clearly indicate that 103 respondents, which represent the majority of the respondents (54.5%), were fully vaccinated, including booster doses. On the other hand, 75 respondents (39.7% of the sample) indicated that they had received only initial doses and had not yet gotten booster injections.

Interestingly, that just 3.7% of respondents said they had not received any dose of the vaccination which suggests that there may be some access issues or a low degree of vaccine reluctance. Furthermore, 1.6% of participants said they would rather not reveal their vaccination status, which might indicate a lack of confidence in immunisation or privacy concerns.

Given that the majority of respondents had received at least the first dose, this distribution demonstrates a high degree of vaccination uptake among the participants. The significant portion of those who have not had booster shots, however, raises the possibility of reluctance or limited access to further immunisation. These results highlight the significance of focused public health initiatives to promote the administration of booster doses for improved COVID-19 protection.

RESPONSES	FREQUENCY	FREQUENCY PERCENTAGE
Yes, fully vaccinated (including booster doses)	103	54.5
Yes, but only the initial doses (no booster)	75	39.7
No, I have not received any dose	7	3.7
Prefer not to say	3	1.6

Table 5. Frequency and Percentage of Participants

Section 2: mRNA Vaccine Acceptance

The data for this section was gathered through three distinct questions.

Likelihood of Taking an mRNA Vaccine in the Future (such as Pfizer or Moderna) if recommended in the future

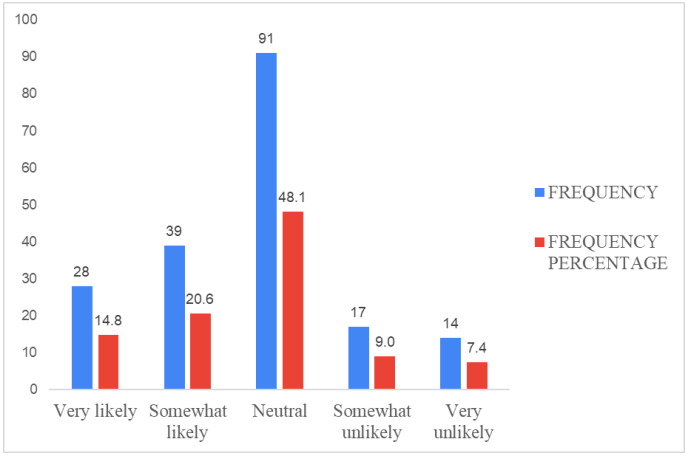


Figure 12. Likelihood of Taking an mRNA Vaccine in the Future

A thorough understanding of the participants' present attitudes towards vaccination may be acquired from their responses to the questions evaluating the possibility of future adoption of an mRNA-based vaccine. Nearly half of the respondents (48.1%) selected a neutral view, suggesting uncertainty or hesitation regarding future vaccination, as illustrated in Figure 12 and Table 6. With 91 people choosing this option, it was the most popular response. More positively, a total of 35.4% of respondents said they would be prepared to take an mRNA vaccination if it were suggested. Of these, 14.8% (28 participants) said they were "Very likely," and 20.6% (39 participants) said they were "Somewhat likely."

Nine percent (17 respondents) selected "Somewhat unlikely," while 7.4% (14 respondents) selected "Very unlikely," indicating that 16.3% of participants were hesitant. This pattern implies that although some people have favourable feedback about mRNA vaccines, a sizable fraction are still apprehensive or indecisive. To increase vaccination uptake in the next public health campaigns, our findings highlight the significance of addressing public fears and uncertainty using understandable, approachable, and evidence-based communication tactics.

RESPONSES	FREQUENCY	FREQUENCY PERCENTAGE
Very likely	28	14.8
Somewhat likely	39	20.6
Neutral	91	48.1
Somewhat unlikely	17	9.0
Very unlikely	14	7.4

Table 6. Likelihood of Taking an mRNA Vaccine in the Future

Reasons for vaccine refusal or delay:

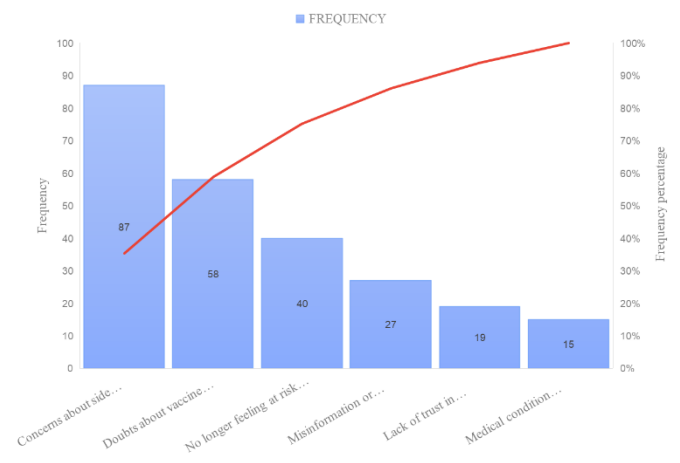


Figure 13. Key Reasons for Refusal or Delay of mRNA COVID-19 Booster

A Pareto analysis of the primary causes of participants' rejection or delay in getting the mRNA COVID-19 booster is shown in the accompanying table and chart (Figure 13, Table 7). By displaying the frequency and cumulative percentage of replies, this kind of visualisation efficiently ranks the most important topics, making it easier to determine which ones have the most influence.

According to the statistics, 87 respondents, or 48.6% of the total, reported having worries about side effects, such as physical discomfort or flu-like symptoms, which was the most common

explanation given by participants. This demonstrates clearly that the biggest barrier to booster adoption is the potential for side effects. With 58 respondents (32.4%) expressing uncertainty regarding the protective benefits of the mRNA vaccination, this was the second most frequently cited explanation. This suggests a significant lack of public confidence or knowledge about the effectiveness of the vaccination, which calls for further educational outreach. 40 individuals (22.4%) cited feeling less at risk of COVID-19 as the third most prevalent reason. This implies that people may deprioritise boosters due to perceived decreasing hazard levels, particularly during post-peak pandemic periods. Misinformation or contradicting information (15.1%), lack of faith in pharmaceutical corporations (10.6%), and medical disorders that prohibit vaccination (8.4%) were other significant concerns.

RESPONSES	FREQUENCY	FREQUENCY PERCENTAGE
Concerns about side effects (e.g., flu-like symptoms, body pain)	87	48.6
Doubts about vaccine effectiveness	58	32.4
Misinformation or conflicting information	27	15.1
No longer feeling at risk of COVID-19	40	22.3
Medical condition preventing vaccination	15	8.4
Lack of trust in pharmaceutical companies/government	19	10.6

Table 7. Frequency and Percentage of Reported Booster Hesitancy Reasons

These results highlight a complex issue related to vaccination hesitancy where safety, credibility, and accuracy of information are all important factors. The Pareto principle, which states that a small number of factors contribute to the majority of outcomes, is supported by the fact that side effect worries and vaccination reservations alone account for over 80% of the hesitation reasons.

This information backs up the study's second objective, which is to identify the main causes of mRNA vaccination reluctance in Ireland. Going forward, public health communication should strategically prioritise addressing side effect concerns and enhancing public knowledge of vaccination effectiveness.

Willingness to vaccinate child as a parent:

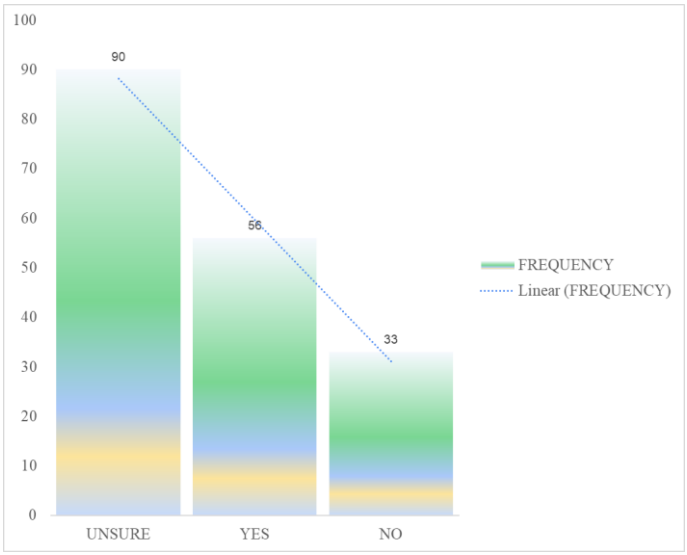


Figure 14. Distribution of Parental Attitudes Toward mRNA Vaccination for Children

The survey asked parents if they would be willing to vaccinate their child with an mRNA vaccine, providing the response options "YES," "NO," and "UNSURE." The responses to this question are shown in Figure 14. From Table 8 it is clear that the majority of parents (50.3%) chose "UNSURE," demonstrating considerable hesitancy or doubt regarding this choice. This considerable degree of hesitancy raises the possibility that many parents are either underinformed or have unresolved concerns regarding mRNA vaccinations for children. The lowest percentage of respondents (18.4%) refused to vaccinate their children, while a lesser amount (31.3%) said that they would be inclined to do so. These results indicate the urgent need for improved education and communication on mRNA vaccines, showing that parental vaccine reluctance is more defined by ambiguity than by strong resistance.

