



*Perspectives and Preferences of Pharmacists about the role of
E-prescription Systems implementation in Pakistan to Improve
the Rational use of Antibiotics:*

A Qualitative Study and A Quantitative Survey

By

Attika Majeed

Masters in Global Health

Session

2023

Norwegian University of Science and Technology

Acknowledgments

I would like to thank Prof. Biraj Karmacharya for his assistance and encouragement throughout this thesis. His notable and gracious support was of numerous values through word and perception. I express my appreciation for his gentle assistance and guidance during many challenging periods of study.

Secondly, I am grateful to our Co-Supervisor Sohail Riaz for his guidance in the discussions and searching for the literature to carry out research leading to the completion of this thesis. I offer my regards to my parents for their deep affection and motivational support in all the challenges that I have been through in my life.

Lastly, I would like to thank Dr. Håkon Angell Bolkan for providing insightful feedback in reviewing my thesis. I am also thankful to my friend Deeparani Sagapam, for her practical help while designing the survey and generating forms.

Finally, I would also like to thank Shanawar Ali Khan for his unconditional support throughout this process.

ABBREVIATIONS AND ACRONYMS

AMR Antimicrobial Resistance

ANN Artificial Neural Network

CRNN Convolutional Recurrent Neural Network

EHRs Electronic Health Records

HIE Health Information Exchange

SPSS Statistical Package for the Social Sciences

TSD Service for Student Data

WHO World Health Organization

Contents

Acknowledgments	1
Abstract	11
CHAPTER 1. INTRODUCTION	13
1.1 Introduction	13
1.2 Problem statement	16
1.3 Significance of the Study	16
1.4. Scope and Limitations	17
1.5 Research Questions	17
1.6 Aim of Study	18
1.6 Research Objectives	18
2. LITERATURE REVIEW	19
2.1 Rational Use of Antibiotics	19
2.2 Global Burden of Antibiotic Resistance	19
2.3 Impact of Irrational Antibiotic Use on Public Health	20
2.4 Importance of Promoting Rational Use of Antibiotics	20
2.5 Antibiotic Prescribing Practices in Pakistan	21
2.5.1 Overview of Antibiotic Prescribing Patterns in Pakistan	21
2.5.2 Factors Influencing Prescribing Decisions	21

2.5.3 Prevalence of Antibiotic Overuse and Misuse	22
2.5.4 Consequences of Inappropriate Antibiotic Use in Pakistan	22
2.6 Pharmacist's Role in Promoting Rational Antibiotic Use	23
2.6.1 Importance of Pharmacists in Healthcare Settings	23
2.6.2 Contribution of Pharmacists to Rational Antibiotic Use	23
2.6.3 Challenges Faced by Pharmacists in Antibiotic Dispensing and Counseling	24
2.7 E-prescription Systems and Their Potential Benefits	24
2.7.1 Definition and Features of E-prescription Systems	24
2.7.2 Advantages of E-prescription Systems in Healthcare	25
2.7.3 Role of E-prescription in Reducing Medication Errors	25
2.7.4 Potential Impact of E-prescription on Rational Antibiotic Use	26
2.8 E-prescription Systems Implementation in Developing Countries	26
2.8.1 Adoption and Implementation Challenges in Developing Nations	26
2.8.2 Success Stories of E-prescription Implementation in Other Countries	27
2.8.3 Lessons Learned from E-prescription Initiatives	27
2.9 E-prescription Systems in Pakistan: Current State	29
2.9.1 Overview of E-prescription Systems Adoption in Pakistan	29
2.9.2 Analysis of Existing E-prescription Platforms	29
2.9.3 Usage Rates and Acceptance Among Healthcare Providers	29

2.10 Benefits and Barriers of E-prescription Systems for Pharmacists	30
2.10.1 Perceived Benefits of E-prescription for Pharmacists	30
2.10.2 Challenges and Concerns Related to E-prescription Adoption	30
2.10.3 Factors Influencing Pharmacists' Willingness to Embrace E-prescription	31
2.11 Impact of E-prescription on Pharmacist-Physician Collaboration	32
2.11.1 Communication and Information Exchange between Pharmacists and Physicians	32
2.11.2 Collaborative Efforts in Promoting Rational Antibiotic Use	32
2.11.3 Enhancing Interprofessional Relationships through E-prescription	33
2.12 Patient Perspectives on E-prescription Systems and Antibiotics	34
2.12.1 Patient Understanding and Acceptance of E-prescription	34
2.12.2 Patient Preferences for Electronic versus Paper Prescriptions	34
2.12.3 Impact of E-prescription on Patient Adherence to Antibiotic Regimens	35
2.14 Regulatory and Policy Framework for E-prescription in Pakistan	35
2.14.1 Government Initiatives and Support for E-prescription Implementation	35
2.15 E-prescription and Healthcare Digitalization in Pakistan	36
2.15.1 Integration of E-prescription in the Wider Healthcare System	36
2.15.2 Synergy between E-prescription and Electronic Health Records (EHRs)	37
2.15.3 Digital Health Infrastructure and Readiness for E-prescription	37
2.16 E-prescription and Pharmacy Information Systems in Pakistan	38

2.16.1 Integration of E-prescription with Pharmacy Information Systems	38
2.16.2 Streamlining Antibiotic Dispensing through E-prescription Integration	38
CHAPTER 3. METHODOLOGY	40
3.1 RESEARCH DESIGN:	40
3.2 Mixed-Methods Design:	40
3.3 QUALITATIVE STUDY:	40
3.3.1 Participants and Sample:	40
Details of participants	42
3.3.2 Data Collection:	44
3.3.3 Audio Recording and Transcription:	44
3.3.4 Data Analysis of Qualitative study:	45
3.3.5 Ethical Considerations:	45
3.4 QUANTITATIVE STUDY (SURVEY)	46
3.4.1 Study Setting, Procedure, and Duration:	46
3.4.2 Data Collection and Study tool:	46
3.4.3 Analysis for Quantitative study:	46
3.6 Informed Consent:	47
3.7 Confidentiality and Anonymity:	47
3.8 EXPECTED OUTCOMES:	47

