Changes to primary care delivery during the COVID-19 pandemic and perceived impact on medication safety: A survey study

Laura L. Gleeson [a], Aoife Ludlow [a], Emma Wallace [b], Rob Argent [a], Claire Collins [c], Barbara Clyne [b], Lisa Mellon [d], James W. Barlow [e], Benedict Ryan [a], Aoife De Brún [f], Alice Holton [a], Muriel Pate [g], Ciara Kirke [g], Michelle Flood [a,1], Frank Moriarty [a,1,*]

[a] School of Pharmacy and Biomolecular Sciences, RCSI University of Medicine and Health Sciences, Dublin, Ireland
[b] Department of General Practice, RCSI University of Medicine and Health Sciences, Dublin, Ireland
[c] Research Unit, Irish College of General Practitioners, Dublin, Ireland
[d] Division of Population Health Sciences, RCSI University of Medicine and Health Sciences, Dublin, Ireland
[e] Department of Chemistry, RCSI University of Medicine and Health Sciences, Dublin, Ireland
[f] UCD Centre for Interdisciplinary Research, Education and Innovation in Health Systems (UCD IRIS), School of Nursing, Midwifery & Health Systems, University College Dublin, Ireland
[g] National Medication Safety Programme, National Quality and Patient Safety Directorate, Health Service Executive, Ireland

ARTICLE INFO

ABSTRACT

Introduction: The COVID-19 pandemic has had a profound impact on the delivery of primary care around the world. In Ireland, the use of technologies such as virtual consultations and the electronic transfer of prescriptions became widespread in order to deliver care to patients while minimising infection risk. The impact of these changes on medication safety is not yet known.

Objectives: The aims of this survey study were to investigate 1) the changes that have occurred in Irish primary care since the start of the COVID-19 pandemic and 2) the impact of these changes on medication safety.

Methods: Anonymous, online surveys were distributed to general practitioners (GPs) and pharmacists from August–September 2021. Surveys contained quantitative (multiple-choice, Likert scale) and qualitative (free-text) questions concerning workflow changes, medication safety incidents and near misses, and GP/pharmacist perspectives on medication safety and COVID-19. Reported medication safety incidents and near misses were categorised according to the WHO Conceptual Framework for the International Classification for Patient Safety.

Results: In total, there were 251 responses to the survey, comprising of 211 pharmacists and 40 GPs. The most significant workflow changes during the pandemic were the widespread use of a secure clinical email service (Healthmail) that facilitates electronic prescription transfer and communication (75.3% of respondents) and the increased use of telephone consultations (49%). Overall, Healthmail was widely perceived to have had a positive impact on medication safety. Most GPs did not perceive a change in the frequency of medication safety incidents during the pandemic, while most pharmacists reported a slight increase in incidents. Survey participants highlighted pressure, patient expectations, and patient monitoring as significant challenges encountered during the pandemic.

Conclusions: During the pandemic, a number of significant changes occurred in primary care in Ireland, particularly involving communication of healthcare information, with varying impacts on workflow and medication safety. Future research should focus on the optimisation of electronic prescribing and telemedicine services in Ireland, patient perspectives on the changes in primary care, and interventions to improve medication safety in primary care.

1. Introduction

Medicines are the most common intervention used to maintain and improve health in primary care.[1] The COVID-19 pandemic has had a profound impact on the long-established practices of safe prescribing, dispensing and management of medicines around the world.[2] In Ireland, supported by legislative and policy amendments, technologies such as virtual consultations and the electronic transfer of prescriptions, and services such as the home delivery of medicines, became widely used to reduce the spread of COVID-19 in healthcare settings.[3,4] While these changes served an

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important and timely role in reducing spread of the virus, they reduced opportunities for traditional face-to-face interaction and informal communication between patients and healthcare professionals about safe medicines use.[5]

In 2017, the World Health Organisation announced its third Global Patient Safety Challenge, *'Medication without Harm'*, which aims to reduce the worldwide level of severe, avoidable harm related to medications by 50% over 5 years.[6] However, despite increased awareness and an increased focus on patient safety research in recent years as recently as 2019, the WHO estimated that 1 in every 300 patients dies due to a preventable medical accident, and that up to 4 in 10 patients suffer an adverse event while receiving primary or ambulatory care.[7] Medication safety incidents, defined as any preventable event that may cause or lead to inappropriate medication use or patient harm, can occur at any stage during the prescribing, compounding, dispensing, administration, education, monitoring and use of medicines.[8]

An early finding of patient safety research was the need to adopt a proactive approach to safety in healthcare, rather than reacting every time a medication safety incident occurs.[9] Risk management should be an integral part of the work of a healthcare organisation and members should always be aware of risks that could occur. The delivery of primary care in Ireland and other countries changed rapidly at the start of the COVID-19 pandemic; however the impact of these changes on medication safety is not yet clear.[10] Many of these changes may persist as the COVID-19 pandemic continues and potentially beyond, hence it is important to examine and understand their impact. The aims of this survey study were: 1) to investigate how Irish primary care has changed since the start of the COVID-19 pandemic and 2) to examine the perceived impact these changes could have on medication safety.

2. Methods

2.1. Study design and participants

This was a cross-sectional study of community pharmacists and general practitioners (GPs) using an online anonymous survey. Ethical approval for the study was granted by the Research Ethics Committee of the Royal College of Surgeons in Ireland (REC No. 202105021). Electronic copies of the surveys were shared on social media (Twitter and LinkedIn) over a four-week period in August and September 2021, inviting community pharmacists and GPs to take part. There are approximately 6800 pharmacists and 2500 GPs in Ireland currently. An invitation to the survey was also distributed to community pharmacists via the Pharmaceutical Society of Ireland (PSI) email list. Eligibility criteria were being a registered pharmacist/ physician and being in active practice as a community pharmacist/GP in Ireland since January 2020 (to ensure participants had experience of primary care practice prior to the introduction of the COVID-19 public health measures in March 2020). Participants confirmed their eligibility and provided consent at the outset of the survey. Participation in the survey was voluntary, with no incentive offered, and an indicative time for completion of 10 min was given to participants.

2.2. Concepts and definitions

For the purposes of this paper, the term 'telemedicine' will refer to the use of technology to deliver healthcare at a distance, the term 'virtual consultations' will refer to the use of telephone and video consultations to deliver care to patients, and 'primary care' refers to general practice and community pharmacy. 'Healthmail' refers to a secure clinical email service which was introduced in Ireland in 2014 to transfer patient information. Healthmail did not become widely used until 2020, when legislative changes allowed prescriptions to be transferred electronically for the first time, via the service, and it was integrated into GP prescribing software.[11,12] Prior to the pandemic, community pharmacist practice in Ireland included reviewing, reconciliation and dispensing medications, patient counselling, managing minor ailments,

and influenza and pneumococcal vaccinations.[13] This scope of practice was formally extended to dispense prescriptions transferred electronically via Healthmail, apply professional judgement to dispense a prescription up to 9 months after its date of issue (compared to the previous validity of 6 months) and administer COVID-19 vaccines from July 2021.

2.3. Data collection

A specific survey was designed for each participant group to investigate their attitudes and experiences regarding the impact of the COVID-19 pandemic on medication safety in primary care (Appendices 1 and 2). Informed consent was obtained from respondents in the first page of the survey, where they were presented with study information, and at the end, asked to tick several boxes to confirm they consented to participate (see Appendices 1 and 2). Surveys were developed with input from pharmacist and GP members of the research group, including piloting. Each survey was delivered via SurveyMonkey® and consisted of four sections containing a combination of multiple-choice, Likert scale and free-text questions:

1. Demographics
2. Workflow Changes and COVID-19
3. Medication Safety Incidents and Near Misses
4. Opinions on Medication Safety and COVID-19

The following demographic information was collected in Section 1: gender, age group, and practice/pharmacy location. In Section 2, respondents were asked what new services/technologies were introduced into their practice during the pandemic, e.g., home delivery of medicines, electronic transmission of prescriptions and video or telephone consultations, and the perceived impact on medication safety. In Section 3, respondents were given definitions for medication safety incidents and near misses, asked whether they had been involved in either in the past 8 weeks and, if so, to provide details. Finally, in Section 4, Likert-scaled and free-text questions assessed the perceived impact of the COVID-19 pandemic on medication safety. 'Not applicable' and 'Don't know' options were included for all questions, and no mandatory responses were required. Key differences between the GP and pharmacist surveys were that GPs were additionally asked about the impact of the COVID-19 pandemic on laboratory and other monitoring relating to patients' medications, with other questions relating to services and technologies tailored to the practice setting i.e. only pharmacists were asked about home delivery of medicines.