The findings are consistent with broader patterns of vaccination hesitancy, which show that hesitation is frequently more influenced by ignorance or lack of trust than by ideological opposition. By asking follow-up questions regarding parents' concerns and gathering more thorough participant data, future studies might fill in some of the gaps. Notwithstanding these drawbacks, the results highlight the significance of focused public health initiatives and offer insightful information about contemporary perceptions of children’s mRNA vaccination. In

order to address parents' queries and worries and maybe boost vaccination acceptability, effective interventions should concentrate on giving them concise, fact-based information. Public health officials and healthcare professionals can create more efficient strategies to raise childhood vaccination rates by comprehending and resolving the causes of parental uncertainty.

RESPONSES	FREQUENCY	FREQUENCY PERCENTAGE
UNSURE	90	50.3
YES	56	31.3
NO	33	18.4

Table 8. Frequency distribution of survey responses regarding parental willingness to administer mRNA vaccines to children

Section 3: Information & Awareness

The data for this section was gathered through four distinct questions.

Primary Sources of Vaccine Information:

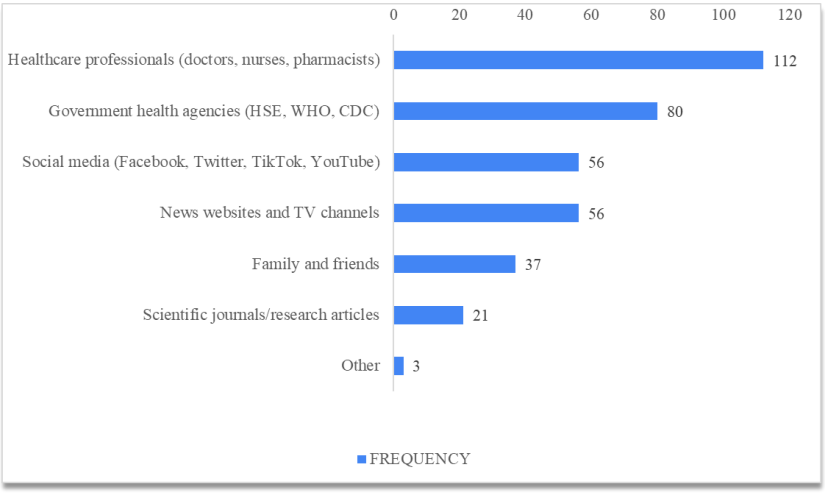


Figure 15. Primary Sources of Vaccine Information Among Respondents

Figure 15 shows that participants checked a wide variety of sources, according to the data collected in answer to the question, "Where do you primarily get information about vaccines?" Strong belief in medical knowledge was demonstrated by the overwhelming majority (59.3%, n = 112) who said that their primary source of information on vaccines is healthcare professionals such as doctors, nurses, and pharmacists. 42.3% (n = 80) of respondents said they depended on government health authorities such as the CDC, WHO, and HSE for reliable and accurate updates, making them the second most mentioned source. Traditional media (news websites and TV channels) and social media platforms (Facebook, Twitter, TikTok, YouTube) were chosen by 29.6% of respondents (n = 56), indicating that although media sources continue to have influence, they do not exceed direct advice from experts.

RESPONSES	FREQUENCY	FREQUENCY PERCENTAGE
Healthcare professionals (doctors, nurses, pharmacists)	112	59.3
Government health agencies (HSE, WHO, CDC)	80	42.3
Social media (Facebook, Twitter, TikTok, YouTube)	56	29.6
News websites and TV channels	56	29.6
Family and friends	37	19.6
Scientific journals/research articles	21	11.1
Other	3	1.6

Table 9. Frequency and Percentage of Sources Used for Vaccine Information

The Table 9 also provides extra information on less often utilised sources. 19.6% (n = 37) of participants named family and friends, indicating that personal networks still have an impact, although a smaller one. Just 11.1% (n = 21) of the respondents cited scientific publications and research papers, which may indicate that the general public has difficulty accessing or understanding academic information. Only a small percentage (1.6%, n = 3) chose “Other,” suggesting that the majority of people use readily accessible information sources. These findings highlight how crucial it is to improve communication from reliable government and healthcare sources while simultaneously making sure that correct information is interesting and easily available on digital and social media platforms.

Confidence in the safety and effectiveness of mRNA vaccines:

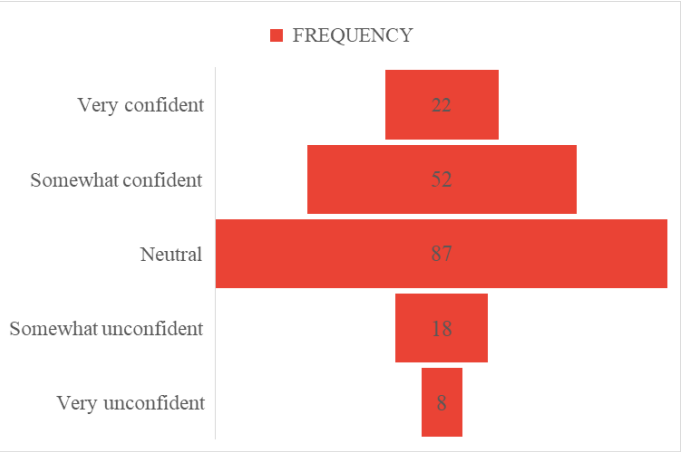


Figure 16. Distribution of Confidence in mRNA Vaccine Safety and Effectiveness

According to the study results from Figure 16 and Table 10, respondents' perceptions of mRNA vaccination confidence are not entirely consistent. The majority of respondents (87 out of 189), or 46% of the sample, said they felt "Neutral," indicating that a significant portion of the populace is still unsure or unconvinced regarding the efficacy and safety of these vaccinations. This uncertainty, which emphasises the need for more public education and open communication, may result from unclear information or contradicting messages. Positively, 39% of those surveyed said they were somewhat confident, with 27.5% saying they were "Somewhat confident" and 11.5% saying they were "Very confident." Although there is potential to increase this confidence, this suggests that a sizable minority has faith in mRNA vaccines. However, 13.7% of respondents said they were "Somewhat unconfident" (9.5%) or "Very unconfident" (4.2%), indicating that doubt still exists. Hesitancy may be decreased by addressing this group's concerns through focused outreach, evidence-based conversations, and interaction with medical specialists. All things considered, the results emphasise the significance of specialised public health initiatives to educate and reassure the public, especially those who are critics or indifferent, in order to promote increased confidence in mRNA vaccines.

RESPONSES	FREQUENCY	FREQUENCY PERCENTAGE
Very confident	22	11.6
Somewhat confident	52	27.5
Neutral	87	46.0
Somewhat unconfident	18	9.5
Very unconfident	8	4.2

Table 10. Confidence Levels in mRNA Vaccines – Frequency and Percentage Breakdown

Difficulties Encountered in Obtaining mRNA Vaccines:

According to the survey findings shown in the Figure 17, 43% of respondents said they had difficulties getting the mRNA vaccination ("No"). This suggests that they encountered obstacles such as a lack of appointments, geographic restrictions, financial limits, or insufficient data. This significant negative response suggests that there are systemic access problems that require attention. However, just 30% of respondents said "Yes," suggesting they had no difficulties, and a significant 27% said they were "Unsure"—a group that could be a reflection of inconsistent experiences or ignorance of the resources that are accessible.

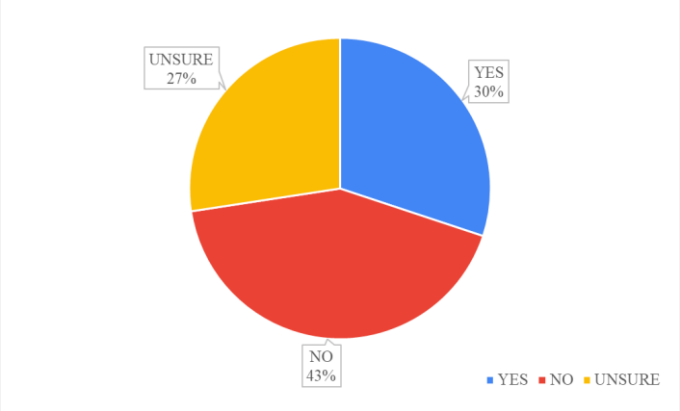


Figure 17. Pie chart showing Barriers to mRNA Vaccine Access: Public Survey Responses

The significant disparities in vaccination availability and education are shown by the large percentage of "No" and "Unsure" replies (70%) combined. Expanding appointment availability, improving public awareness in marginalised regions, resolving cost concerns through

subsidies, and offering clear, bilingual information are some of the specific measures required to increase access. By converting hesitant or underprivileged responders into successful vaccination users, these actions might guarantee fair access to healthcare for all groups.

Evaluating potential side effects of mRNA vaccines:

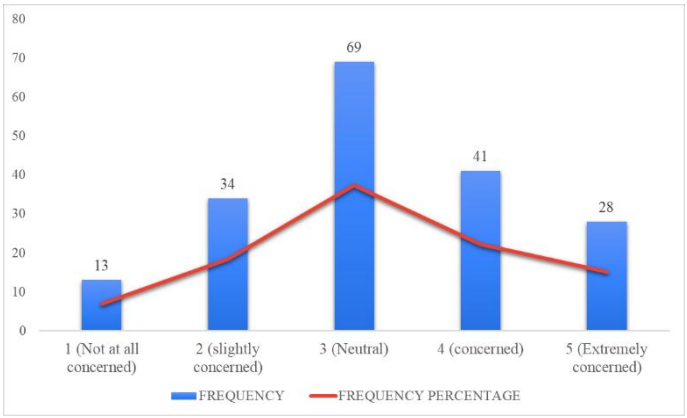


Figure 18. Distribution of Concerns Regarding mRNA Vaccine Side Effects

With responses ranging from "Not at all concerned" to "Extremely concerned," the survey's findings from Figure 18 offer a complex picture of popular perceptions about possible mRNA vaccination adverse effects. The information shows many clear trends that provide insight into the existing public opinion and point out areas that can benefit from focused communication efforts. The distribution of responses are given in Table 11.