3.8.1 Insights into Pharmacists' Perspectives and Preferences:	47
3.8.2 Challenges in Implementing E-prescription Systems in Pakistan:	48
3.8.3 Implications for Policymakers and Healthcare Professionals:	48
CHAPTER 4. RESULTS	49
I. QUALITATIVE FINDINGS	49
4.1 Challenges of Handwritten Prescriptions and Advantages of E-prescriptions	49
4.2 Antibiotic Resistance in Pakistan and Contributing Factors	49
4.3 Patient Perspectives on E-prescriptions	49
4.4 Patient Behavior Regarding Antibiotic Prescriptions	49
4.5 E-prescriptions as a Tool to Combat Antibiotic Resistance	49
4.6 Barriers to E-prescription Implementation in Pakistan	49
4.7 Benefits of e-prescription to patients and healthcare providers in Pakistan	49
4.8 Suggestions for antibiotic resistance	49
4.1 Challenges of Handwritten Prescriptions and Advantages of E-prescriptions	49
4.1.1 Difficulties with Deciphering Handwritten Prescriptions	50
4.1.2 Potential Errors and Ambiguities in Handwritten Prescriptions	51
4.1.3 Benefits of E-prescription System in Modernizing Healthcare	52
4.1.4: Improving Efficiency and Patient Safety with E-prescriptions	53
4.1.5: Patient Acceptance and Perception of E-prescriptions	54

4.2 Antibiotic Resistance in Pakistan and Contributing Factors	55
4.2.1: Causes of Antibiotic Resistance in Pakistan	56
4.2.2: Overprescribing and Inappropriate Use of Antibiotics	57
4.2.3 Lack of Public Awareness and Education on Antibiotic Usage	58
4.2.4 Inadequate Infection Control Practices in Healthcare Settings	59
4.2.5 Availability of Counterfeit or Substandard Antibiotics	60
4.2.6 Self-medication and Absence of Strict Regulations on Antibiotic Dispensing	61
4.3 Patient Perspectives on E-prescriptions	62
4.3.1 The Role of Education and Awareness	64
4.4 Patient Behavior Regarding Antibiotic Prescriptions	65
4.4.1 Reusing Antibiotic Prescriptions	65
4.4.2 Reasons for Reusing Prescriptions	66
4.5 E-prescriptions as a Tool to Combat Antibiotic Resistance	67
4.5.1 E-prescription's Role in Rational Antibiotic Use	68
4.5.2 Better Control and Monitoring of Antibiotic Prescribing	69
4.5.3 Facilitating Interventions to Address Antibiotic Misuse	71
4.5.4 E-prescription Implementation and its Impact on Antibiotic Resistance	72
4.6 Barriers to E-prescription Implementation in Pakistan	73
4.6.1 Limited Technology Infrastructure	74

4.6.2 Lack of Digital Literacy among Healthcare Providers and Patients	75
4.6.3 Resistance to Change from Traditional Practices	76
4.7 Benefits of e-prescription to patients and healthcare providers in Pakistan	77
4.8 Suggestions for antibiotic resistance	77
II. QUANTITATIVE DATA	80
4.9 Demographic Characteristics	80
Table 4.9 Demographic Characteristics	80
4.10 Prescription System	81
Table 4.10 Prescription System	81
4.11 Perspective on e-prescription	82
Table 4.11 Perspective on e-prescription	82
4.12 Perspectives on antibiotic resistance	84
Table 4.12 Perspectives on antibiotic resistance	84
4.13 Importance of E-Prescription for Rational Antibiotic Use in Pakistan	86
Table 4.13 Importance of E-Prescription for Rational Antibiotic Use in Pakistan	87
4.14 Barriers to E-Prescription Implementation	87
Table 4.14 Barriers to E-Prescription Implementation	88
CHAPTER 5 DISCUSSION AND CONCLUSIONS	89
5.1 DISCUSSION	89

5.2 CONCLUSION	95
5.3 FUTURE RECOMMENDATIONS	96
5.4 STUDY LIMITATION	97
REFERENCES	99

Abstract

Background: The implementation of E-prescription systems holds the potential to revolutionize healthcare practices, particularly in the context of antibiotic dispensing. This study aims to investigate the perspectives, preferences, and challenges faced by pharmacists in Pakistan regarding the integration of E-prescription systems to enhance the rational use of antibiotics. A mixed-methods approach, combining qualitative interviews and quantitative surveys, was adopted to achieve a comprehensive understanding of pharmacists' attitudes toward E-prescription systems.

Objectives: The study aimed to explore pharmacists' perspectives on E-prescription system implementation, assess their preferences concerning E-prescription systems for antibiotic dispensing, and identify challenges encountered during the integration of such systems in Pakistan.

Methods: This mixed-methods study combined in-depth interviews with 30 pharmacists and a quantitative survey of 200 pharmacists in Pakistan's community pharmacies. Purposive sampling ensured diverse perspectives. Thematic analysis was applied to interview data using "diktafon" software for audio recording and transcription. The online survey via Google Forms gathered preferences, attitudes, and challenges. Ethical guidelines were followed, ensuring confidentiality and anonymity. For qualitative data thematic analysis was used to analyze interview data, identifying patterns, themes, and categories. NVivo's coding features were used to group data into potential themes, which were then refined and validated. This systematic examination helped identify recurring themes and extract meaningful insights. However, for quantitative study the data was analyzed using descriptive statistics in SPSS to summarize and characterize responses to closed-ended questions, providing insights into prevailing trends.