2.4. Data analysis

Quantitative data analyses were conducted using Stata version 17 (StataCorp, College Station, Texas, USA). Descriptive statistics were generated for all quantitative survey questions, separately for pharmacist and GP respondents. The medication safety incidents and near misses reported by respondents in Section 3 were categorised according to the WHO Conceptual Framework for the International Classification for Patient Safety (ICPS).[14]

No hypothesis testing was specified a priori. As a post-hoc analysis, Spearman's rank correlation and Kendall's tau correlation were computed to assess the relationship between answers to the question *'In your opinion, how have the number of medication safety incidents in your practice changed since the COVID-19 pandemic?'* and responses to the following two statements: 1) *'In this practice/pharmacy, we are open to embracing new technologies in our work processes'* and 2) *'In this practice/pharmacy, we are open to embracing workflow changes to improve medication safety'*. The responses to each of these questions were 5-point Likert scales. For the purposes of these tests, the responses for pharmacists and GPs were combined and a significance level of $p \leq 0.05$ was adopted.

Using conventional content analysis, responses to free-text survey questions were reviewed and grouped into categories reflecting the attitudes of survey respondents towards the impact of COVID-19 on medication safety.

2.5. Patient and public involvement

Patients provided input in identifying and prioritising the focus of the project at the design stage through short interviews with a small number of patients, designed to gather information to guide study priorities and enhance potential impact for patients. This initial work identified that people's usual routines for engaging with primary care had been significantly disrupted by logistical changes and feeling fearful about exposure to COVID-19 when in healthcare facilities. It was noted that while some impacts have been positive e.g. medicines delivery for regular prescriptions, there were concerns about how to access information about medicines and supplements. This helped to shape the research questions of this study in focusing on changes to primary care delivery and medication safety.

3. Results

3.1. Demographics

In total, there were 251 responses to the survey, comprising of 211 pharmacists and 40 GPs. Demographic information about survey respondents are presented in Table 1. The majority of respondents were female (*n* = 162, 64.5%), aged 30–49 (*n* = 170, 67.8%), and based in a town (population 1500-49,999) (*n* = 130, 51.8%). Most GPs worked in a group practice (*n* = 34, 85%), while most pharmacists worked in an independent pharmacy (*n* = 93, 44.1%).

3.2. Workflow changes

The most widely introduced workflow change across both subgroups was the use of Healthmail (*n* = 182, 72.5%), followed by telephone consultations (*n* = 123, 49%). Detailed results regarding the categories and sub-categories of new services introduced during the COVID-19 pandemic are presented in Appendix 3. The most common new service introduced by pharmacists was 'Electronic receipt of prescriptions via Healthmail' (*n* = 151, 71.6%), followed by 'Communication with other healthcare professionals via Healthmail' (*n* = 147, 60.7%). The most common new services introduced

Table 1
Demographics.

	Pharmacist (*n* = 211)	Pharmacist (%)	GP (*n* = 40)	GP (%)	Total (*n* = 251)	Total (%)
Gender						
Male	68	32.2	17	42.5	85	33.9
Female	140	66.4	22	55.0	162	64.5
Non-Binary or Prefer not to say[a]	3	1.4	1	2.5	4	1.6
Age						
<30	13	6.2	1	2.5	14	5.6
30–39	71	33.6	14	35.0	85	33.9
40–49	73	34.6	12	30.0	85	33.9
50–59	37	17.5	11	27.5	48	19.1
>60	17	8.1	2	5.0	19	7.6
Location						
City	68	32.2	19	47.5	87	34.7
Town	116	55.0	14	35.0	130	51.8
Village	27	12.8	7	17.5	34	13.5
Practice type						
Single-handed			5	12.5		
Group			34	85.0		
Other			1	2.5		
Pharmacy type						
Independent	93	44.1				
Small Group	29	13.7				
Large Group	49	23.2				
Chain	27	12.8				
Other	13	6.2				

[a] Categories combined for reporting due to low numbers in sub-groups.

by GPs during the COVID-19 pandemic were 'Electronic transmission of prescriptions via Healthmail' and 'Phone consultations for COVID-19 screening', each of which were introduced by 77.5% of GP respondents (*n* = 31).

Fig. 1 shows the effect of new services on medication safety, as perceived by pharmacist and GP respondents. The service that was perceived by most pharmacists who used it to have a positive effect on medication safety was 'Healthmail, for electronic prescription transfer and/or HCP communications' (*n* = 96, 45.1%), while the service most perceived to have a negative effect was 'Telephone Consultations' (*n* = 13, 6.2%). Similarly for GPs, 'Healthmail, for electronic prescription transfer and/or HCP communications' was perceived by the highest percentage of respondents who introduced it to have a positive effect on medication safety (*n* = 27, 67.5%), while the service most perceived to have a negative effect was 'Email Consultations' (*n* = 5, 12.5%).

Table 2 presents a selection of survey respondents' comments on the impact of the most widely introduced changes, Healthmail and virtual consultations, on medication safety. Participants reported that Healthmail had a significant impact on pharmacists' workflow, allowing prescriptions to be prepared in advance of the patient arriving at the pharmacy, and both pharmacists and GPs agreed that Healthmail had a positive impact on interprofessional communication. However, pharmacists also commented that paperwork associated with Healthmail could increase their workload, and that Healthmail lacked the advantages of a fully integrated electronic prescribing system. Similarly, while there were advantages to virtual consultations, especially during a pandemic, both GPs and pharmacists acknowledged that they could not substitute face-to-face care, due to a lack of physical examinations and visual cues.

3.3. Medication safety incidents and near misses

Of 211 pharmacist respondents, 73 (34.6%) reported being involved in a medication safety incident in the past 8 weeks of their practice, while 114 (53.3%) reported being involved in a near miss. Three GP respondents (7.5%) reported being involved in a medication safety incident in the past 8 weeks of their practice, and ten (25.0%) reported being involved in a near miss.

In total, 92 pharmacists provided information on the type of medication safety incident or near miss in which they were involved. Two incidents involved more than one type of error, therefore 94 incident types were categorised according to the ICPS (Fig. 2). 'Wrong Dose/Strength/Frequency' was the incident type most commonly reported by pharmacists (*n* = 39, 41.5%), followed by 'Wrong Drug' (*n* = 27, 28.7%). Only eight GPs provided information on the type of medication safety incident or near miss in which they were involved; these results were not analysed due to the small sample size.

3.4. Medication safety and COVID-19

When asked 'In your opinion, how has the number of medication safety incidents in your practice changed since the COVID-19 pandemic?', 39.3% of pharmacists (*n* = 83) felt there had been an increase in medication safety incidents, 31.8% felt that there had been no change (*n* = 67), and 16.1% felt there had been a decrease (*n* = 34). More than one third of GPs (35.0%, *n* = 14) felt there had been an increase in medication safety incidents, while 27.5% felt there had been no change (*n* = 11), and 20.0% felt there had been a decrease (n = 8) (Fig. 3).