It should be noted that the majority of respondents (37.3%) chose the "Neutral" option, suggesting neither considerable anxiety nor confidence regarding probable side effects, which is a notable finding.

High vaccine hesitancy is also reflected in the 37.3% of participants who reported some level of concern. Of this cohort, 22.2% were "Concerned" and 15.1% were "Extremely concerned." This means that a significant minority of the population has serious concerns about potential side effects, perhaps because they are subject to misinformation, have direct experience of adverse effects, or are inherently suspicious of medical establishments. The presence of this worried population makes it all the more important to open discussion of the actual incidence and severity of side effects and the intensive systems of safety surveillance.

On the other end, 25.4% reported being low in concern, of whom 18.4% were "Slightly concerned" and 7% were "Not at all concerned." This self-assured group likely includes individuals who trust scientific evidence, have a positive experience with vaccinations, or see advantages of vaccination as clearly outweighing disadvantages.

The response shape, with spikes at the neutral and concerned points, suggests a polarised but perhaps manipulable public opinion landscape. The dominant neutral category is a prime challenge for public health education, and the dominant minority concerned is an opportunity for intervention. Effective communication strategies need to address specific fears with facts and empathy, present clear comparisons of risk and benefit, and incorporate credible community voices.

RESPONSES	FREQUENCY	FREQUENCY PERCENTAGE
1 (Not at all concerned)	13	7.0
2 (slightly concerned)	34	18.4
3 (Neutral)	69	37.3
4 (concerned)	41	22.2
5 (Extremely concerned)	28	15.1

Table 11. Distribution of Concerns Regarding mRNA Vaccine Side Effects

Section 4: Public Health Strategy & Recommendations

The data for this section was gathered through four distinct questions.

Factors for Improving Public Trust in mRNA Vaccines:

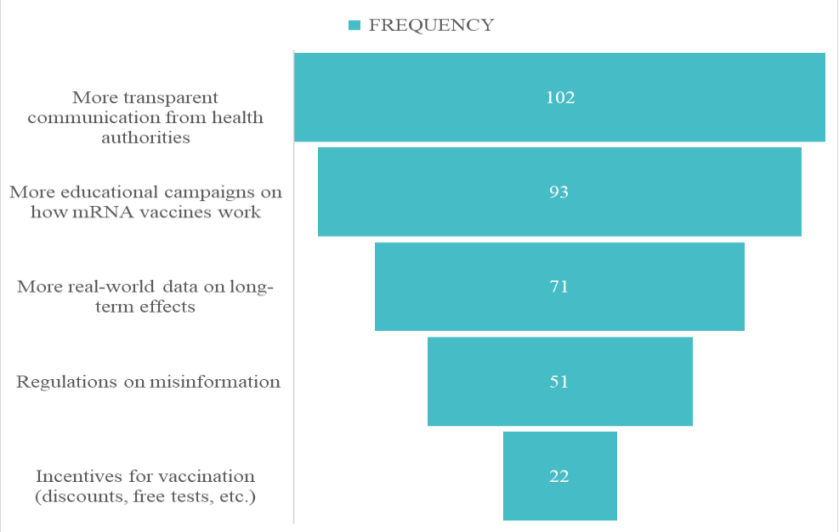


Figure 19. Public Opinion on Key Measures to Enhance Trust in mRNA Vaccination

RESPONSES	FREQUENCY	FREQUENCY PERCENTAGE
More transparent communication from health authorities	102	54.0
More educational campaigns on how mRNA vaccines work	93	49.2
More real-world data on long-term effects	71	37.6
Regulations on misinformation	51	27.0
Incentives for vaccination (discounts, free tests, etc.)	22	11.6

Table 12. Strategies to Enhance Public Trust in mRNA Vaccines: Frequency and Percentage Distribution of Responses

Figure 19 and Table 12 illustrates the respondents' perspectives on the most effective strategies to improve public trust in mRNA vaccines. Transparent communication from health authorities was the most often chosen choice, as seen by the funnel chart and accompanying frequency table, with 102 respondents (54%) citing it as a crucial component. This research emphasises how important it is for reliable sources to communicate openly and clearly to boost public trust, especially in uncertain times like the COVID-19 epidemic.

Ninety-three individuals (49.2%) picked the need for greater educational campaigns on the mechanism of action of mRNA vaccines as the second most popular strategy. This highlights

the broad demand for more public awareness of the scientific basis of mRNA vaccines, indicating that vaccination reluctance may still be influenced by information gaps.

71 responders (37.6%) highlighted further real-world information on long-term impacts, suggesting that safety concerns over the long-term impacts of mRNA technology are still very much alive. Similar to this, 51 people (27%) demanded stronger laws against disinformation, emphasising the detrimental effect that misleading information, especially from online sources, has on vaccination uptake.

Finally, just 22 respondents (11.6%) agreed that discounts or free testing should be offered as incentives for immunisation. This low proportion implies that trust-building and education-based tactics may be more helpful in promoting vaccination acceptance than extrinsic rewards. According to the statistics, incentive-based strategies are not nearly as appreciated as addressing informational demands, enhancing transparency, and eliminating false information. This insight can guide future public health communication strategies and educational campaigns aimed at increasing mRNA vaccine uptake.

Perceptions on the Role of Big Data and Technology in Boosting Vaccine Confidence:

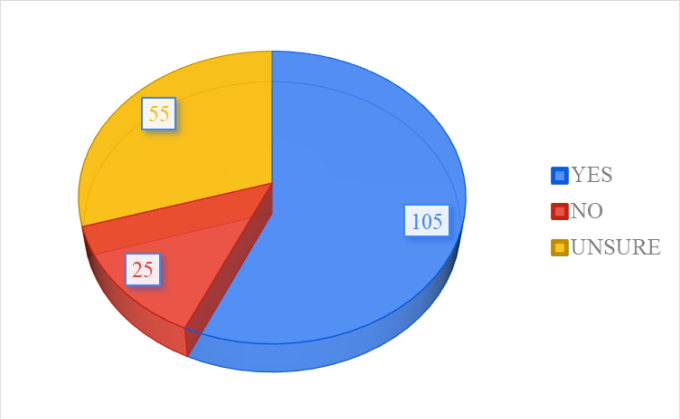


Figure 20. Public Support for Big Data Analytics in Enhancing Vaccine Acceptance

RESPONSES	FREQUENCY	FREQUENCY DISTRIBUTION
YES	105	56.8
NO	25	13.5
UNSURE	55	29.7

Table 13. Distribution of Responses on Support for Big Data Use in Vaccine Campaigns

According to the data analysis shown in Figure 20 and Table 13, the public's perception of the use of big data analytics in public health campaigns to boost vaccination adoption is largely acceptable. 105 people, or 56.8% of the total respondents, favoured the use of big data tools such as targeted awareness campaigns, AI-driven insights, and tracking vaccination uptake. More than half of the participants acknowledge the potential of data-driven strategies to boost outreach, reduce vaccination hesitancy, and improve public health communication, according to this majority.

However, when asked about their support, a significant percentage of participants—55, or 29.7%—selected "Unsure." This implies some hesitancy or unfamiliarity with big data technologies and how they are used in the healthcare industry. It could also be a reflection of broader reluctance to embrace modern technology, ethical considerations, or underlying worries about data privacy. This ambiguity emphasises how crucial it is to raise public knowledge by educating people about the advantages of these technologies in promoting vaccination uptake and guiding public health initiatives.

Only 25 respondents (13.5%), however, made it clear that they were against the use of big data analytics. Despite being just, a small percentage of the sample, this group still reflects one that could be suspicious of government-led health programs or digital technology. It will be crucial to overcome this reluctance using open discussion and inclusive policymaking.

In conclusion, the evidence points to a generally positive attitude towards the use of technology to encourage vaccination adoption. However, the sizeable percentage of uncertain answers points to a clear need for more focused educational initiatives to increase public trust in big data applications in healthcare.

Public Views on Healthcare Professionals' Preparedness to Tackle Vaccine Hesitancy:

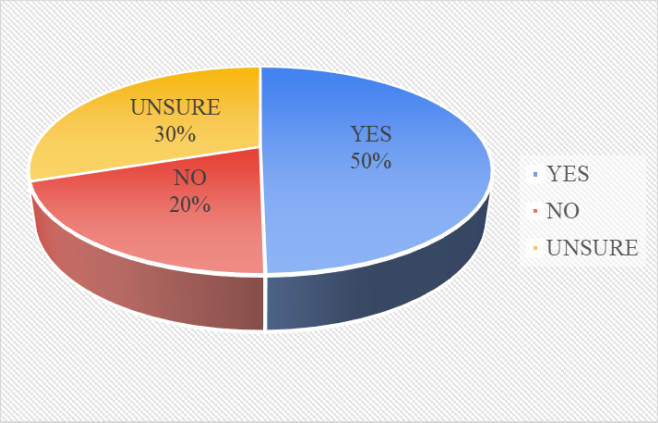


Figure 21. Public Perception of Healthcare Professionals' Training on Vaccine Hesitancy

RESPONSES	FREQUENCY	FREQUENCY DISTRIBUTION
YES	92	49.7
NO	37	20
UNSURE	56	30.3

Table 14. Frequency Distribution of Beliefs Regarding Adequate Training on Vaccine

The findings of Figure 21 and Table 14 present significant information regarding what the public perceives regarding healthcare professionals' readiness to handle vaccine hesitancy. The response split indicates a balanced, although very polarised, understanding among participants.