Results: The qualitative study showed the thematic analysis reflect pharmacists' recognition of the potential of E-prescription systems to address challenges related to handwritten prescriptions, enhance antibiotic stewardship, and improve patient care. The study suggests that addressing antibiotic resistance requires multifaceted efforts, including technological advancements, educational campaigns, and policy interventions. While, quantitative findings revealed that

maximum respondents (n=189 93.1%) belonged to age group of 25-34 years. Majority of respondents (n=137, 67.5%) were male. Most of the participants (n=88, 43.3%) belonged to Punjab. Most of the participants (n=118, 58.1%) were community pharmacists. Majority of respondents (n=166, 81.8%) had experience of 1-5 years. Out of the total respondents, (n=27, 13.3%) have experienced E-prescriptions, while the majority, accounting for (n=176, 86.7%) received manual prescriptions. Regarding the legibility of handwritten prescriptions, 61.6% of respondents received prescriptions that were clear enough to read, and (n=65, 32.0%) encountered illegible prescriptions that were not clear enough to be read. Respondents from Balochistan, as well as other regions, demonstrated positive attitudes towards E-prescription systems for antibiotic dispensing.

Conclusion: This study provides valuable insights into pharmacists' perspectives, preferences, and challenges related to E-prescription systems for antibiotic dispensing in Pakistan. The results highlight the potential benefits of E-prescriptions in promoting rational antibiotic use and combating antibiotic resistance. The study's findings could inform policymakers and healthcare professionals in devising strategies to enhance E-prescription system implementation and contribute to the improvement of healthcare practices in the country.

CHAPTER 1. INTRODUCTION

1.1 Introduction

Antibiotic resistance has emerged as a significant issue in public health, attracting worldwide attention due to its extensive implications for healthcare systems and the well-being of patients (1). The healthcare issue in Pakistan has reached alarming levels, presenting a significant challenge for healthcare providers and policymakers (2). The prevalence of antibiotic-resistant infections has been on the rise, increasing morbidity and mortality rates and a significant escalation in healthcare expenditures (3). Patients afflicted with infections caused by multidrug-resistant bacteria frequently endure protracted illnesses and encounter restricted treatment alternatives, necessitating more assertive and costly therapeutic interventions (4).

The importance of rational antibiotic use cannot be overstated in the ongoing fight against antibiotic resistance. The concept of rational use encompasses the judicious and suitable utilization of antibiotics, which is informed by evidence-based guidelines and driven by clinical necessity. The primary objective of this study is to enhance patient outcomes by effectively managing the emergence and transmission of antibiotic-resistant bacteria (5). The adherence to rational use principles in healthcare settings enables providers to ensure the appropriate prescription of antibiotics, limiting their use to cases where they are truly necessary. Additionally, this approach allows for carefully selecting the most effective drug to treat a specific infection (6).

The importance of promoting rational antibiotic use extends beyond the well-being of individual patients, encompassing the wider community as well. The rapid spread of antibiotic-resistant bacteria within healthcare settings and communities presents a significant public health concern. The implementation of appropriate antibiotic stewardship practices, which involve the rational utilization of antibiotics, has been shown to significantly mitigate the spread of antibiotic-resistant strains and safeguard susceptible populations, including the elderly, young children, and individuals with compromised immune systems (7).

Antimicrobials, a category of pharmaceutical agents, have emerged as crucial components in contemporary medical practice. These drugs have demonstrated their efficacy in combatting and averting infections caused by various microorganisms, including bacteria, viruses, fungi, and parasites. Their significant impact on public health is evidenced by the countless lives they have saved (8). The indiscriminate and unnecessary use of antimicrobial agents has been identified as a significant factor contributing to the emergence of antimicrobial resistance (AMR). Antimicrobial resistance (AMR) is a phenomenon observed when microorganisms, including bacteria, acquire the capacity to endure the impact of antimicrobial agents, leading to the ineffectiveness of these medications in combating infections (8). The observed phenomenon presents a substantial risk to global health, as formerly manageable infections are becoming increasingly difficult to control, leading to higher rates of illness, death, and healthcare expenditures (9).

In light of the escalating apprehension surrounding antimicrobial resistance (AMR), there has been a concerted endeavor to enhance the judicious utilization of antibiotics. Electronic prescription systems, also called E-prescriptions, have been identified as a potential solution to tackle the above mentioned issue. E-prescriptions have revolutionized the healthcare industry by allowing providers to electronically create and send prescriptions to pharmacies, eliminating reliance on traditional paper-based prescriptions (10). This technological advancement has streamlined the prescription process, making it more efficient and convenient for healthcare professionals and patients. With e-prescriptions, healthcare providers can generate prescriptions digitally, reducing the risk of errors associated with handwritten prescriptions. Additionally, the electronic transmission of prescriptions to pharmacies ensures a faster and more accurate dispensing process, ultimately improving patient safety and medication adherence.

The adoption of e-prescriptions has significantly transformed the prescription workflow, enhancing the quality of healthcare delivery. Integrating technology into the prescription process has led to the development of E-prescriptions, which have been found to offer numerous advantages. These advantages include improved accuracy in prescription fulfilment, enhanced communication channels between healthcare providers and pharmacists, and the ability to access patients' medical histories in real-time.

The current study aims to address the existing gap in knowledge regarding the perceptions and preferences of pharmacists in Pakistan regarding E-prescription systems and their potential benefits in promoting rational antibiotic use. By conducting a comprehensive analysis, this research sheds light on the attitudes and opinions of pharmacists in Pakistan towards E-prescription systems, thus contributing to a better understanding of the current landscape and potential barriers to implementing such systems in the country. The role of pharmacists in the medication management process is widely recognized as crucial. In order to gain a comprehensive understanding of the challenges and opportunities associated with implementing E-prescriptions, it is essential to consider pharmacists' perspectives. Their insights provide valuable insights into the complexities of this technological advancement in pharmacy.