Fig. 4 shows the responses of GPs to the questions 'To what extent has the COVID-19 pandemic impaired the ability to ensure appropriate laboratory monitoring relating to your patients' medications?' and 'To what extent has the COVID-19 pandemic impaired the ability to appropriately conduct other monitoring (e.g. blood pressure monitoring) relating to your patients' medications?'. Most GP respondents reported some degree of impairment to monitoring, with nearly half (*n* = 19, 47.5%), reporting that the COVID-19 pandemic had moderately impaired laboratory monitoring of patients' medications, while 37.5% (*n* = 15) felt that other types of monitoring had been moderately impaired.
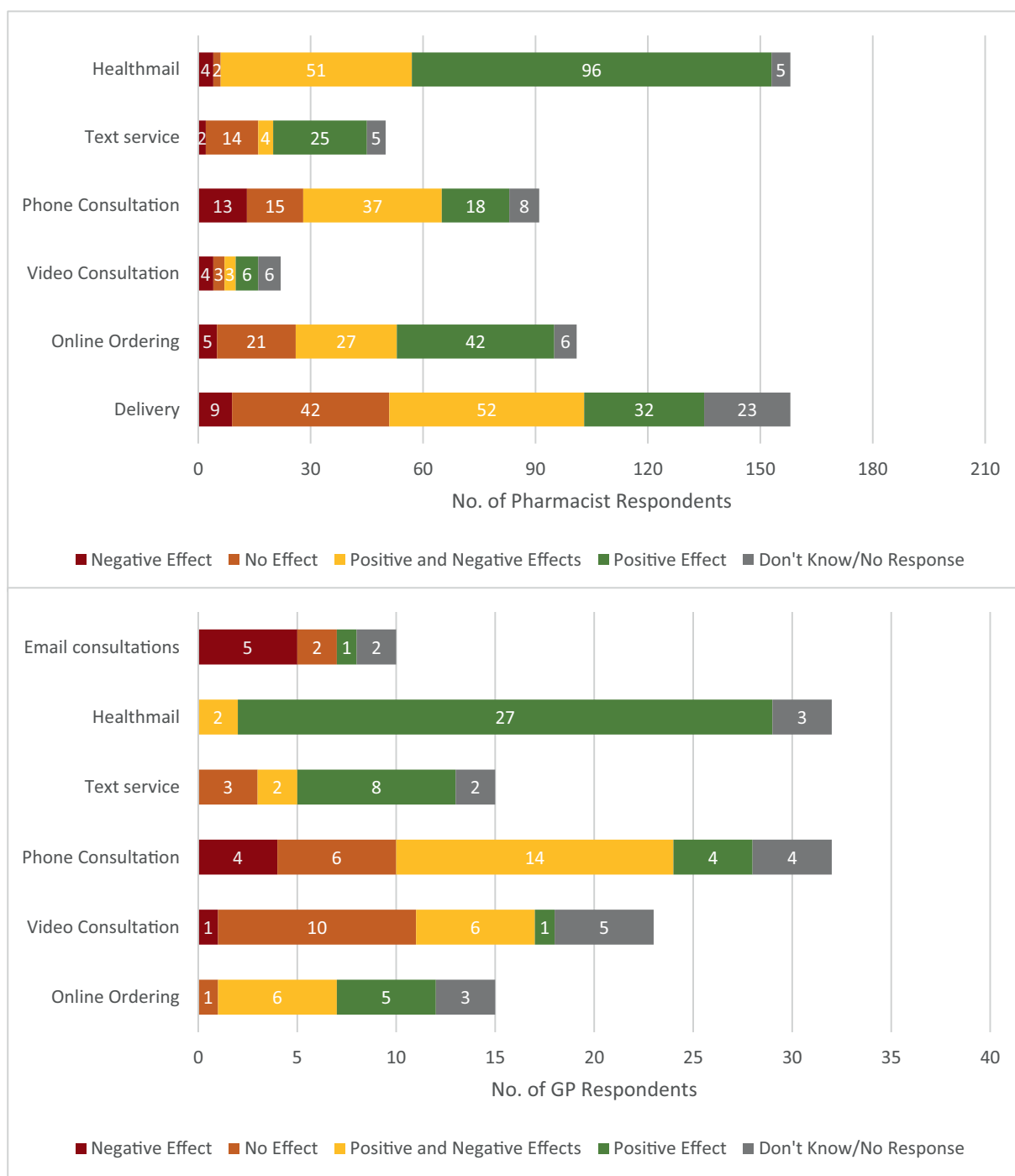
Fig. 1. Perceived effects of new services on medication safety reported by pharmacists and GPs.

Both pharmacists and GPs indicated that they were open to implementing new measures to improve medication safety; 55.0% (n = 116) and 65.0% (n = 26) respectively agreed with the statement *'In this pharmacy/practice, we are open to implementing new measures to improve medication safety'*. Similarly, more than two thirds of both pharmacists (n = 142, 67.3%) and GPs (n = 29, 72.5%) agreed with the statement *'In this pharmacy/practice, we are open to implementing new technologies in our work processes'* (Fig. 5). When asked whether their attitudes towards new technologies had changed since the COVID-19 pandemic, 57.5% of GPs (n = 23) and 46.9% of pharmacists (n = 99)

responded that their practice/pharmacy was more open to new technologies than they were before COVID-19.

In post-hoc analysis, there was a small, but statistically significant, association between a perceived increase in the number of medication safety incidents since the onset of the COVID-19 pandemic, and openness to embracing new technologies in work processes (r (182) = 0.167, p = 0.024, τb = 0.151, p = 0.022). However, no statistically significant correlation was identified between the number of medication safety incidents and openness to embracing new workflow changes, although the sample

Table 2
Illustrative comments on the perceived impact of workflow changes on medication safety.

Healthmail	• *'We are now rarely preparing a prescription for someone who is waiting in store for it. This means that we are continuously and steadily busy but never under severe pressure'* (P30)
	• *'Healthmail has been positive in many aspects but it is not true e--prescribing, so many downfalls'* (P77)
	• *'It does increase the workload as the pharmacy must print the prescriptions'* (P7)
	• *'Healthmail has been really helpful during the pandemic, however patients often have unrealistic expectations that their prescription should be ready for collection as soon as the Dr presses send on his/her computer'* (P85)
	• *'It should be easy to reply to the prescription with a query but replies are seldom received resulting in having to phone surgery to clarify issues resulting in delays in patients receiving medications'* (P40)
Virtual consultations	• *'Patients can check what medicine they have at home and have access to what they are taking but missing visual aspect of consultation can be problematic'* (GP8)
	• *"Hard to read a patients understanding over a phone without the usual visible signs"* (P7)
	• *"Patients' contact with their GPs seems to have decreased significantly. Patients are not having their medicines reviewed regularly because they haven't been attending their doctors as often. Repeat prescriptions are just sent via healthmail without a health check from the doctor or a medication review, which could lead to medication safety issues"* (P2)
	• *'Patients would email at all hours of the day and night and expect an instant answer'* (GP2)

who responded to this latter question was smaller (r (143) = 0.109, *p* = 0.196, τb = 0.095, p = 0.19).

3.5. Views on medication safety and COVID-19

Responses to open-ended questions asking about the most significant changes to pharmacy and general practice, contained in Section 4 of the survey, were subjected to conventional content analysis. Respondents most often mentioned Healthmail, virtual consultations and COVID-19 safety measures such as social distancing as significant changes relating to medication safety. With respect to challenges, respondents highlighted

pressure, patient expectations, and patient monitoring. Illustrative comments in relation to several themes are shown in Table 3.

4. Discussion

The aims of this survey study were to investigate 1) the changes that occurred in Irish primary care because of the COVID-19 pandemic and 2) the perceived impact of these changes. Increased adoption of telehealth may have improved access for people who had challenges attending healthcare settings in person, and electronic prescription transfer (via Healthmail) reduced the need for patients to visit pharmacies. However these changes also affected the opportunities for patient-health professional communication.