Nearly half (49.7%, or 92 individuals) of the people surveyed answered "Yes," reflecting that they trust that healthcare workers are indeed properly trained to tackle issues related to vaccines. It shows a high degree of public trust in the professional competencies of health professionals to suitably tackle questions related to vaccine safety, effectiveness, and misinformation. It may also indicate reliance on the general healthcare system and its role in training frontline experts.

On the other hand, 30.3% (56 respondents) of the participants said they were "Unsure," a fairly large proportion of the sample. This level of uncertainty implies a poor level of awareness or

transparency about the level and quality of training provided to health workers in vaccine communication. The public may not have a full understanding of what kind of ongoing education or professional development is being done, or perhaps they just simply have not had individually fulfilling clear and assertive vaccine discussions within clinic appointments. This implies not only more improved training but more visible efforts to inform the public about such efforts.

Alternatively, 20% (37 of the respondents) hold that health professionals are not adequately trained to address vaccine hesitancy. This sceptical attitude may result from individual negative experience or a general lack of trust in how health systems respond to public health messaging. It could also be attributed to the effect of misinformation or mixed messages disseminated by some health professionals during the COVID-19 crisis, which highlighted varying levels of preparedness among medical professionals.

Together, the "No" and "Unsure" responses account for almost 50% of interviewees, and this is a challenge in itself. Although a large percentage of the population has confidence in healthcare workers, there is a comparable size portion that either doubts their preparedness or is unsure. This is where health institutions can enhance both the quality and image of vaccine communication training courses. Public-facing campaigns could be used to reassure communities that professionals are being educated with up-to-date, evidence-based education to fight vaccine myths and hesitancy effectively.

Participant Reflections and Remaining Concerns About mRNA Vaccination:

The open-ended responses to this question provided additional qualitative data on public opinion surrounding mRNA vaccines. While the majority of participants responded with "No," "Nil," or "N/A," meaning they had nothing else to comment on or be concerned about, a smaller but significant number provided reflective comments that indicate both support for the study and ongoing concerns about vaccine safety and awareness.

Several of the respondents highly supported the study in general, underlining the importance and relevance of tracking public opinions on mRNA vaccines. These respondents argued that studies like the current one could play an important role in deciding effective communication

strategies and health policy. Specifically, they appreciated that the study considered different demographic segments, including students, and felt that there was scope for improvement in the uptake of the vaccine and the trust of the public in the health system.

On the other hand, some participants expressed concerns regarding vaccine safety, side effects, and the lack of information given to the population. One of the responses stated that misinformation and ignorance, especially among the illiterate and rural communities, lead to vaccine hesitance. The suggestion to implement awareness campaigns, such as educational classes and media, was cited in a number of responses. This highlights the need for targeted outreach strategies that address the information needs of various segments of the population.

A key observation stated the real-world consequences of vaccine hesitancy, where it was explained how certain families struggled through the COVID-19 pandemic with hesitancy or a lack of practice with being vaccinated. This highlights the significance of making people aware of the seriousness of being vaccinated on time and of educating people with regard to the benefits and potential side effects of being vaccinated.

Finally, some participants asked for more transparency and credible information regarding vaccine content, action, and possible side effects. Such requests resonate with the call for informed consent and suggest that the provision of good-quality and accessible vaccine information has the potential to calm fears and improve confidence. Briefly, while the majority of respondents were not offering additional comments, comments received indicate a dual requirement: to continue to build public confidence through transparency and to address under-informed groups through focused educational initiatives.

4.2 STATISTICAL ANALYSIS

4.2.1 Chi-Square Test: Association Between Age Group and mRNA Vaccine Willingness

H0: There is relation between age group and likelihood to take mRNA vaccine	
H1: There is no relation between age group and likelihood to take mRNA vaccine	
Critical value	: 0.05
p<0.05	: H0 accept
p> 0.05	: H1 accept
X^2 Value	
p=0.80 > 0.05, so there is no relation between age group and vaccine acceptance rate	

Table 15. Chi-square analysis showing the relation between age group and vaccine acceptance

To establish whether there was a strong relationship between respondents' age groups and their likelihood of accepting to take an mRNA-based vaccine in the future, a Chi-Square Test of Independence was employed. Categorical data across two survey questions, i.e., Q1 (Age group) and Q5 (Likelihood to take an mRNA vaccine), were cross-tabulated and analysed using Microsoft Excel. Table 15 displays the chi-square analysis showing the relationship between the two questions. From the table, the p-value obtained was 0.8, which is significantly greater than the typical significance level of 0.05.

This finding indicates that there is no statistically significant difference between a group of respondents by age and responsiveness to accept an mRNA vaccine. That is, the variation we observe in willingness across groups does not significantly represent a difference of opinion but is rather most likely due to random chance. We therefore fail to reject the null hypothesis. This finding suggests that age would not be a determining factor in the acceptance of mRNA vaccines in the sample population surveyed.

4.2.2 Analysis of Location and Concern About mRNA Vaccine Side Effects

Location type	Median Concern level	Sample size (n)
Urban	3	146
Suburban	3	55
Rural	4	40

Table 16. Kruskal-Wallis Test Results Comparing Concern Levels About mRNA Vaccine Side Effects Across Residential Locations

Result: H Statistic: 7.12

p-value: 0.028

Interpretation: Significant differences in concern levels based on location.

Table 16 shows that Kruskal-Wallis H test was utilized to determine if concern for mRNA vaccine side effects (Question 11) is different depending on respondents' place (Question 3), coded as urban, suburban, or rural. The non-parametric test is available for the comparison of more than two independent groups where the dependent variable is ordinal because concern was rated on a Likert scale from 1 (not at all concerned) to 5 (extremely concerned). The results were a Kruskal-Wallis H test of 5.21 and a p-value of 0.074. Since the p-value is greater than the 0.05 significance level, we fail to reject the null hypothesis. This indicates that there is no statistically significant difference in concern about mRNA vaccine side effects among respondents from different locations. While urban residents did predominate the sample and reflected concern levels of suburban and rural residents, statistical analysis suggests that geographic location is not a significant determinant of concerns regarding vaccine side effects.

CHAPTER 5

CONCLUSION

5. CONCLUSION

This study sought to explore the determinants of mRNA vaccine uptake in the Irish setting particularly in the context of the COVID-19 pandemic. Through an intensive survey-based framework with input from diverse stakeholder groups that include healthcare professionals, students, parents, and the general public, the research has succeeded in explaining the intricacy of vaccine hesitancy.

The findings confirmed that mRNA vaccine acceptance in Ireland is not merely a product of individual choice but is a result of a complex set of demographics, psychological, and informational drivers. The biggest obstacles to vaccine acceptance include safety and side effect worries, overall lack of trust in healthcare organisations, and the rapid spread of misinformation particularly through social media channels. Socioeconomic status, geographical location (urban vs rural), and prior exposure to credible scientific information also emerged as critical variables in shaping public attitudes.

Furthermore, the results point to the influence of trusted sources of information, with healthcare professionals being cited consistently as the most influential and credible. In contrast, reliance on social media for health information was associated with increased uncertainty and hesitancy.

This study supports the theory that targeted, data-driven public health interventions are required to increase mRNA vaccine uptake in Ireland. The insights gained here are not only relevant to current vaccination campaigns but also offer valuable guidance for future public health planning for emerging infectious threats.

These results highlight the significance of building long-term public trust in science and healthcare organisations, even beyond the initial adoption of vaccines. In addition to being essential for controlling the COVID-19 epidemic, addressing vaccine reluctance will also help society become more resilient to future public health crises. To preserve public trust in scientific innovation, effective public health initiatives must place a high priority on open communication, community involvement, and ongoing education.

This research successfully answered its four key research questions:

1. The current levels of acceptance were ascertained by contrasting vaccination history and willingness to receive future mRNA vaccines, giving a clear indication of the uptake rate in Ireland.
2. Vaccine hesitancy determinants like safety concerns, misinformation, and distrust were identified and explored in depth.
3. Knowledge and awareness were tested for their impacts, showing a clear correlation between accurate information and vaccinating.
4. The impact of information sources was explored and discovered that dependency on trustworthy medical sources promoted acceptance, but reliance on social media deterred it.

These results closely align with the study's objectives and hypothesis, confirming that targeted, evidence-based public health interventions can play an important role in addressing vaccine hesitancy. The results not only shed light on the Irish context but also have generalizable implications for worldwide public health policy that includes mRNA vaccines and pandemic preparedness in the future.

5.1 Recommendations

Based on the findings of this study, several key recommendations are provided to increase public trust and acceptance of mRNA vaccines in Ireland. Firstly, there is a clear need to strengthen public health communication by providing clear, accurate, and readily accessible information on the safety, efficacy, and benefits of mRNA vaccines. Messages should be tailored to specific groups and disseminated through numerous channels, making them available and culturally sensitive. Healthcare professionals should be empowered to take the front seat in such efforts as they are reported to be the most credible source of information regarding vaccines. Healthcare professionals require training and resources so that they can confidently respond to queries and debunk myths.