The present study aims to address the existing knowledge gap by investigating pharmacists' viewpoints and preferences regarding the utilization of E-prescription systems to enhance the rational utilization of antibiotics in Pakistan. This study aims to examine the factors that may impact the effective implementation of E-prescription systems in antibiotic management practices. This will be achieved by gathering perspectives from frontline healthcare professionals directly involved in medication dispensing. By exploring their insights, the study aims to uncover the obstacles and enablers that could influence the integration of E-prescription systems in this specific context.

Exploring pharmacists' perceptions and preferences regarding E-prescriptions is crucial to gain a comprehensive understanding of the factors influencing the rational use of antibiotics in Pakistan. By examining pharmacists' perspectives, valuable insights can be obtained to inform the development of targeted strategies to improve antibiotic prescribing practices. This study aims to contribute to the existing body of literature on antimicrobial stewardship by examining the potential benefits and challenges associated with adopting E-prescription systems in the fight against antimicrobial resistance (AMR). The findings of this research will provide valuable insights for policymakers and healthcare professionals, enabling them to make informed decisions regarding implementing E-prescription systems in their respective healthcare settings. By addressing the gaps in knowledge surrounding this topic, this study aims to enhance our understanding of E-prescription systems' role in combating AMR and ultimately improving

patient outcomes. This study's primary objective is to support evidence-based decision-making and promote the adoption of more efficient and effective antibiotic prescribing practices. This is crucial to protect the long-term effectiveness of these vital medications for future generations.

1.2 Problem statement

The landscape of healthcare delivery is rapidly evolving, and one of the pivotal advancements is the integration of technology, including the implementation of E-prescription systems. However, within Pakistan's specific context, there is a noticeable gap in the comprehension of pharmacists' perspectives regarding these systems. As E-prescription systems are introduced and adopted across the healthcare spectrum, it is imperative to comprehend how pharmacists, who play a crucial role in medication dispensing and patient safety, view and engage with these technological innovations. This research aims to bridge this gap by delving into the viewpoints of pharmacists regarding E-prescription systems, thereby shedding light on their thoughts, concerns, and expectations.

Amidst the integration of E-prescription systems, it is vital to acknowledge that the successful implementation of such systems is contingent upon not only technical functionality but also the acceptance and utilization by healthcare professionals. Among these professionals, pharmacists are pivotal figures entrusted with dispensing medications, offering consultation, and ensuring the rational use of drugs. Therefore, it becomes paramount to emphasize the need to delve into the preferences and challenges pharmacists encounter in antibiotic dispensing through E-prescription systems. By exploring these aspects, this research seeks to unearth valuable insights that can guide the design and refinement of E-prescription systems to better align with the needs and expectations of pharmacists, fostering a more seamless and effective collaboration between technology and healthcare expertise.

1.3 Significance of the Study

The ramifications of irrational antibiotic use and the emergence of antibiotic-resistant strains of bacteria pose significant threats to global public health. In this context, this research holds substantial significance in its potential to address these pressing issues. By delving into the

perspectives of pharmacists, who act as pivotal gatekeepers in medication dispensing, the study can offer insights to optimize E-prescription systems for antibiotic dispensing. Consequently, this can foster a more judicious use of antibiotics, combating the spread of antibiotic resistance and safeguarding patient health. Moreover, this research holds the promise of enhancing E-prescription systems themselves. By uncovering pharmacists' viewpoints and preferences, the study can inform the development and refinement of these systems to align with the practical needs of healthcare professionals. This alignment can result in more seamless integration, reduced friction in usage, and increased overall effectiveness of E-prescription systems, benefiting not only pharmacists but also patients and the healthcare system at large.

The potential positive impact of this research extends to the broader public health arena. By contributing to the rational use of antibiotics, the study indirectly addresses a critical facet of healthcare that affects individuals, communities, and societies. The insights generated from this research can contribute to the mitigation of antibiotic resistance, safeguarding the efficacy of antibiotics for current and future generations.

1.4. Scope and Limitations

This research focuses on the geographical context of Pakistan, where E-prescription systems are gradually being integrated into healthcare practices. The study hones in on the specific realm of E-prescription systems and their interaction with antibiotic dispensing, aiming to shed light on pharmacists' experiences within this context.

While the insights garnered from this research hold the potential for meaningful contributions, it's important to acknowledge certain limitations. The scope of the study is restricted to a particular geographical location and a specific area of healthcare technology. Additionally, potential limitations such as sample size constraints, respondent bias, and the inherent limitations of qualitative and survey research methodologies may impact the generalizability of findings. Nonetheless, the research aims to mitigate these limitations by adopting rigorous methodologies and ensuring ethical considerations.

1.5 Research Questions

1. What are pharmacists' perspectives in Pakistan regarding implementing E-prescription systems for medication dispensing, particularly focusing on antibiotics?
2. What are pharmacists' preferences concerning using E-prescription systems in dispensing antibiotics, and how do these preferences align with their professional responsibilities?
3. What challenges do pharmacists face while implementing and utilising E-prescription systems in Pakistan, specifically in the domain of antibiotic dispensing?

1.6 Aim of Study

This study aims to explore and understand the perspectives, preferences, and challenges of pharmacists in Pakistan concerning implementing E-prescription systems for the rational dispensing of antibiotics. By investigating these aspects, the study seeks to provide valuable insights that can contribute to optimising E-prescription systems, enhance the collaboration between technology and healthcare expertise, and ultimately contribute to promoting rational antibiotic use and mitigating antibiotic resistance.

1.6 Research Objectives

- To explore the perspectives of pharmacists about the implementation of E-prescription systems in Pakistan.
- To assess the preferences of pharmacists regarding the use of E-prescription systems in dispensing antibiotics.
- To identify the challenges faced by pharmacists in implementing E-prescription systems in Pakistan.