Overall, use of Healthmail was the workflow change most widely reported by respondents; it was also the change most widely perceived to have had a positive impact on medication safety by both subgroups. In the free-text comments, pharmacists reported that Healthmail had a significant, mostly positive impact on pharmacy workflow, allowing prescriptions to be prepared in advance of patients' arrival at the pharmacy, and both GPs and pharmacists reported that Healthmail had a positive impact on interprofessional communication, allowing queries and messages to be transferred more quickly and easily.

While both electronic prescription transfer and integrated electronic prescribing systems have been widely used in countries such as England, Denmark and the United States for several years, legislation for the electronic transfer of prescriptions was not introduced in Ireland until April 2020.[4,15,16] Countries with integrated e-prescribing systems have benefitted from safer and more streamlined medicines management processes.[15,17] In 2021, the Irish Medication Safety Network published a report outlining the disadvantages of the Healthmail system, including a lack of integration within existing electronic systems, impact on current workflow practices, the risk of selecting an inappropriate prescription recipient, and the risk of poor quality documentation.[18] Although some of these disadvantages were highlighted in the survey findings, most notably the impact on workflow, Healthmail was generally perceived positively by survey respondents. The widespread use of Healthmail in Ireland represents a significant step forward from paper-based prescriptions, yet it remains an electronic prescription transfer system, which lacks the advantages of a fully integrated electronic prescribing system. The National eHealth (electronic health) Strategy, published in 2013, advocates
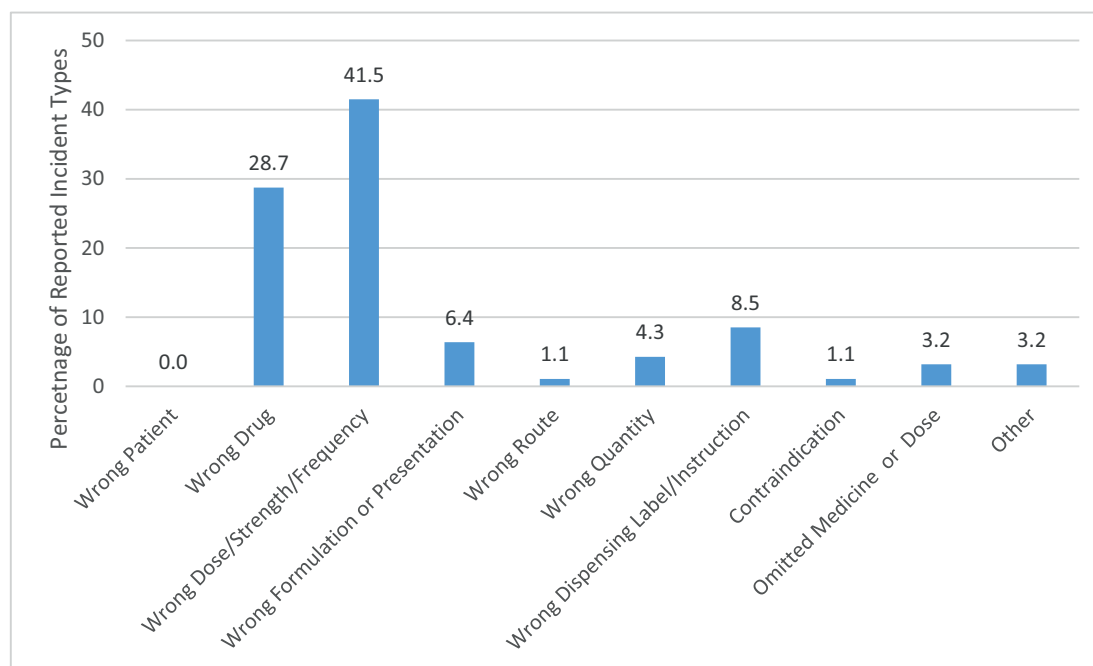

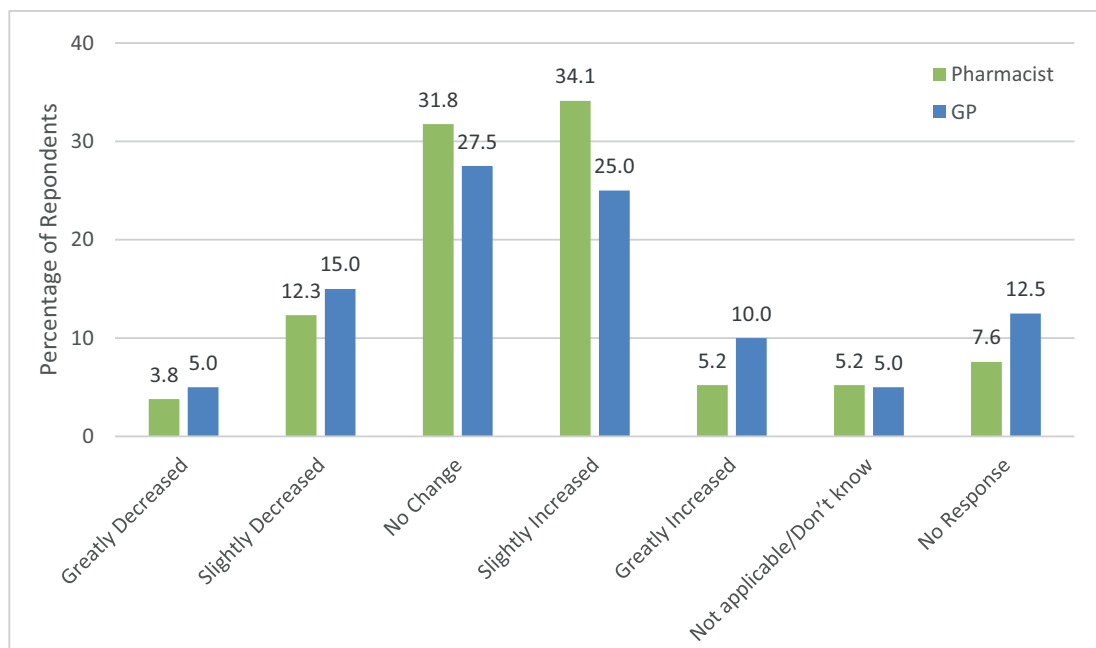**Fig. 2.** Types of Medication Safety Incidents Reported by Pharmacists.

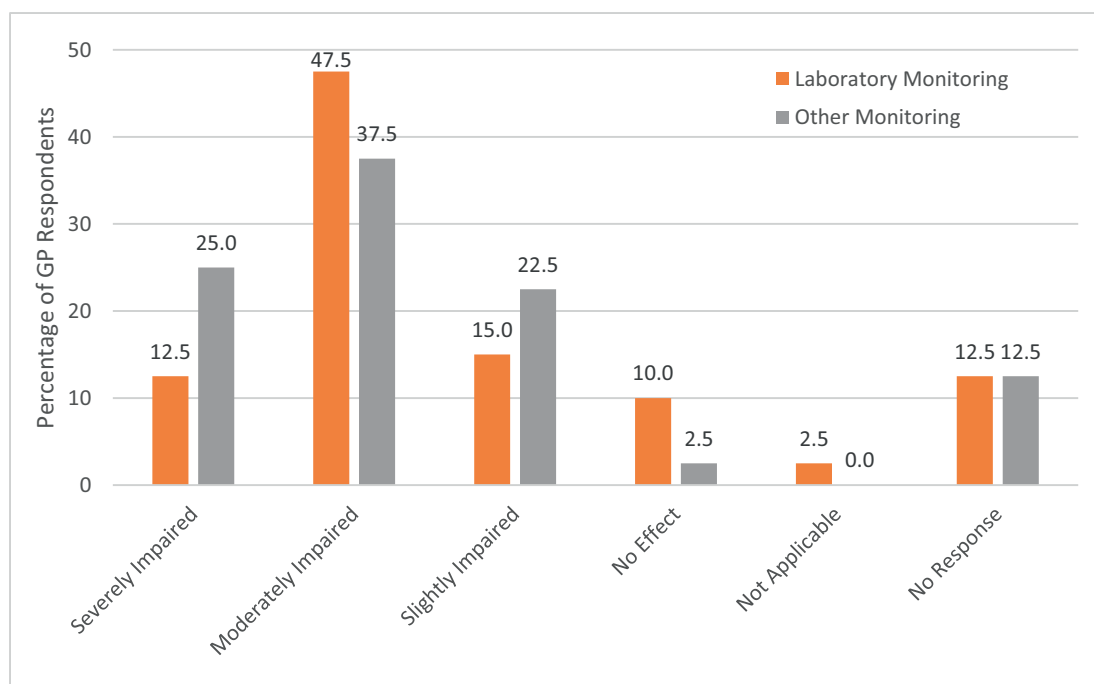**Fig. 3.** Reported Impact of COVID-19 on Medication Safety Incidents.