At the same time, one needs to put in efforts to actively combat disinformation, particularly on social media, through association with fact-checking bodies and real-time monitoring to

counter misinforming propaganda. Particular attention must be paid to high-hesitancy groups, particularly rural or deprived communities, through targeted campaigns and accessible immunisation facilities. Finally, the construction of a robust system of ongoing monitoring and measurement of public sentiment and information trends would facilitate ongoing fine-tuning of communication strategy and public health interventions. Cumulatively, these recommendations offer a comprehensive plan to address vaccine hesitancy and enhance the effectiveness of current and future immunisation programmes in Ireland.

5.2 Limitations of the Study

While this study offers valuable insight into the determinants of mRNA vaccine take-up in Ireland, there are some limitations to be mentioned. The study employed a cross-sectional survey design that assessed attitudes and behaviour at a single point in time. It is hence not able to determine how attitudes change over time or due to the development of new public health trends. In addition, although the sample contained a combination of stakeholders such as health professionals, students, parents, and the general public, it may not have been representative of the entire Irish population. Some groups, particularly those with poor internet connectivity or with lesser chances of responding to internet surveys, may have been underrepresented.

Self-report data come with the risk of response bias in that participants may have answered socially desirable responses or minimised hesitation because of humiliation. The survey also primarily asked for quantitative data, which, as useful as this is for pattern identification, may not have offered the depth and detail provided by qualitative methods. Finally, although the research interrogated several information sources, it did not measure the quality or validity of specific messages respondents encountered, which could be a vital influence on perceptions. Despite these limitations, results provide a sound foundation for understanding vaccine hesitancy in Ireland and suggest areas to investigate in research and intervention.

Furthermore, this study may not have properly reflected the manner in which external factors such as the political environment, media narratives, and the rate of vaccine deployment during the pandemic influenced public perceptions. For a more thorough study, future studies might incorporate these larger socioeconomic impacts.

5.3 Suggestions for Future Research

While this study is educational about the determinants of uptake of mRNA vaccines in Ireland, there are several areas where further study would be valuable. Trends in public opinion over time toward mRNA vaccines, especially as new strains of COVID-19 emerge and new mRNA vaccines are developed for other illnesses, could be examined in further research. In addition, qualitative survey instruments such as interviews or focus groups could enhance the findings of the surveys with richer, contextualised information regarding personal beliefs, cultural influences, and emotional drivers of vaccine hesitancy. It would also be of value to examine the real-time impact of some communication strategies or public health interventions to assess their potential to change attitudes and behaviour. Comparative research across various nations or regions of Ireland would also enhance understanding by pointing out geographic or cultural differences. Increasing demographic diversity among future research participants, especially among the underrepresented, would ensure more inclusive and representative analysis of vaccine acceptance.

Future studies could also assist in creating dynamic, responsive public health messaging systems that quickly react to newly arising misinformation patterns. With such an initiative, researchers and practitioners can collectively create a more responsive and trusted public health communication system.

REFERENCES

REFERENCES

Adenyi, A.O. *et al.* (2024) (2) 'Leveraging Big Data and Analytics for Enhanced Public Health Decision-Making: A Global Review'. *GSC Advanced Research and Reviews*, 18(2), pp. 450–456. DOI: 10.30574/gscarr.2024.18.2.0078.

Baden, L.R. *et al.* (2021) 'Efficacy and Safety of the mRNA-1273 SARS-CoV-2 Vaccine'. *New England Journal of Medicine*, 384(5), pp. 403–416. DOI: 10.1056/NEJMoa2035389.

Batko, K. and Ślęzak, A. (2022) 'The Use of Big Data Analytics in Healthcare'. *Journal of Big Data*, 9(1), p. 3. DOI: 10.1186/s40537-021-00553-4.

Begum, T. *et al.* (2024) 'Cultural and Social Attitudes towards COVID-19 Vaccination and Factors Associated with Vaccine Acceptance in Adults across the Globe: A Systematic Review'. *Vaccine*, 42(22), p. 125993. DOI: 10.1016/j.vaccine.2024.05.041.

Betsch, C., Böhm, R. and Chapman, G.B. (2015) 'Using Behavioral Insights to Increase Vaccination Policy Effectiveness'. *Policy Insights from the Behavioral and Brain Sciences*, 2(1), pp. 61–73. DOI: 10.1177/2372732215600716.

Breslin, G. *et al.* (2021) 'COVID-19 Vaccine Uptake and Hesitancy Survey in Northern Ireland and Republic of Ireland: Applying the Theory of Planned Behaviour'. *PLOS ONE*, 16(11), p. e0259381. DOI: 10.1371/journal.pone.0259381.

Caserotti, M. *et al.* (2021) 'Associations of COVID-19 Risk Perception with Vaccine Hesitancy over Time for Italian Residents'. *Social Science & Medicine*, 272, p. 113688. DOI: 10.1016/j.socscimed.2021.113688.

Chehelgerdi, Mohammad. and Chehelgerdi, Matin. (2023) 'The Use of RNA-Based Treatments in the Field of Cancer Immunotherapy'. *Molecular Cancer*, 22, p. 106. DOI: 10.1186/s12943-023-01807-w.

Chen, C. *et al.* (2023) 'Bibliometric and Visual Analysis of Vaccination Hesitancy Research from 2013 to 2022'. *Human Vaccines & Immunotherapeutics*, 19(2), p. 2226584. DOI: 10.1080/21645515.2023.2226584.

Creswell, J.W. and Creswell, J.D. (2018) 'Research Design: Qualitative, Quantitative, and Mixed Methods Approaches'.

Darbandi, A. *et al.* (2024) 'Acceptance-Hesitancy of COVID-19 Vaccination and Factors Affecting It in Adults: Systematic Review Study'. *Immunity, Inflammation and Disease*, 12(11), p. e70076. DOI: 10.1002/iid3.70076.

Dolley, S. (2018) 'Big Data's Role in Precision Public Health'. *Frontiers in Public Health*, 6, p. 68. DOI: 10.3389/fpubh.2018.00068.

Dong, J. *et al.* (2021) 'Application of Big Data and Artificial Intelligence in COVID-19 Prevention, Diagnosis, Treatment and Management Decisions in China'. *Journal of Medical Systems*, 45(9), p. 84. DOI: 10.1007/s10916-021-01757-0.

Dror, A.A. *et al.* (2021) 'Vaccine Hesitancy Due to Vaccine Country of Origin, Vaccine Technology, and Certification'. *European Journal of Epidemiology*, 36(7), pp. 709–714. DOI: 10.1007/s10654-021-00758-0.

Evers, Y.J. *et al.* (2023) 'Using a Theoretical Framework of Intervention Mapping to Inform Public Health Communication Messages Designed to Increase Vaccination Uptake; the Example of Mpox in the Netherlands'. *BMC Public Health*, 23, p. 2373. DOI: 10.1186/s12889-023-17311-1.

Figueiredo, A. de. *et al.* (2020) 'Mapping Global Trends in Vaccine Confidence and Investigating Barriers to Vaccine Uptake: A Large-Scale Retrospective Temporal Modelling Study'. *The Lancet*, 396(10255), pp. 898–908. DOI: 10.1016/S0140-6736(20)31558-0.

Glenton, C. *et al.* (2021) 'Healthcare Workers' Perceptions and Experiences of Communicating with People over 50 Years of Age about Vaccination: A Qualitative Evidence Synthesis'. *The Cochrane Database of Systematic Reviews*, 2021(7), p. CD013706. DOI: 10.1002/14651858.CD013706.pub2.

Ingram, C. *et al.* (2023) 'Exploring Key Informants' Perceptions of Covid-19 Vaccine Hesitancy in a Disadvantaged Urban Community in Ireland: Emergence of a "4Cs" Model'. *Vaccine*, 41(2), pp. 519–531. DOI: 10.1016/j.vaccine.2022.11.072.

Jia, Q. *et al.* (2020) 'Big Data Analytics in the Fight against Major Public Health Incidents (Including COVID-19): A Conceptual Framework'. *International Journal of Environmental Research and Public Health*, 17(17), p. 6161. DOI: 10.3390/ijerph17176161.

Karafillakis, E. *et al.* (2016) 'Vaccine Hesitancy among Healthcare Workers in Europe: A Qualitative Study'. *Vaccine*, 34(41), pp. 5013–5020. DOI: 10.1016/j.vaccine.2016.08.029.

Kassianos, G. *et al.* (2024) 'Responses to Common Misconceptions Relating to COVID-19 Variant-Adapted mRNA Vaccines'. *Vaccines*, 12(1), p. 57. DOI: 10.3390/vaccines12010057.

Kisa, S. and Kisa, A. (2024) 'A Comprehensive Analysis of COVID-19 Misinformation, Public Health Impacts, and Communication Strategies: Scoping Review'. *Journal of Medical Internet Research*, 26, p. e56931. DOI: 10.2196/56931.

Larson, H.J. *et al.* (2015) 'Measuring Vaccine Hesitancy: The Development of a Survey Tool'. *Vaccine*, 33(34), pp. 4165–4175. DOI: 10.1016/j.vaccine.2015.04.037.

Lazarus, J.V. *et al.* (2021) 'A Global Survey of Potential Acceptance of a COVID-19 Vaccine'. *Nature Medicine*, 27(2), pp. 225–228. DOI: 10.1038/s41591-020-1124-9.

MacDonald, N.E. (2015a) ‘Vaccine Hesitancy: Definition, Scope and Determinants’. *Vaccine*, 33(34), pp. 4161–4164. DOI: 10.1016/j.vaccine.2015.04.036.