2. LITERATURE REVIEW

2.1 Rational Use of Antibiotics

Rational use of antibiotics is a critical aspect of healthcare practices aimed at ensuring the appropriate and judicious utilization of these antimicrobial agents (11). This practice entails the judicious prescription of antibiotics, ensuring their administration at the appropriate dosage and duration, following evidence-based guidelines and considering individual patient characteristics. The fundamental tenet underlying the practice of rational antibiotic utilization involves the deliberate choice of highly efficacious and targeted antibiotics, intending to reduce the likelihood of antimicrobial resistance development while optimizing the effectiveness of treatment. Healthcare providers strive to optimize patient outcomes, minimize adverse effects, and tackle the global issue of antibiotic resistance, which poses a threat to public health on a global scale (12).

The issue of antibiotic resistance has garnered considerable attention due to the excessive and inappropriate utilization of antibiotics, resulting in the emergence of bacteria that are resistant to drugs and consequently diminish the efficacy of previously successful treatments (13). Contributing factors to the global crisis include the inappropriate prescription of antibiotics for viral infections, patient non-compliance with prescribed regimens, and the utilization of broad-spectrum antibiotics without sufficient justification. Healthcare professionals have a crucial role in the fight against antimicrobial resistance and the preservation of the effectiveness of current antibiotics by promoting rational antibiotic use (9).

2.2 Global Burden of Antibiotic Resistance

The issue of antibiotic resistance is a rapidly growing global public health concern that transcends geographical boundaries and impacts populations on a global scale (14). The advent of multidrug-resistant bacteria has significantly reduced the efficacy of formerly dependable antibiotics, leading to prolonged periods of illness, heightened healthcare costs, and elevated rates of mortality. The World Health Organization (WHO) has identified antibiotic resistance as a highly significant challenge of the 21st century, acknowledging its severe implications. If prompt

and resolute measures are not taken, a significant number of lives are in jeopardy due to infections that were previously manageable with the use of antibiotics (15).

2.3 Impact of Irrational Antibiotic Use on Public Health

The generalized utilization of antibiotics presents substantial and wide-ranging detrimental consequences for public health. The excessive prescription and improper utilization of antibiotics significantly contribute to the emergence and proliferation of drug-resistant bacterial strains. Consequently, the emergence of resistant infections has rendered previously manageable cases more difficult to control, resulting in treatment inefficacy and unfavorable patient consequences. The global concern surrounding the emergence of multidrug-resistant bacteria has escalated due to its significant impact on the efficacy of existing antibiotics, thereby reducing the number of viable treatment options available to healthcare providers (16). The consequences of antibiotic resistance are significant, exerting effects on individuals, communities, and healthcare systems. Patients who are infected with drug-resistant bacteria frequently encounter extended periods of hospitalization, prolonged durations of illness, and increased expenditures on healthcare. The utilization of stronger and costlier antibiotics in order to address infections that have developed resistance exacerbates the financial burden on the healthcare system and places additional strain on healthcare resources. In certain instances, it may be necessary for patients to undergo supplementary medical interventions or surgical procedures in order to address complications that arise as a result of treatment failures. This can result in heightened demands on healthcare systems (17).

2.4 Importance of Promoting Rational Use of Antibiotics

The promotion of rational antibiotic use holds significant importance due to a multitude of compelling factors. First and foremost, it assumes a crucial role in the preservation of the efficacy of current antibiotics, thereby guaranteeing the continued viability of these essential medications as potential treatment choices for forthcoming generations (18). The escalating issue of antimicrobial resistance poses a significant threat, as it jeopardizes the efficacy of existing antibiotics, thereby limiting our ability to effectively address infections. Healthcare providers can make a significant contribution to the preservation of the effectiveness and longevity of

antibiotics by advocating for responsible and evidence-based antibiotic usage. The judicious utilization of antibiotics plays a crucial role in mitigating the prevalence of antibiotic-resistant infections. The excessive and incorrect utilization of antibiotics are substantial factors in the emergence of drug-resistant bacterial strains, resulting in challenges in the treatment of infections and an increase in the occurrence of treatment failures. Healthcare providers can effectively mitigate the emergence of resistant bacteria and decrease reliance on costly and potentially hazardous second-line treatments by adhering to evidence-based prescribing practices. Consequently, this not only enhances patient outcomes but also mitigates the strain on healthcare systems and facilitates the optimal distribution of healthcare resources (19).

2.5 Antibiotic Prescribing Practices in Pakistan

2.5.1 Overview of Antibiotic Prescribing Patterns in Pakistan

The antibiotic prescription practices in Pakistan have elicited considerable apprehension among healthcare practitioners and policymakers, primarily owing to their potential implications for the development of antimicrobial resistance and the well-being of patients. A multitude of studies have provided insight into the concerning prevalence of antibiotic prescriptions in diverse healthcare environments, including hospitals, clinics, and pharmacies (20). A matter of particular concern pertains to the widespread occurrence of empirical prescribing, whereby antibiotics are frequently prescribed in the absence of specific laboratory tests or cultures that would enable the identification of the underlying pathogen responsible. The prevalence of this empirical approach has led to a significant increase in the unnecessary administration of antibiotics, wherein patients are prescribed antibiotics even in cases where alternative treatments may be more suitable (21).

2.5.2 Factors Influencing Prescribing Decisions

The landscape of antibiotic prescribing in Pakistan is influenced by a multitude of intricate factors, and comprehending these elements is of utmost importance in formulating efficacious strategies to address the issue of inappropriate antibiotic utilization and the emergence of antimicrobial resistance (22). One of the primary factors influencing healthcare providers is the requests made by patients for antibiotics. This places considerable strain on providers,

particularly when faced with viral infections that are unresponsive to antibiotic treatment. Despite the existence of medical evidence that establishes the ineffectiveness of antibiotics in treating viral illnesses, it is frequently observed that patients maintain the expectation or make requests for antibiotics as a convenient solution to alleviate their symptoms. The inclination towards immediate alleviation and the perception of antibiotics as a universal remedy can result in unjustified prescriptions of antibiotics (23).