Fig. 4. GP reported impact of COVID-19 on patient monitoring relating to medications.

for the implementation of an eHealth system eHealth (Electronic Health) involving '*the integration of all information and knowledge sources involved in the delivery of healthcare via information technology-based systems*', however an updated strategy has yet to be published.[19]

The other major change noted in the survey was the increased use of virtual consultations in primary care. At the beginning of the pandemic in Ireland, the general advice to the public was to reduce social interactions.[20] Although the practical implementation of this advice varied across pharmacies and general practice clinics, survey results indicate that telephone consultations were widely introduced by GPs, and that many pharmacies began

to conduct telephone consultations after deliver medicines to patients' homes. A survey of members of the Irish College of General Practitioners (ICGP) found that there was a significant decrease in the number of face-to-face consultations, and a significant increase in the number of virtual consultations, between February and June 2020, as well as a decrease in consultations for non-COVID related symptoms.[21] While these changes were necessary to prevent COVID-19 infection in healthcare settings, many survey respondents reported concerns regarding the lack of face-to-face contact with patients, including the increased likelihood of misdiagnoses and reduced opportunities for patient monitoring.
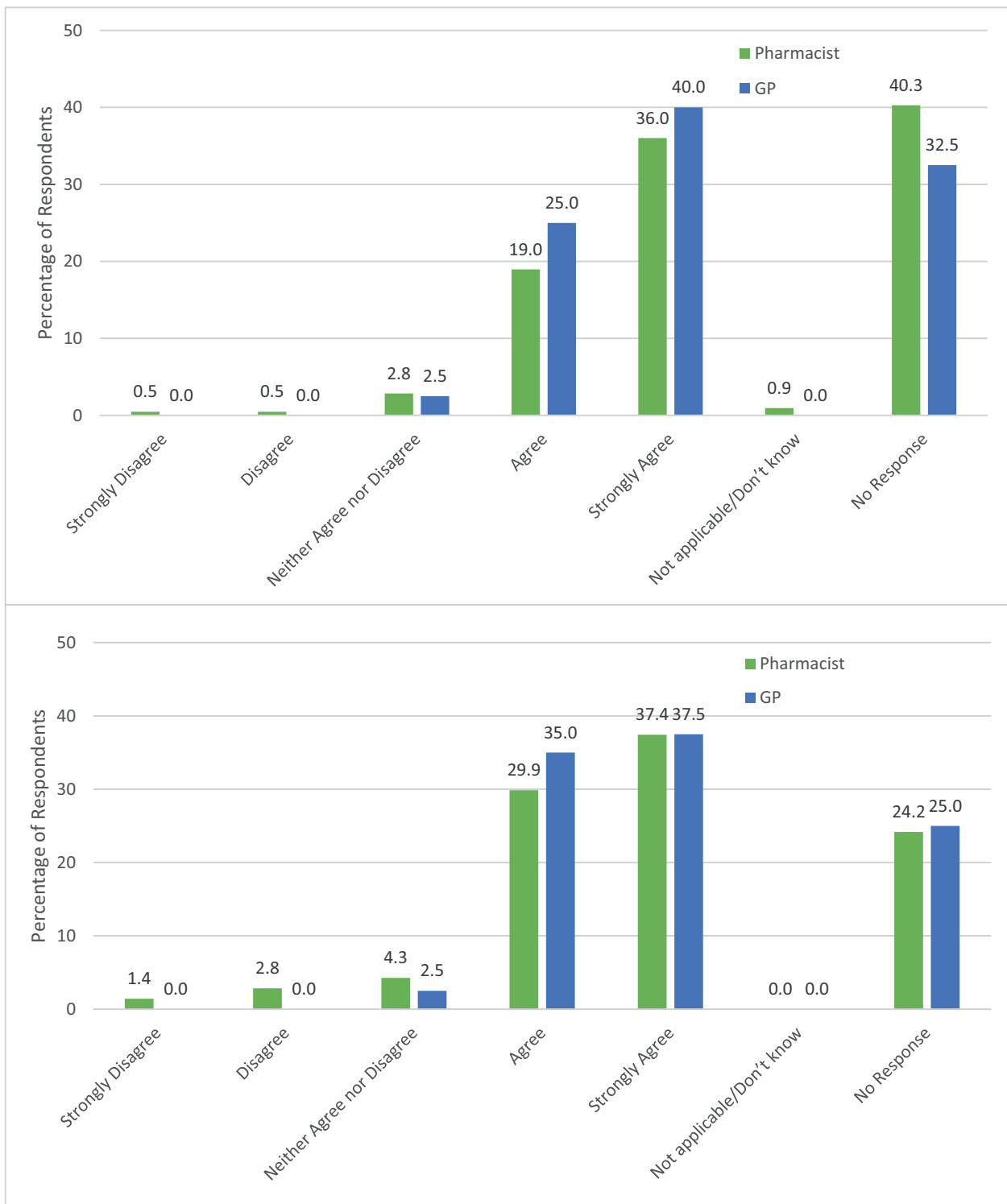
Fig. 5. Level of respondent agreement on the openness within their Pharmacy/Practice to implementing new measures to improve medication safety (top) and to implementing new technologies in their work processes (bottom).

The widespread use of telephone and video consultations is a relatively new phenomenon in Ireland, however studies on the safety and efficacy of telemedicine and virtual consultations have been conducted in recent years in other countries. A 2010 review of systematic reviews found mixed evidence for the effectiveness of telemedicine, and highlighted a lack of evidence regarding patient satisfaction with telemedicine and its impact on relationships between patients and healthcare professionals.[22] A 2017 study on the use of telemedicine in Norway reported that a long process

of learning and adaptation was required before telemedicine could be successfully implemented in a healthcare organisation, and a 2018 study, conducted in the United Kingdom, found that while virtual consultations are safe, effective, and practical for certain patients, there are challenges associated with embedding the service within routine practice.[23,24]

The increase in telemedicine occurred quickly in Ireland, with little implementation research or guidance for patients and healthcare professionals. The Irish Medical Council has produced guidance for doctors

Table 3
Illustrative comments on the perceived significant changes and challenges faced in primary care during the COVID-19 pandemic.