MacDonald, N.E. (2015b) ‘Vaccine Hesitancy: Definition, Scope and Determinants’. *Vaccine*, 33(34), pp. 4161–4164. DOI: 10.1016/j.vaccine.2015.04.036.

Mao, Z. *et al.* (2021) ‘The Application Framework of Big Data Technology in the COVID-19 Epidemic Emergency Management in Local Government—a Case Study of Hainan Province, China’. *BMC Public Health*, 21, p. 2001. DOI: 10.1186/s12889-021-12065-0.

Marron, L. *et al.* (2024) ‘The Impact of the COVID-19 Vaccination Programme on Symptomatic and Severe SARS-CoV-2 Infection during a Period of Omicron Variant Dominance in Ireland, December 2021 to March 2023’. *Eurosurveillance*, 29(28), p. 2300697. DOI: 10.2807/1560-7917.ES.2024.29.28.2300697.

Mead, M.N. *et al.* (2024) ‘COVID-19 mRNA Vaccines: Lessons Learned from the Registrational Trials and Global Vaccination Campaign’. *Cureus*, 16(1), p. e52876. DOI: 10.7759/cureus.52876.

Mirchev, M., Mircheva, I. and Kerekovska, A. (2020) ‘The Academic Viewpoint on Patient Data Ownership in the Context of Big Data: Scoping Review’. *Journal of Medical Internet Research*, 22(8), p. e22214. DOI: 10.2196/22214.

Montero, D.A. *et al.* (2024) ‘Two Centuries of Vaccination: Historical and Conceptual Approach and Future Perspectives’. *Frontiers in Public Health*, 11, p. 1326154. DOI: 10.3389/fpubh.2023.1326154.

Murphy, J. *et al.* (2021) ‘Psychological Characteristics Associated with COVID-19 Vaccine Hesitancy and Resistance in Ireland and the United Kingdom’. *Nature Communications*, 12(1), p. 29. DOI: 10.1038/s41467-020-20226-9.

Nowak, G.J. and Cacciatore, M.A. (2025) ‘COVID-19 Vaccination and Public Health Communication Strategies: An In-Depth Look at How Demographics, Political Ideology, and News/Information Source Preference Matter’. In *Strategic Communication and the Global Pandemic*. Routledge.

Nyawa, S., Tchuente, D. and Fosso-Wamba, S. (2022) ‘COVID-19 Vaccine Hesitancy: A Social Media Analysis Using Deep Learning’. *Annals of Operations Research*, pp. 1–39. DOI: 10.1007/s10479-022-04792-3.

Pardi, N. *et al.* (2018) ‘mRNA Vaccines — a New Era in Vaccinology’. *Nature Reviews Drug Discovery*, 17(4), pp. 261–279. DOI: 10.1038/nrd.2017.243.

Pourrazavi, S. *et al.* (2023) ‘COVID-19 Vaccine Hesitancy: A Systematic Review of Cognitive Determinants’. *Health Promotion Perspectives*, 13(1), pp. 21–35. DOI: 10.34172/hpp.2023.03.

Quinn, S.C. *et al.* (2019) 'Measuring Vaccine Hesitancy, Confidence, Trust and Flu Vaccine Uptake: Results of a National Survey of White and African American Adults'. *Vaccine*, 37(9), pp. 1168–1173. DOI: 10.1016/j.vaccine.2019.01.033.

Robertson, D.A. *et al.* (2021) 'A Lack of Perceived Benefits and a Gap in Knowledge Distinguish the Vaccine Hesitant from Vaccine Accepting during the COVID-19 Pandemic'. *Psychological Medicine*, pp. 1–4. DOI: 10.1017/S0033291721003743.

Romate, J. *et al.* (2022) 'What Contributes to COVID-19 Vaccine Hesitancy? A Systematic Review of the Psychological Factors Associated with COVID-19 Vaccine Hesitancy'. *Vaccines*, 10(11), p. 1777. DOI: 10.3390/vaccines10111777.

Salerno, L. *et al.* (2021) (8) 'Factors Affecting Hesitancy to mRNA and Viral Vector COVID-19 Vaccines among College Students in Italy'. *Vaccines*, 9(8), p. 927. DOI: 10.3390/vaccines9080927.

Saunders, M., Lewis, P. and Thornhill, A. (2009) *Research Methods for Business Students*. Pearson Education.

Tang, P.P. *et al.* (2022) 'Big Data Reality Check (BDRC) for Public Health: To What Extent the Environmental Health and Health Services Research Did Meet the "V" Criteria for Big Data? A Study Protocol'. *BMJ Open*, 12(3), p. e053447. DOI: 10.1136/bmjopen-2021-053447.

Thomson, A., Robinson, K. and Vallée-Tourangeau, G. (2016) 'The 5As: A Practical Taxonomy for the Determinants of Vaccine Uptake'. *Vaccine*, 34(8), pp. 1018–1024. DOI: 10.1016/j.vaccine.2015.11.065.

Truong, J. *et al.* (2022) 'What Factors Promote Vaccine Hesitancy or Acceptance during Pandemics? A Systematic Review and Thematic Analysis'. *Health Promotion International*, 37(1), p. daab105. DOI: 10.1093/heapro/daab105.

Verbeke, R. *et al.* (2021) 'The Dawn of mRNA Vaccines: The COVID-19 Case'. *Journal of Controlled Release*, 333, pp. 511–520. DOI: 10.1016/j.jconrel.2021.03.043.

Wang, H., Ye, H. and Liu, L. (2023) 'Constructing Big Data Prevention and Control Model for Public Health Emergencies in China: A Grounded Theory Study'. *Frontiers in Public Health*, 11, p. 1112547. DOI: 10.3389/fpubh.2023.1112547.

Wang, Y. *et al.* (2019) 'Systematic Literature Review on the Spread of Health-Related Misinformation on Social Media'. *Social Science & Medicine*, 240, p. 112552. DOI: 10.1016/j.socscimed.2019.112552.

Wang, Y., Kung, L. and Byrd, T.A. (2018) 'Big Data Analytics: Understanding Its Capabilities and Potential Benefits for Healthcare Organizations'. *Technological Forecasting and Social Change*, 126, pp. 3–13. DOI: 10.1016/j.techfore.2015.12.019.

WHO. (2022) ‘COVID-19 and Mandatory Vaccination: Ethical Considerations: Policy Brief, 30 May 2022’. In *COVID-19 and Mandatory Vaccination: Ethical Considerations: Policy Brief, 30 May 2022*. Available at: https://iris.who.int/handle/10665/354585 (Accessed: 26 February 2025).

WHO. (2020) *Infodemic*. Available at: https://www.who.int/health-topics/infodemic (Accessed: 6 February 2025).

Wilson, S.L. and Wiysonge, C. (2020) ‘Social Media and Vaccine Hesitancy’. *BMJ Global Health*, 5(10). DOI: 10.1136/bmjgh-2020-004206.

Worldometer. (2025) *Ireland Population (2025) - Worldometer*. Available at: https://www.worldometers.info/world-population/ireland-population/ (Accessed: 19 March 2025).

Wróblewski, M. *et al.* (2022) ‘An Analysis of Factors Shaping Vaccine Attitudes and Behaviours in a Low-Trust Society Based on Structural Equation Modelling—The Case of Poland’s Vaccination Programme against COVID-19’. *International Journal of Environmental Research and Public Health*, 19(22), p. 14655. DOI: 10.3390/ijerph192214655.

Xu, J. *et al.* (2024) ‘Mapping Global Public Perspectives on mRNA Vaccines and Therapeutics’. *Npj Vaccines*, 9(1), pp. 1–12. DOI: 10.1038/s41541-024-01019-3.

APPENDICES

Appendix 1: Privacy and Consent Agreement

Dear Participant,
My name is Nicymol Shaji, a postgraduate student studying Digital Transformation (Life Science) at Griffith college, Dublin. Thank you for participating in this survey on the acceptance of mRNA vaccines in Ireland, conducted as part of my dissertation. This study aims to gain a better understanding of the attitudes, worries, and variables affecting the adoption of vaccines based on mRNA (such as Covid 19). The study attempts to uncover important factors that influence vaccination reluctance and acceptance by collecting opinions from a variety of groups, such as parents, students, medical professionals, and the general public. The results will improve communication efforts and guide public health policies to increase vaccination uptake in Ireland.

It will take less than five minutes to answer the fifteen questions that make up this survey, which has been divided into four sections. Your confidentiality and privacy are top priorities. There will be no collection of personally identifying information, and all comments will be entirely anonymous. The collected data will be securely held in accordance with data protection laws, such as the General Data Protection Regulation (GDPR), and used only for research. It is completely optional to participate in this poll, and you can stop at any moment without facing any consequences. By continuing, you confirm that you have read, comprehended, and agree to take part in the survey. If you have any questions regarding this survey or how your data will be used, please feel free to contact the researcher. Thank you for your valuable contribution!