2.5.3 Prevalence of Antibiotic Overuse and Misuse

The excessive and inappropriate utilization of antibiotics has become a prevalent and alarming problem within the healthcare system of Pakistan, giving rise to substantial ramifications for the well-being of the general population. Numerous studies have consistently demonstrated a disconcerting pattern: the excessive prescription of antibiotics for medical conditions that do not necessitate antimicrobial intervention, such as viral upper respiratory tract infections. These infections are predominantly caused by viral agents and are unresponsive to antibiotic treatment (24). The widespread misuse of antibiotics not only exposes patients to potential side effects and adverse reactions, but also plays a significant role in the concerning global issue of antibiotic resistance. The survival and proliferation of antibiotic-resistant bacteria can occur as a result of the selective pressure exerted by the inappropriate prescription of antibiotics. The aforementioned strains exhibit resistance to commonly used antibiotics, resulting in the loss of efficacy of previously effective medications. The ramifications of antibiotic resistance are severe, as it restricts the range of treatment options for infectious diseases, resulting in prolonged periods of illness, escalated healthcare expenditures, and elevated rates of morbidity and mortality (25).

2.5.4 Consequences of Inappropriate Antibiotic Use in Pakistan

The consequences of inappropriate antibiotic use in Pakistan are multifaceted. Antimicrobial resistance has been steadily rising, making infections harder to treat and posing a significant threat to public health. Infections that were once easily treatable are becoming more challenging and costly to manage, leading to increased hospital stays and healthcare expenses. Furthermore, the emergence of resistant bacteria can lead to treatment failures, resulting in prolonged illnesses

and higher mortality rates. Inappropriate antibiotic use also contributes to the disruption of the human microbiome, affecting gut health and potentially causing long-term health issues (26).

2.6 Pharmacist's Role in Promoting Rational Antibiotic Use

2.6.1 Importance of Pharmacists in Healthcare Settings

Pharmacists play a pivotal role in healthcare settings, acting as essential members of the healthcare team. Their expertise in medication management, drug interactions, and dosage guidelines positions them to contribute significantly to rational antibiotic use. Pharmacists have direct access to patients and are often the last line of defense before an antibiotic is dispensed. Their presence in community pharmacies, hospitals, and clinics enables them to engage with patients and healthcare providers, ensuring the appropriate and rational use of antibiotics. Furthermore, pharmacists' accessibility allows for real-time interventions, improving patient outcomes and minimizing the adverse effects of antibiotics (27).

2.6.2 Contribution of Pharmacists to Rational Antibiotic Use

Pharmacists contribute to rational antibiotic use through several key activities. First, they engage in medication reviews, evaluating prescriptions to ensure the appropriateness of the prescribed antibiotics, including the correct dosage and duration of therapy. Pharmacists can recommend narrow-spectrum antibiotics when appropriate, helping to minimize the risk of resistance development. Second, pharmacists provide patient education and counseling on the proper use of antibiotics, emphasizing adherence to prescribed regimens and the importance of completing the full course of treatment. By fostering patient understanding, pharmacists promote responsible antibiotic use and discourage self-medication practices (28). Pharmacists are instrumental in implementing antibiotic stewardship programs in healthcare facilities. They collaborate with healthcare teams to develop and implement evidence-based guidelines for antibiotic use. Pharmacists conduct regular audits of antibiotic prescribing practices, offering feedback and recommendations to improve prescribing patterns. They actively participate in antimicrobial stewardship committees, advocating for rational antibiotic use and promoting the appropriate use of broad-spectrum antibiotics only when necessary (29).

2.6.3 Challenges Faced by Pharmacists in Antibiotic Dispensing and Counseling

Despite their significant contributions, pharmacists face certain challenges in promoting rational antibiotic use. One key challenge is patient expectations and demands for antibiotics, even when not medically indicated. Patients often seek antibiotics for viral infections, where antibiotics are ineffective, and may be reluctant to accept non-antibiotic treatment alternatives. Addressing patient expectations while adhering to evidence-based practices requires effective communication skills and patient education. Time constraints and workload pressures can also impede pharmacists' ability to provide comprehensive counseling to every patient. In busy pharmacy settings, pharmacists may have limited time for individual patient interactions, making it challenging to deliver detailed counseling on antibiotic use. Furthermore, some pharmacists may encounter resistance from prescribers or lack the authority to influence prescribing decisions directly. Collaborating with healthcare providers and demonstrating the value of pharmacists' interventions may require advocacy and perseverance (30).

2.7 E-prescription Systems and Their Potential Benefits

2.7.1 Definition and Features of E-prescription Systems

Electronic prescription systems, commonly referred to as e-prescription systems, have significantly transformed the manner in which healthcare providers and pharmacies manage medication prescriptions. The utilization of advanced digital platforms is of paramount importance in contemporary healthcare, as they effectively enable the efficient creation, transmission, and processing of electronic prescriptions (31). Healthcare professionals benefit from a user-friendly interface that facilitates the electronic composition of prescriptions and provides immediate access to a patient's medication history. Furthermore, these systems play a crucial role in safeguarding patient safety as they conduct thorough checks for potential drug interactions and allergies prior to finalizing prescriptions (32). This prioritization of patient safety is of utmost importance. The adoption of e-prescription systems within the medical field offers several benefits, including the optimization of medication management, enhanced communication among healthcare stakeholders, and a notable decrease in the occurrence of prescription errors. With the ongoing advancement of technology, it is expected that these

systems will persist in exerting a favorable influence on the healthcare domain, thereby providing advantages to both healthcare practitioners and patients (33).

2.7.2 Advantages of E-prescription Systems in Healthcare

E-prescription systems offer numerous advantages in healthcare settings. Firstly, they improve the efficiency and accuracy of the prescription process by eliminating the need for handwritten prescriptions, which can be prone to errors. Electronic prescriptions are legible, reducing the risk of misinterpretation and medication-related mistakes. Secondly, these systems enhance patient convenience and accessibility. Patients can easily receive their prescriptions electronically, allowing them to pick up their medications at any pharmacy of their choice, even when away from their primary healthcare provider. E-prescription systems enable real-time access to patient medication history, allergies, and drug interactions. This feature empowers healthcare providers to make informed decisions about medication choices, reducing the risk of adverse drug events and potential interactions. Additionally, electronic prescriptions can be securely transmitted to pharmacies, minimizing the likelihood of lost or misplaced paper prescriptions (34).