Remote care	• 'Healthmail has had massive benefits from making it easier to query and fix issues we have clinically and administratively with a direct connection to the Dr thereby greatly improving medication safety' (P163) • "Not having patients in the practice and not being able to fully clinically examine them means that medication safety has been compromised e.g. sometimes leads to over/mis/under-prescribing of medications" (GP24) • "Prescriptions arriving from GPs do not always replicate what changes were made from the hospital" (P7)
Patient expectations	• 'Healthmail is brilliant except for the fact that patients walk in straight from their appointment next door in the surgery and expect their prescription to be dispensed and ready to collect instantly' (P5) • 'Customers unrealistic expectations of how prescriptions are prepared leads to increased pressure' (P49) • 'Patients are rushing to get in and out of the pharmacy quickly trying to hurry the dispensing process up' (P8)
Safety strategies	• 'Implementing a 24 h rule for repeat scripts' (P7) • 'Taking a break, organising prescriptions by priority, increasing the waiting time for the patient, trying to control anxiety' (P12) • 'Protected time slots to complete Rx' (GP24)

conducting phone and video consultations during COVID-19, which states that '*doctors are responsible for determining the appropriateness of telemedicine to support the best outcome for their patients, considering their patients' context and symptoms*'; no formal guidance on telemedicine has been produced for pharmacists.[3] The results of this study indicate that patient monitoring and counselling was impaired during the COVID-19 pandemic; 75% and 85% of GPs, reported that laboratory monitoring and other types of monitoring, respectively, had been impaired to some degree, while pharmacists regularly mentioned in the free text comments that checking patient understanding during telephone consultations was difficult due to a lack of visual cues. In the survey of ICGP members, it was noted that while the use of telemedicine was invaluable in the continuation of care during the pandemic, patients who are digitally disadvantaged, and therefore less likely to engage in telemedicine, are often from populations already at greater risks of adverse health outcomes, such as older people and those in lower socioeconomic classes[21]; however, a report from the US National Poll for Healthy Ageing found that telemedicine acceptability amongst older adults increased substantially during the first year of the pandemic.[21,25] Telemedicine can be a safe and effective tool in the provision of medical care to certain patients; however, its implementation requires significant planning and resources, and it cannot act as a blanket substitute for face-to-face care.

Given the numerous ways in which GP and pharmacist workflows changed during the pandemic, it could be expected that the frequency of medication safety incidents would increase; this was supported by the survey results. Survey respondents reported managing patient expectations, longer wait times for prescriptions, and generally 'managing stress' as important safety strategies they had introduced during the pandemic, and also indicated their openness to introducing new technologies and strategies to improve medication safety. The high levels of stress and burnout experienced by frontline workers in Ireland and the UK during the pandemic have been widely reported.[26–28] Introducing such methods to relieve pressure and stress in healthcare organisations could have a positive impact on patient safety and medication incident rates. The pandemic has seen extensive developments of the role of community pharmacists internationally, and during this time, GPs have also increasingly taken on the care and treatment of patients previously managed in hospital.[29,30] It will also be important to consider how the workload and burden associated with these expanded roles could potentially impact patient and medication safety.

This survey study has elucidated the many changes that occurred in Irish primary care during the COVID-19 pandemic, and the impact of these changes. Future research should focus on the possibility of implementing a fully integrated electronic prescribing system in Irish primary care, the optimisation of telemedicine in this setting, and methods to improve medication and patient safety. Research conducted in countries where telemedicine and electronic prescribing have been in place for several years may provide important insights for the future of Irish primary care. Finally, qualitative research may be helpful in exploring some of the issues arising in this paper in more depth, as well as patient perspectives on the changes in primary care.

4.1. Strengths and limitations

To the best of our knowledge, this is the first study to examine the impact of the COVID-19 pandemic on workflow and medication safety in primary care internationally. The survey design provided detailed insights into the experiences of GPs and community pharmacists during the pandemic, and the anonymous nature of the data collection allowed participants to report experiences and opinions they may not otherwise have disclosed. Nonetheless, this study has a number of limitations. The low respondent numbers limit the generalisability of the results. Considerably more pharmacists responded to the survey than GPs, therefore it is possible that the study conclusions are focussed on issues that affected pharmacists more than GPs. This discrepancy in response rates could be due to differing data collection methods between the two groups. However, results are presented by professional group to ensure this does not skew the findings. As the pandemic is ongoing, attitudes towards workflow and medication safety may change with time. We relied on healthcare professionals' reports on the perceived impact on medication safety, and were unable to collect objective outcome measures. There was also a risk of recall bias since respondents were recalling the pre-pandemic period (approximately 18 months previous). However questions were phrased to ask about the current situation, relative to before the pandemic, as a measure to mitigate this.

5. Conclusion

This survey study investigated the changes that occurred in Irish primary care during the COVID-19 pandemic and the impact of these changes on medication safety. A number of changes occurred in primary care during the pandemic, the most significant being the introduction of electronic prescription transfer via Healthmail and the increased use of virtual consultations. Both pharmacists and GPs perceived an increase in medication safety incidents during the pandemic. Future research should focus on methods to improve medication safety in primary care, including the optimisation of electronic prescribing and telemedicine services in Ireland.

Funding

Declaration of Competing Interest

☒ The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

☐ The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

Appendix 1. GP survey

Participant Information Leaflet

This research study is investigating how the COVID-19 pandemic has affected medication safety in primary care and aims to develop a set of resources for patients, GPs, and pharmacists to use to make sure that medicines can be used safely during COVID-19.

Before you decide whether or not you wish to take part, you should read the information provided below carefully. You should clearly understand the risks and benefits of taking part in this study so that you can make an informed decision. You do not have to take part in this study and a decision not to take part will not affect your relationship with any of the research team.

Why is this study being done?

The onset of COVID-19 has affected many areas of healthcare, and one area most impacted in primary care is prescribing and dispensing of medication, which has important implications for patient safety. We are conducting a project to understand and support medication safety since the onset of COVID-19.

As part of this project, we are conducting a survey study to find out about healthcare professionals' experiences of working in primary care during the pandemic, and their perceptions of how the pandemic has affected medication safety in primary care.

Who is organising and funding this study?

This study is being organised by Michelle Flood, who is a lecturer at the School of Pharmacy at the Royal College of Surgeons in Ireland, and is interested in finding ways to help people take medicines safely. The project is being funded by the Research Collaborative in Quality and Patient Safety and is being carried out in collaboration with the HSE National Quality Improvement Team and Dr. Claire Collins (Irish College of General Practitioners).

Why am I being asked to take part?

You have been asked to take part because you are a GP who has worked clinically since the onset of the COVID-19 pandemic. We would like to gather perspectives from you and other people like you to help us understand more about how the COVID-19 pandemic has affected medication safety.

How will the study be carried out/what will happen to me if I agree to take part?

If you decide to take part in the study, we will ask you to complete an online survey about your perspectives/experiences of primary healthcare both before and after the COVID-19 pandemic. The survey should take approximately 10 min to complete, and will not ask for any personal or identifying information. You can opt out at any time by closing this survey page, however you cannot withdraw after submitting the survey, as every response is anonymous. After we have collected and analysed anonymous survey responses from all participants we will use them to help us understand what we can do to support medication safety in GP and Pharmacy settings. We will also publish the findings at academic conferences and in academic journals to that we can share our findings.

During the survey you will be asked about medication safety and medication errors. The survey is anonymous but please try not to mention identifying details of patients or colleagues. It's possible that the survey questions may prompt you to follow-up on specific issues in your professional practice, based on your regulatory body's requirements.

What are the benefits of taking part?

The study findings will help the team (1) to develop a medication safety toolkit for patients and healthcare professionals in primary care, (2) to support safe use of prescription, over-the-counter, and herbal medicines/supplements during and after COVID-19 and, (3) facilitate clear communication about medicines even when care is being delivered remotely.

What are the risks?

We do not foresee any risks for participants in this study.

Is the study confidential?

Yes, we will not collect any personal or identifying information, including IP addresses, in the survey.

Where can I get further information about this study?

If you have any questions about the study, please contact Laura Gleeson (Postdoctoral Researcher at the School of Pharmacy at the Royal College of Surgeons in Ireland) at lauralgleeson@rcsi.com.