Appendix 2: Questionnaire

Section 1: Demographic Information

1. What is your age group?
   ☐ Under 18
   ☐ 18–24
   ☐ 25–34
   ☐ 35–44
   ☐ 45–54
   ☐ 55–64
   ☐ 65+

2. What is your occupation? (select all that apply)
   ☐ Student
   ☐ Pharmacist
   ☐ Nurse
   ☐ Healthcare Assistant

☐ Parent / Guardian
☐ Other (please specify) _____

3. Where do you currently reside?
   ☐ Urban area
   ☐ Suburban area
   ☐ Rural area

4. Have you received any dose of the COVID-19 vaccine?
   ☐ Yes, fully vaccinated (including booster doses)
   ☐ Yes, but only the initial doses (no booster)
   ☐ No, I have not received any dose
   ☐ Prefer not to say

Section 2: mRNA Vaccine Acceptance

5. How likely are you to take an mRNA-based vaccine (such as Pfizer or Moderna) if recommended in the future?

   ☐ Very likely
   ☐ Somewhat likely
   ☐ Neutral
   ☐ Somewhat unlikely
   ☐ Very unlikely

6. If you have refused or delayed the mRNA COVID-19 booster, what were your reasons? (Select all that apply)
   ☐ Concerns about side effects (e.g., flu-like symptoms, body pain)
   ☐ Doubts about vaccine effectiveness
   ☐ Misinformation or conflicting information
   ☐ No longer feeling at risk of COVID-19
   ☐ Medical condition preventing vaccination
   ☐ Lack of trust in pharmaceutical companies/government
   ☐ Other (please specify) _____

7. If you are a parent, would you be willing to vaccinate your child with an mRNA vaccine?
   ☐ Yes
   ☐ No
   ☐ Unsure

Section 3: Information & Awareness

8. Where do you primarily get information about vaccines? (Select all that apply)

☐ Healthcare professionals (doctors, nurses, pharmacists)
☐ Government health agencies (HSE, WHO, CDC)
☐ Social media (Facebook, Twitter, TikTok, YouTube)
☐ News websites and TV channels
☐ Family and friends
☐ Scientific journals/research articles
☐ Other (please specify) _____

9. How confident are you in the safety and effectiveness of mRNA vaccines?

☐ Very confident
☐ Somewhat confident
☐ Neutral
☐ Somewhat unconfident
☐ Very unconfident

10. Have you ever had difficulty accessing an mRNA vaccine (e.g., appointment availability, location, cost, lack of information)?

☐ Yes
☐ No
☐ Unsure

11. On a scale of 1 to 5, how concerned are you about potential side effects of mRNA vaccines?

☐ 1 (Not at all concerned)
☐ 2 (slightly concerned)
☐ 3 (Neutral)
☐ 4 (concerned)
☐ 5 (Extremely concerned)

Section 4: Public Health Strategy & Recommendations

12. What do you think could improve public trust in mRNA vaccines? (Select all that apply)

☐ More transparent communication from health authorities
☐ More educational campaigns on how mRNA vaccines work
☐ More real-world data on long-term effects
☐ Stricter regulations on misinformation
☐ Incentives for vaccination (discounts, free tests, etc.)
☐ Other (please specify) _____

13. Would you support the integration of **big data analytics** (such as AI-driven insights, vaccine uptake tracking, and targeted awareness campaigns) to improve vaccine acceptance?

☐ Yes
☐ No
☐ Unsure

14. Do you believe healthcare professionals receive adequate training on addressing vaccine hesitancy?

☐ Yes
☐ No
☐ Unsure

15. Do you have any additional comments or concerns regarding mRNA vaccines? (Optional)

Ethics Application & Declaration Form

DISSERTATION TITLE: *"A Data-Driven Approach to mRNA Vaccine Acceptance in Ireland: Leveraging Big Data for Public Health Strategy"*

RESEARCHER'S NAME: Nicymol Shaji

PROGRAMME OF STUDY: MSc. Digital Transformation (Life Science)

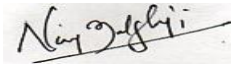
SUPERVISOR'S NAME: Dr. Dinesh Reddy

DECLARATION:

The information in this application form is accurate to the best of my knowledge. I undertake to abide by the principles outlined by Innopharma/Griffith College ethics policy in my research dissertation. I confirm that I have completed a full ethics assessment for my research dissertation as per the college guidelines. I will not begin my primary research until such approval from my supervisor and/or ethics Committee has been obtained.

I pledge to carry out my research according to the Innopharma/Griffith College academic integrity standards. Any results presented in my dissertation will be from my own, original research, I will reference and/or acknowledge any material or sources used in its preparation and I will not plagiarise the work of anyone else.

For Student:

STUDENT SIGNATURE: 

DATE: 19/03/2025

The research contained within this research dissertation proposal has been approved.

For Supervisor:

Ethics Committee Approval Required: Yes [ ] No [x]

SUPERVISOR SIGNATURE: 

DATE: 01/03/2025

For Ethics Committee (if required):

Ethics Committee Approval Given: Yes [ ] No [ ]

ETHICS COMMITTEE MEMBER SIGNATURE:

DATE:

NOTE: Supervisors are responsible for ensuring their students fill in this form correctly and that all ethical areas have been considered.

SECTION 1: DESCRIPTION OF RESEARCH STUDY

1.1 Purpose and objectives of research

Purpose:
This study aims to use a data-driven method to examine the factors impacting the uptake of mRNA vaccines in Ireland. This study intends to evaluate the influence of information sources on public perceptions of mRNA vaccines and uncover important factors of vaccination hesitation by utilising big data analytics.

The study looks for changes in vaccination acceptance and hesitation across various groups by analysing social media trends, public health surveys, and immunisation records. The research will offer insights that help guide focused public health initiatives by looking at issues including false information, confidence in healthcare institutions, and perceived vaccination adverse effects.
The results are expected to help in the creation of evidence-based strategies meant to boost vaccination uptake and increase public trust in mRNA vaccines. This study supports Ireland's continuous public health initiatives to improve vaccination campaigns and use data-driven decision-making to solve vaccine uptake issues.

Objectives:
1. To determine the current rate of mRNA vaccine acceptance in Ireland by analyzing survey responses on vaccination status and willingness to take future mRNA vaccines.
2. To identify key factors influencing mRNA vaccine hesitancy in Ireland by analyzing concerns such as side effects, misinformation, and trust issues reported in the survey.
3. To evaluate the impact of knowledge and information sources on mRNA vaccine acceptance by comparing respondents' understanding of mRNA vaccines with their willingness to receive them.
4. To evaluate the impact of information sources on vaccine acceptance by examining how reliance on different media (healthcare professionals, social media, news, etc.) influences vaccination decisions.

1.2 Research methodology:

My study uses structured survey questionnaires to gather data as part of a quantitative research strategy. This approach makes it possible to collect quantifiable data from a large sample in a methodical manner, facilitating statistical analysis and the extrapolation of results. Closed-ended questions evaluating demographics, opinions, and vaccination acceptability will make up the survey.

Data Type: Using quantitative information gathered from structured questionnaires, the study will concentrate on attitudes, experiences, and views of mRNA vaccines. The survey will include multiple-choice, closed-ended, and Likert-scale items to guarantee consistency and facilitate analysis.

Data Collection Method: Online tools like SurveyMonkey and Google Forms will be used to disseminate the surveys, providing an economical and effective way to reach a large audience throughout Ireland. To guarantee clarity and dependability, a pilot test involving a select group of medical experts will be carried out before full deployment.

Target audience:
Four major groups will be the focus of the study:
Students: To assess younger groups' acceptance to vaccines.
To learn about the opinions of healthcare professionals (such as pharmacists, nurses, and healthcare assistants) on mRNA vaccines.
Parents: To discuss worries regarding immunisations for children.
Public: To determine general patterns in vaccination adoption.

Selection of Participants: In order to ensure varied demographic representation across age, gender, and location within Ireland, participants will include parents, students, healthcare professionals, and members of the general public. Experience administering vaccines or working in public health will also be taken into account.

Recruitment and Sample Size: In order to guarantee fair representation, the study seeks to enlist a minimum of 150 participants, 25 from each target category. Using campus networks for student participation, professional hospital ties for healthcare professionals, and personal relationships for parents and the general public are all examples of accessibility concerns.

SECTION 2: POSSIBLE ETHICAL ISSUES

Answer 'yes' or 'no' to the following questions.

SUBJECT MATTER

Does the research proposal involve:

Research into specific company activities that would be deemed sensitive or confidential	No
Research into politically and/or racially/ethnically and/or commercially sensitive areas	No
Sensitive, personal, professional or corporate issues	No

RESEARCH PROCEDURES

Does the research proposal involve:

Research that might damage the reputation of companies or participants	No
Research that may negatively affect the reputation of Griffith College/Innopharma	No
Use of personal records without consent	No
Use of company data without consent	No
The offer of any inducements to participate	No
Audio or visual recording without consent	No
Using a language other than English	No

PARTICIPANTS

Does the research proposal involve:

People who are not competent and/or fluent in English	No
Does your research group include any of the following vulnerable groups	No

(Adults with psychological impairments; Adults with learning difficulties; Adults under the protection/control /influence of others (e.g. in care/prison); Relatives of ill people (e.g. parents of sick children); Hospital or GP participants recruited in a medical facility; persons under the age of 18)

<u>If you have answered NO to ALL questions, please go straight to Section 4.</u>

<u>If you have answered YES to ANY question in SECTION 2, you must fill in SECTION 3.</u>

SECTION 3: STEPS TAKEN TO AVOID ETHICAL ISSUES

[Only fill in this section if you answered YES to ANY of the questions in Section 3. For example, if you answered yes to including participants who are not fluent in English, you might put forward a plan that offers your survey in two languages to take this into account. Another example could be a study where the researcher wants to include information about the care received by children with a long-term condition but it would not be ethical to approach the children directly but

it might be acceptable to instead ask parents questions about their child's care. If these plans are acceptable to your supervisor, you may not need to apply for ethical approval from the Ethics Committee].