2.7.3 Role of E-prescription in Reducing Medication Errors

E-prescription systems play a critical role in reducing medication errors, which can have severe consequences for patient safety. By automating the prescription process, these systems help prevent common errors, such as illegible handwriting, incorrect dosages, and drug-drug interactions. The availability of decision support tools in e-prescription systems alerts healthcare providers to potential issues, such as allergies or contraindications, ensuring that medications are prescribed appropriately. These decision support tools serve as a safety net, prompting healthcare professionals to double-check prescriptions and make necessary adjustments (35). Moreover, e-prescription systems can facilitate medication reconciliation during care transitions, such as hospital admissions or transfers. Ensuring accurate medication lists during these critical points in care can prevent medication errors and improve patient outcomes. By reducing medication errors, e-prescription systems contribute to a safer and more efficient healthcare system (36).

2.7.4 Potential Impact of E-prescription on Rational Antibiotic Use

Electronic prescription systems have the capacity to significantly influence the appropriate utilization of antibiotics in a beneficial manner. By granting healthcare providers with the means to access evidence-based guidelines and clinical decision support tools, these systems can effectively assist them in selecting the most suitable antibiotics for particular infections. E-prescription systems have the potential to deter the inappropriate utilization of antibiotics for viral infections or non-bacterial ailments by means of alerts and reminders (37). These systems have the potential to enhance surveillance initiatives for antimicrobial resistance through the collection of data pertaining to antibiotic prescriptions and patterns of resistance. The aforementioned data possesses the potential to be utilized for the purpose of monitoring trends, identifying areas of concern, and providing guidance for public health interventions aimed at addressing emerging issues related to resistance. Electronic prescription systems have the potential to enhance communication and foster collaboration among healthcare providers and pharmacists, thereby fostering a culture of shared decision-making in the realm of antibiotic prescribing. Pharmacists have the capability to receive electronic prescriptions, assess their suitability, and provide counseling to patients, thereby facilitating the promotion of rational antibiotic utilization. Electronic prescription systems provide numerous advantages in the healthcare sector, encompassing enhancements in prescription precision and patient well-being, as well as the encouragement of judicious antibiotic utilization. Through the utilization of the characteristics and benefits inherent in these systems, healthcare providers and pharmacists can collaborate in order to guarantee the proper utilization of antibiotics, thereby making a valuable contribution to the worldwide endeavors aimed at combating antimicrobial resistance and preserving the effectiveness of these indispensable medications (38).

2.8 E-prescription Systems Implementation in Developing Countries

2.8.1 Adoption and Implementation Challenges in Developing Nations

The adoption and effective implementation of electronic prescription systems in developing nations pose distinct challenges. The widespread adoption of e-prescription systems may be impeded by the limited availability of technology and internet connectivity in remote or

underserved regions. The effectiveness of these systems may be hindered by insufficient infrastructure and a deficiency in digital literacy among healthcare professionals (39). The consideration of costs presents a substantial obstacle to the implementation process. Developing nations may encounter financial limitations when it comes to procuring and sustaining e-prescription systems, as these systems typically necessitate significant investments in hardware, software, and training. Resource-limited healthcare settings may face challenges in managing the ongoing expenses related to system maintenance, updates, and technical support. During the implementation of e-prescription systems, there may be concerns that emerge in relation to data security and privacy. Developing nations may exhibit a deficiency in comprehensive data protection regulations and the requisite proficiency to adequately safeguard sensitive patient data. The establishment of confidentiality and integrity measures for patient data is imperative in cultivating trust within the system and fostering its widespread acceptance (40).

2.8.2 Success Stories of E-prescription Implementation in Other Countries

Despite the challenges, there have been success stories in e-prescription implementation in various countries. For instance, Sweden has achieved widespread adoption of e-prescription systems, enabling seamless communication between healthcare providers and pharmacies. The success in Sweden was attributed to the country's robust digital infrastructure, strong commitment from healthcare stakeholders, and clear policies promoting electronic health records and e-prescriptions. The United States, several states have implemented successful e-prescription initiatives. The benefits of these initiatives include improved medication safety, reduced prescription errors, and enhanced patient convenience. The integration of e-prescription systems into electronic health records has facilitated the adoption process and encouraged healthcare providers to embrace the technology (31).

2.8.3 Lessons Learned from E-prescription Initiatives

Lessons learned from successful e-prescription initiatives in various countries can guide developing nations in their own implementation efforts. Firstly, strong leadership and stakeholder engagement are crucial for driving successful adoption. Government support and commitment to investing in healthcare technology play a pivotal role in overcoming financial barriers. Engaging

healthcare professionals, pharmacists, and patients in the planning and implementation process fosters ownership and acceptance of the system. Building a robust digital infrastructure and ensuring interoperability between different health systems are essential prerequisites for e-prescription implementation. Developing countries can learn from success stories by prioritizing the development of electronic health record systems and digital health infrastructure (33). Implementing e-prescription systems in developing countries comes with its own set of challenges and considerations. Learning from the successes and lessons of other countries can help inform effective strategies for adoption and implementation. By addressing infrastructure, financial, and regulatory hurdles while engaging stakeholders and prioritizing patient data security, developing countries can harness the potential of e-prescription systems to enhance healthcare delivery and promote rational medication use (33).

2.9 E-prescription Systems in Pakistan: Current State

2.9.1 Overview of E-prescription Systems Adoption in Pakistan

The adoption of e-prescription systems in Pakistan's healthcare system is still in its early stages. While there is a growing recognition of the potential benefits of these systems, their implementation and widespread adoption are not yet fully realized. Various factors, including technological infrastructure limitations, financial constraints, and resistance to change, have contributed to the slower adoption rate compared to more developed countries (41).