Consent & Eligibility

	Yes	No
I have read and understood the **Information** about this research project. The information has been fully explained to me and I have been able to ask questions, all of which have been answered to my satisfaction.	☐	☐
I understand that I don't have to take part in this study and that I can opt out at any time before submitting responses. I understand that I don't have to give a reason for opting out and I understand that opting out won't affect me in any way.	☐	☐
I am aware of the potential risks, benefits and alternatives of this research study.	☐	☐
I have been assured that no personal or identifying information about me will be collected.	☐	☐
I consent to take part in this research study having been fully informed of the risks, benefits and alternatives.	☐	☐
I give informed explicit consent to have my data processed as part of this research study.	☐	☐
I confirm that I was practising as a GP in the Republic of Ireland prior to 1st January 2020.	☐	☐

Section 1: Demographics

1. Please tick the box that represents the type of practice you currently work in:
   - Single-handed practice ☐
   - Group practice ☐
   - Other ☐ (Please specify_____)

2. Please tick the box that represents your gender:
   - Male ☐
   - Female ☐
   - Non-binary ☐
   - Prefer not to say ☐

3. Please tick the box that represents your age group:
   - <30 ☐
   - 30–39 ☐
   - 40–49 ☐
   - 50–59 ☐
   - 60–69 ☐
   - 70 + ☐

4. Please tick the box that represents that location of the practice you currently work in:
     A City (50,000 + population) ☐
     A Town (1500–49,999 population) ☐
     A Village (≤1499 population) ☐

Section 2: Background

Note: throughout this survey you will be asked questions about medication safety incidents in your practice. For the purposes of this survey, medication safety incidents includes both medication errors (issues identified after they have reached the patient) and near misses (issue identified after reaching the patient).

1. In your opinion, has there been an increase in medication safety incidents since the COVID-19 pandemic?
     Greatly Increased ☐
     Slightly Increased ☐
     No Change ☐
     Slightly Decreased ☐
     Greatly Decreased ☐
     Don't Know ☐
     Not Applicable ☐

2. To what extent has the COVID-19 pandemic impaired the ability to conduct appropriate laboratory monitoring relating to your patients' medications?
     No effect ☐
     Slightly impaired ☐
     Moderately impaired ☐
     Severely impaired ☐
     Don't Know ☐
     Not Applicable ☐

3. To what extent has the COVID-19 pandemic impaired the ability to appropriately conduct other monitoring (e.g. blood pressure monitoring) relating to your patients' medications?
     No effect ☐
     Slightly impaired ☐
     Moderately impaired ☐
     Severely impaired ☐
     Don't Know ☐
     Not Applicable ☐

Section 3: Identifying workflow changes since COVID-19

Please indicate if you have introduced any of the following in your practice since the COVID-19 pandemic?

- Online system for patients to order repeat prescriptions from the GP practice

  o App ☐
  o Practice Website ☐
  o Email ☐
  o Other ☐ – please specify: _____
- Video consultations

  o COVID screening ☐
  o Triage of non-COVID patients to determine whether in-person consultation is necessary ☐
  o Full consultations ☐

    ▪ What platform do you use to conduct video consultations with patients (e.g. Zoom, Microsoft Teams, Attend Anywhere)? (Free text box)
- Telephone consultations

  o COVID screening ☐
  o Triage of non-COVID patients to determine whether in-person consultation is necessary ☐
  o Full consultations ☐
- Electronic transmission of prescriptions (to pharmacies) via Healthmail ☐
- Communication with other primary care healthcare professionals via Healthmail ☐
- Email consultation/queries from patients ☐
- Text service to patients

  o Prescription reminders ☐
  o Appointment reminders ☐
  o Results ☐
  o Screening reminders ☐

*For each of the above that are ticked, prompt the following question:

- In your opinion, how has this affected medication safety?
  o Positive effect ☐
  o Both positive and negative effects ☐
  o Negative effect ☐
  o No effect ☐
  o Don't know ☐

- Please explain your answer: _____

1. In this practice, we are open to embracing new technologies in our work processes.
     Strongly Agree ☐
     Agree ☐
     Neither Agree nor Disagree ☐
     Disagree ☐
     Strongly Disagree ☐
     Don't Know ☐
     Not Applicable ☐

2. How do you feel compared to before COVID-19?
     More open than before COVID-19 ☐
     Less open than before COVID-19 ☐
     No Change ☐
     Don't Know ☐
     Not Applicable ☐

Section 4: Identifying recent medication near misses and safety incidents

1. In the past 8 weeks of my practice I have been involved in a prescribing/medication safety "near miss" (i.e. an issue that was identified and avoided before it reached the patient)

Yes ☐
No ☐
Don't Know ☐
Not Applicable ☐

2. In the past 8 weeks of my practice I have been involved in a prescribing/medication safety error (i.e. an issue that was identified after it had reached the patient)

Yes ☐
No ☐
Don't Know ☐
Not Applicable ☐

3. **If you answered 'Yes' to either of the questions above, please complete the following table. If you answered 'No' to both questions, please move on the Section 3.**

What happened? (Please provide <u>anonymous</u> details of near miss/medication safety incident)	What medicine(s) were involved?	What factors were identified (if any) that potentially contributed to the incident?	What corrective action was taken?

Section 5: Your Opinions on Medication Safety and COVID-19

1. In your opinion, what has been the most important change to your workflow with respect to medication safety since the COVID-19 pandemic? (please write your answer in the space provided)

2. In your opinion, what are the most important issues affecting medication safety since the COVID-19 pandemic? (please write your answer in the space provided)

3. In your opinion, what are the most important strategies you have implemented to mitigate medication safety risks in your practice since the COVID-19 pandemic? (please write your answer in the space provided)

4. In this practice, we are open to embracing workflow changes to improve medication safety.

Strongly Agree ☐
Agree ☐
Neither Agree nor Disagree ☐
Disagree ☐
Strongly Disagree ☐
Don't Know ☐
Not Applicable ☐

Final Page:
Your opinions and experiences on this topic are hugely valuable. If you would be open to discussing this topic further with a member of our research team please click here to provide your contact details (link to an MS Forms page to securely collect contact information).

Appendix 2. Pharmacist survey

Participant Information Leaflet
This research study is investigating how the COVID-19 pandemic has affected medication safety in primary care and aims to develop a set of resources for patients, GPs, and pharmacists to use to make sure that medicines can be used safely during COVID-19.

Before you decide whether or not you wish to take part, you should read the information provided below carefully. You should clearly understand the risks and benefits of taking part in this study so that you can make an informed decision. You do not have to take part in this study and a decision not to take part will not affect your relationship with any of the research team.

Why is this study being done?
The onset of COVID-19 has affected many areas of healthcare, and one area most impacted in primary care is prescribing and dispensing of medication, which has important implications for patient safety. We are conducting a project to understand and support medication safety since the onset of COVID-19.

As part of this project, we are conducting a survey study to find out about healthcare professionals' experiences of working in primary care during the pandemic, and their perceptions of how the pandemic has affected medication safety in primary care.

Who is organising and funding this study?
This study is being organised by Michelle Flood, who is a lecturer at the School of Pharmacy at the Royal College of Surgeons in Ireland, and is interested in finding ways to help people take medicines safely. The project is being funded by the Research Collaborative in Quality and Patient Safety.

Why am I being asked to take part?
You have been asked to take part because you are a pharmacist who has worked clinically since the onset of the COVID-19 pandemic. We would like to gather perspectives from you and other people like you to help us understand more about how the COVID-19 pandemic has affected medication safety.

How will the study be carried out/what will happen to me if I agree to take part?
If you decide to take part in the study, we will ask you to complete an online survey about your perspectives/experiences of primary healthcare both before and after the COVID-19 pandemic. The survey should take approximately 10 min to complete, and will not ask for any personal or identifying information. You can opt out at any time by closing this survey page, however you cannot withdraw after submitting the survey, as every response is anonymous. After we have collected and analysed anonymous survey responses from all participants we will use them to help us understand what we can do to support medication safety in GP and Pharmacy settings. We will also publish the findings at academic conferences and in academic journals so that we can share our findings.

During the survey you will be asked about medication safety and medication errors. The survey is anonymous but please try not to mention identifying details of patients or colleagues. It's possible that the survey questions may prompt you to follow-up on specific issues in your professional practice, based on your regulatory body's requirements.

What are the benefits of taking part?
The study findings will help the team (1) to develop a medication safety toolkit for patients and healthcare professionals in primary care, (2) to support safe use of prescription, over-the-counter, and herbal medicines/supplements during and after COVID-19 and, (3) facilitate clear communication about medicines even when care is being delivered remotely.