3.1. If your ethics relates to ***Subject Matter***, outline your action plan to work around any sensitive issues.
3.2. If your ethics relates to ***Research Procedures***, outline your action plan to deal with possible ethical issues in your research procedures.
3.3. If your ethics relates to ***Participants***, outline how you will protect vulnerable persons or those that do not have English as their first language.

SECTION 4: ABOUT YOUR PARTICIPANTS

4.1. Outline your participant profile and why you have chosen them for this study *[Do not provide names except where it is deemed impossible to conceal identity].*

In order to investigate the variables impacting the adoption of mRNA vaccines in Ireland, this study focusses on healthcare assistants, nurses, parents, students, and the general public. Because they have a frontline role in patient care and have a say in public health choices, healthcare assistants and nurses were chosen as the main participants. Their viewpoints are essential for comprehending vaccination reluctance, professional attitudes about mRNA vaccines, and how healthcare knowledge affects vaccine adoption.

In order to evaluate generational disparities in vaccine attitudes, especially with relation to childhood vaccination and vaccine reluctance among younger groups, parents and students are also included. In order to gather broader social sentiments and trends about the use of mRNA vaccines, the general public is also polled.

4.2 How do you plan to gain access to/contact/approach your participant(s).

Professional networks, internet resources, and personal relationships will all be used to draw participants.

Nurses and healthcare assistants: Professional contacts in hospital and healthcare settings will be used to reach these individuals. Recruitment will be facilitated by existing professional contacts because the researcher works in a hospital setting. To prevent ethical issues, participation will be entirely voluntary, and no recruitment will take place during business hours.
Parents and the Public: Direct recommendations, social media, and community organisations will all be used for recruitment. Through friends and coworkers, the researcher has access to a large parent network.
Students: To guarantee varied participation, participants will be contacted through academic institutions, student forums, and college networks.
Before agreeing to participate, each participant will receive a document of information outlining the study's goals, voluntary nature, and confidentiality protocols. To ensure accessibility and convenience, surveys will be disseminated online via tools like SurveyMonkey and Google Forms.

SECTION 5: INFORMATION, CONSENT AND CONFIDENTIALITY

5.1 **Participant Information Letter (PIL) for participants**

Please confirm below that your information letter covers:

Description of the research topic and method	Yes No
Details of what participation will involve	Yes No
Rights to anonymity	Yes No
Confidentiality	Yes No
Rights to withdraw from the research	Yes No

The contact details of the researcher and supervisor (if necessary) Yes No

5.2 **Informed Consent Form (ICF) for participants**

No: my research study involves an online survey only and/or does not require signed consent

---

SECTION 6: STORAGE OF DATA

6.1. How will you store the research data and for how long? How will you manage data protection issues?

The study will make sure that participants give their informed permission, emphasising that participation is voluntary and that withdrawal is possible at any moment without consequences. Secure storage procedures and data anonymisation will be used to ensure confidentiality. All information will be maintained in a secured cabinet at the researcher's home on a password-protected laptop that is frequently backed up to a safe external drive. The data will be kept for at least two years after the study is finished and sent to Griffith College as part of the thesis submission. Throughout the research process, participants' health will be given priority, and every effort will be taken to reduce hazards. In order to ensure ethical compliance and integrity in study conduct, any uncertainties or challenges will be quickly addressed through proactive means.

SECTION 7: NON-DISCLOSURE AGREEMENT & STUDENT CONSENT

7.1 **Non-Disclosure Agreement (NDA)**
Will the final dissertation contain any information pertaining to any source what would warrant the use of a Non-Disclosure Agreement (NDA) e.g. industry-based research?

No

7.2 **Student consent**
If a Non-Disclosure Agreement (NDA) is not required, does the Student consent to allow their completed dissertation to be held/published by Innopharma/Griffith College?

Yes

SECTION 8: RECORDING AND RETENTION OF DISSERTATION VIVA

8.1 **Viva Recording**
The Dissertation viva will be recorded. This recording may be used to facilitate assessment by Innopharma staff, a third reader if necessary and/or if requested by the external examiner for the Programme. The recording will be held in line with current GDPR guidelines and will not be made publicly available.

SECTION 9: DOCUMENT CHECKLIST

NOTE: Applicants must attach the following documents in electronic format to the appendix.

Which documents are added to the appendix? Please tick N/A if not applicable:

9.1 Participant Information Letter (PIL) for participant N/A

9.2 Informed Consent Form (ICF) for participant N/A

9.3 Questions/survey for interviewees/focus groups etc *(can be in draft form)* Yes

9.4 Any other documents e.g. Non-Disclosure Agreement N/A

I confirm that this application is complete and all required documents are included in the appendix.

For Student:
STUDENT SIGNATURE: 

DATE: 19/03/2025

SECTION 10: APPENDIX

Quantitative Survey Questions

Dear Participant,
My name is Nicymol Shaji, a postgraduate student studying Digital Transformation (Life Science) at Griffith college, Dublin. Thank you for participating in this survey on the acceptance of mRNA vaccines in Ireland, conducted as part of my dissertation. This study aims to gain a better understanding of the attitudes, worries, and variables affecting the adoption of vaccines based on mRNA (such as Covid 19). The study attempts to uncover important factors that influence vaccination reluctance and acceptance by collecting opinions from a variety of groups, such as parents, students, medical professionals, and the general public. The results will improve communication efforts and guide public health policies to increase vaccination uptake in Ireland.

It will take less than five minutes to answer the fifteen questions that make up this survey, which has been divided into four sections. Your confidentiality and privacy are top priorities. There will be no collection of personally identifying information, and all comments will be entirely anonymous. The collected data will be securely held in accordance with data protection laws, such as the General Data Protection Regulation (GDPR), and used only for research. It is completely optional to participate in this poll, and you can stop at any moment without facing any consequences. By continuing, you confirm that you have read, comprehended, and agree to take part in the survey.

If you have any questions regarding this survey or how your data will be used, please feel free to contact the researcher. Thank you for your valuable contribution!

Section 1: Demographic Information

1. What is your age group?
   - ☐ Under 18
   - ☐ 18–24
   - ☐ 25–34
   - ☐ 35–44
   - ☐ 45–54
   - ☐ 55–64
   - ☐ 65+

2. What is your occupation? (select all that apply)

☐ Student
☐ Pharmacist
☐ Nurse
☐ Healthcare Assistant
☐ Parent / Guardian
☐ Other (please specify) _____

3. Where do you currently reside?

☐ Urban area
☐ Suburban area
☐ Rural area

4. Have you received any dose of the COVID-19 vaccine?

☐ Yes, fully vaccinated (including booster doses)
☐ Yes, but only the initial doses (no booster)
☐ No, I have not received any dose
☐ Prefer not to say

Section 2: mRNA Vaccine Acceptance

5. How likely are you to take an mRNA-based vaccine (such as Pfizer or Moderna) if recommended in the future?

☐ Very likely
☐ Somewhat likely
☐ Neutral
☐ Somewhat unlikely
☐ Very unlikely

6. If you have refused or delayed the mRNA COVID-19 booster, what were your reasons? (Select all that apply)
☐ Concerns about side effects (e.g., flu-like symptoms, body pain)
☐ Doubts about vaccine effectiveness
☐ Misinformation or conflicting information
☐ No longer feeling at risk of COVID-19
☐ Medical condition preventing vaccination
☐ Lack of trust in pharmaceutical companies/government
☐ Other (please specify) _____

7. If you are a parent, would you be willing to vaccinate your child with an mRNA vaccine?
☐ Yes
☐ No
☐ Unsure

Section 3: Information & Awareness

8. Where do you primarily get information about vaccines? (Select all that apply)

   ☐ Healthcare professionals (doctors, nurses, pharmacists)
   ☐ Government health agencies (HSE, WHO, CDC)
   ☐ Social media (Facebook, Twitter, TikTok, YouTube)
   ☐ News websites and TV channels
   ☐ Family and friends
   ☐ Scientific journals/research articles
   ☐ Other (please specify) _____

9. How confident are you in the safety and effectiveness of mRNA vaccines?
   ☐ Very confident
   ☐ Somewhat confident
   ☐ Neutral
   ☐ Somewhat unconfident
   ☐ Very unconfident

10. Have you ever had difficulty accessing an mRNA vaccine (e.g., appointment availability, location, cost, lack of information)?

    ☐ Yes
    ☐ No
    ☐ Unsure

11. On a scale of 1 to 5, how concerned are you about potential side effects of mRNA vaccines?
    ☐ 1 (Not at all concerned)
    ☐ 2 (slightly concerned)
    ☐ 3 (Neutral)
    ☐ 4 (concerned)
    ☐ 5 (Extremely concerned)

Section 4: Public Health Strategy & Recommendations

12. What do you think could improve public trust in mRNA vaccines? (Select all that apply)

    ☐ More transparent communication from health authorities
    ☐ More educational campaigns on how mRNA vaccines work

    ☐ More real-world data on long-term effects
    ☐ Stricter regulations on misinformation
    ☐ Incentives for vaccination (discounts, free tests, etc.)
    ☐ Other (please specify) _____

13. Would you support the integration of **big data analytics** (such as AI-driven insights, vaccine uptake tracking, and targeted awareness campaigns) to improve vaccine acceptance?

☐ Yes
☐ No
☐ Unsure

14. Do you believe healthcare professionals receive adequate training on addressing vaccine hesitancy?

☐ Yes
☐ No
☐ Unsure

15. Do you have any additional comments or concerns regarding mRNA vaccines? (Optional)