What are the risks?
We do not foresee any risks for participants in this study.

Is the study confidential?
Yes, we will not collect any personal or identifying information, including IP addresses, in the survey.

Where can I get further information about this study?
If you have any questions about the study, please contact Laura Gleeson (Postdoctoral Researcher at the School of Pharmacy at the Royal College of Surgeons in Ireland) at lauralgleeson@rcsi.com.

Consent & Eligibility

	Yes	No
I have read and understood the **Information Leaflet** about this research project. The information has been fully explained to me and I have been able to ask questions, all of which have been answered to my satisfaction.	☐	☐
I understand that I don't have to take part in this study and that I can opt out at any time. I understand that I don't have to give a reason for opting out and I understand that opting out won't affect me in any way.	☐	☐
I am aware of the potential risks, benefits and alternatives of this research study.	☐	☐
I have been assured that no personal or identifying information about me will be collected.	☐	☐
I consent to take part in this research study having been fully informed of the risks, benefits and alternatives.	☐	☐
I give informed explicit consent to have my data processed as part of this research study.	☐	☐
I confirm that I was practising as a pharmacist in the Republic of Ireland prior to 1st January 2020.	☐	☐

Section 1: Demographics

1. Please tick the box that represents the type of pharmacy you currently work in:

    Independent ☐
    Small group (3 or fewer pharmacies) ☐
    Large group (More than 3 pharmacies) ☐
    Chain ☐
    Other ☐ (Please specify_____)

2. Please tick the box that represents your gender:

    Male ☐
    Female ☐
    Non-binary ☐
    Prefer not to say ☐

3. Please tick the box that represents your age group:

    <30 ☐
    30–39 ☐
    40–49 ☐
    50–59 ☐
    60–69 ☐
    70 + ☐

4. Please tick the box that represents that location of the pharmacy you currently work in:

    A City (50,000 + population) ☐
    A Town (1500–49,999 population) ☐
    A Village (≤1499 population) ☐

Section 2: Background

Note: throughout this survey you will be asked questions about medication safety incidents in your practice. For the purposes of this survey, medication safety incidents includes both medication errors (issues identified after they have reached the patient) and near misses (issue identified after reaching the patient).

1. In your opinion, how have the number of medication safety incidents changed since the COVID-19 pandemic?

    Greatly Increased ☐
    Slightly Increased ☐
    No Change ☐
    Slightly Decreased ☐
    Greatly Decreased ☐
    Don't Know ☐
    Not Applicable ☐

Section 3: Identifying workflow changes since COVID-19

Please indicate which of the following you have introduced in your pharmacy since the start of the COVID-19 pandemic.

- Home delivery service

    o Pharmacy organised ☐

      ▪ Prescription meds ☐
      ▪ OTC meds ☐
    o Community organised ☐

      ▪ Prescription meds ☐
      ▪ OTC meds ☐
- Online Prescription Ordering

    o App ☐
    o Website ☐
    o Other ☐ (please state _____)
    o Email ☐
- Video consultations

    o COVID screening ☐
    o Minor ailment consultations ☐
    o Full Rx consultations ☐
- Telephone consultations

    o COVID screening ☐
    o Minor ailment consultations ☐
    o Full Rx consultations ☐
    o Other ☐ (please state _____)

- Text service

    o Rx reminders ☐
    o Rx ordering ☐
    o Rx collection ☐
- Email consultation/queries from patients ☐
- Electronic transmission of prescriptions via Healthmail ☐
- Communication with other healthcare professionals via Healthmail ☐

*For each of the above that are ticked, prompt the following question:

- In your opinion, how has this affected medication safety?
  o Positive effect ☐
  o Both positive and negative effects ☐
  o Negative effect ☐
  o No effect ☐
  o Don't know ☐

- Please explain your answer: _____

1. In this pharmacy, we are open to embracing new technologies in our work processes.	Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree ☐ Don't Know ☐ Not Applicable ☐
2. How do you feel compared to before COVID-19?	More open than before COVID-19 ☐ Less open than before COVID-19 ☐ No Change ☐ Don't Know ☐ Not Applicable ☐

Section 4: Identifying recent medication near misses and safety incidents

1. In the past 8 weeks of my practice I have been involved in a medication safety "near miss" (i.e. an issue that was identified and avoided before it reached the patient)	Yes ☐ No ☐ Don't Know ☐ Not Applicable ☐
2. In the past 8 weeks of my practice I have been involved in a medication safety incident (i.e. an issue that was identified after it had reached the patient)	Yes ☐ No ☐ Don't Know ☐ Not Applicable ☐

If you answered 'Yes' to either of the questions above, please complete the following table. If you answered 'No' to both questions, please move on the Section 3.

What happened? (Please provide <u>anonymous</u> details of near miss/medication safety incident)	What medicine(s) were involved?	What factors were identified (if any) that potentially contributed to the incident?	What corrective action was taken?

Section 5: Your Opinions on Medication Safety and COVID-19

1. In your opinion, what has been the most important change to your workflow since the COVID-19 pandemic?

2. In your opinion, what are the most important issues affecting medication safety since the COVID-19 pandemic?

3. In your opinion, what are the most important strategies you have implemented to mitigate medication safety risks in your practice since the COVID-19 pandemic?

4. In this pharmacy, we are open to embracing workflow changes to improve medication safety.	Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree ☐ Don't Know ☐ Not Applicable ☐

Final Page:
Your opinions and experiences on this topic are hugely valuable. If you would be open to discussing this topic further with a member of our research team please click here to provide your contact details (link to an MS Forms page to securely collect contact information).

Appendix 3. Reported introduction of new types and subtypes of services by pharmacist and GP respondents

Pharmacist Services	Use (Frequency)	Use (%)	GP Services	Use (Frequency)	Use (%)
Home Delivery	158	74.9			
Delivery (Pharmacy organised, Rx)	127	60.2			
Delivery (Pharmacy organised, OTC)	75	35.5			
Delivery (Community organised, Rx)	57	27.0			
Delivery (Community organised, OTC)	21	10.0			
Online Ordering	101	47.9	**Online Ordering**	15	37.5
Online Ordering (Website)	23	10.9	Online Ordering (Website)	8	20.0
Online Ordering (Email)	71	33.6	Online Ordering (Email)	11	27.5
Online Ordering (App)	48	22.7	Online Ordering (App)	0	0.0
Video Consultation	22	10.4	**Video Consultation**	23	57.5
Video Consultation (COVID screening)	3	1.4	Video Consultation (COVID screening)	13	32.5
Video Consultation (Minor ailments)	15	7.1	Video Consultation (Triage)	13	32.5
Video Consultation (Full consultation)	11	5.2	Video Consultation (Full consultation)	19	47.5
Phone Consultation	91	43.1	**Phone Consultation**	32	80.0
Phone Consultation (COVID screening)	36	17.1	Phone Consultation (COVID screening)	31	77.5
Phone Consultation (Minor ailments)	74	35.1	Phone Consultation (Triage)	30	75.0
Phone Consultation (Full consultation)	53	25.1	Phone Consultation (Full consultation)	29	72.5
Text service	50	23.7	**Text service**	15	37.5
Text service (Prescription reminder)	24	11.4	Text service (Prescription reminder)	5	12.5
Text service (Prescription orders)	37	17.5	Text service (Appointment reminder)	6	15.0
Text service (Prescription collection)	40	19.0	Text service (Results)	15	37.5
			Text service (Screening reminder)	4	10.0
Healthmail	158	74.9	**Healthmail**	32	80.0
Healthmail (Prescriptions)	151	71.6	Healthmail (Prescriptions)	31	77.5
Healthmail (Communication with HCPs)	147	69.7	Healthmail (Communication with HCPs)	20	50.0
Other (Email queries)	56	26.5	Other (Email consultations)	10	25.0

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