2.9.2 Analysis of Existing E-prescription Platforms

Currently, several e-prescription platforms are being utilized in Pakistan. These platforms aim to streamline the prescription process and enhance communication between healthcare providers and pharmacies (42). However, the scope and functionality of these platforms vary. Some platforms offer basic e-prescription capabilities, allowing healthcare providers to generate electronic prescriptions and transmit them to pharmacies. Others may provide additional features, such as drug interaction checking, medication history review, and decision support tools. Evaluating the usability, efficiency, and compatibility of these existing e-prescription platforms is crucial to understanding their effectiveness in promoting rational antibiotic use (43).

2.9.3 Usage Rates and Acceptance Among Healthcare Providers

To improve acceptance and usage among healthcare providers, initiatives are needed to increase awareness about the benefits of e-prescription systems. Training programs and support for healthcare professionals can enhance their understanding of the systems and foster confidence in their use. Collaborative efforts among healthcare authorities, professional organizations, and technology vendors can promote the implementation and adoption of standardized e-prescription systems throughout the country. The current state of e-prescription systems in Pakistan reflects a gradual adoption process with various challenges. While there are existing platforms being used, their usage rates among healthcare providers are still relatively low. Addressing barriers related to infrastructure, finance, awareness, and training is crucial to promote the widespread adoption of e-prescription systems in Pakistan. By overcoming these challenges, Pakistan can harness the

potential of e-prescription systems to improve the rational use of antibiotics and enhance overall healthcare delivery (44).

2.10 Benefits and Barriers of E-prescription Systems for Pharmacists

2.10.1 Perceived Benefits of E-prescription for Pharmacists

E-prescription systems have been found to offer numerous perceived benefits for pharmacists, thereby enhancing their role within healthcare settings. One of the primary benefits of utilizing technology in the healthcare industry is the improvement in accuracy. This is achieved by effectively addressing the challenges associated with deciphering illegible handwritten prescriptions, thereby reducing the risk of medication errors and dispensing mishaps. Furthermore, it is important to note that these systems have the capability to provide pharmacists with real-time access to vital patient information. This includes comprehensive medication histories, documented allergies, and potential drug interactions. By having access to this valuable data, pharmacists are empowered to make informed decisions and offer personalized medication counseling to patients (45).

2.10.2 Challenges and Concerns Related to E-prescription Adoption

The adoption of e-prescription systems for pharmacists has gained significant attention due to its potential benefits. However, this transition is not without its fair share of challenges and concerns. One potential obstacle that pharmacists may encounter in accessing these systems is the presence of technological barriers. These barriers can manifest in various forms, including limited internet connectivity and inadequate digital infrastructure in certain regions. These limitations may hinder pharmacists' ability to effectively utilize the systems in question. Furthermore, it is important to note that the initial implementation costs can pose a considerable challenge for pharmacies, particularly in settings with limited resources. Thirdly, it is important to consider that the transition from paper-based prescriptions to electronic systems may introduce a learning curve for pharmacists. This learning curve has the potential to impact workflow efficiency, particularly during the initial stages of implementation. In addition to the aforementioned points, it is important to consider concerns regarding data security and privacy of

patient information. These concerns may become more prominent, especially in situations where there is a lack of comprehensive data protection regulations in place. In conclusion, it is important to address the interoperability concerns that arise when using various e-prescription platforms and electronic health record systems. These issues can pose significant obstacles to the seamless exchange of information, ultimately impacting the overall effectiveness and efficiency of the system. The successful integration and utilization of e-prescription systems in pharmacy practices necessitates addressing these challenges (46).

2.10.3 Factors Influencing Pharmacists' Willingness to Embrace E-prescription

The adoption of e-prescription systems by pharmacists is influenced by various significant factors. First and foremost, it is imperative to provide pharmacists with comprehensive training and continuous technical support in order to ensure they possess the essential skills and confidence required for the effective utilization of these systems. Furthermore, the seamless integration of pharmacy workflows and electronic health record systems plays a crucial role in enhancing the probability of successful adoption. Thirdly, it is imperative to address concerns related to data security and ensure strict adherence to data protection regulations in order to foster trust in the technology. In addition to the aforementioned points, it is worth noting that there is substantial evidence supporting the advantages associated with the integration of technology in pharmacy practice. One significant benefit is the enhanced accuracy of prescriptions, which can be attributed to the utilization of technological tools. By leveraging these tools, pharmacists are able to minimize errors in prescription processing, thereby ensuring that patients receive the correct medications and dosages. This not only promotes patient safety but also contributes to improved health outcomes. Furthermore, the integration of technology in pharmacy practice has been shown to have a positive impact on patient outcomes. Through the use of electronic health records and other digital platforms, pharmacists are able to access comprehensive patient information, including medical history, allergies, and current medications. This enables them to make more informed decisions when dispensing medications, taking into account potential drug interactions or contraindications. In conclusion, the cultivation of robust collaboration between pharmacists and prescribers during the implementation phase of healthcare initiatives is crucial for fostering mutual understanding and acceptance. In conclusion,

the adoption of e-prescription systems has the potential to greatly improve the ability of pharmacists to effectively manage medication, ensuring safety and efficiency. However, it is crucial to address technological challenges and concerns in order to achieve widespread implementation and acceptance of these systems. By taking into account various factors and offering the required assistance, the healthcare system can optimize the potential advantages of e-prescription systems and enhance the quality of patient care (47).

2.11 Impact of E-prescription on Pharmacist-Physician Collaboration

2.11.1 Communication and Information Exchange between Pharmacists and Physicians

The utilization of e-prescription systems has been found to enhance communication between healthcare providers and pharmacists. This improved communication enables more efficient clarification of prescription instructions. The ability of pharmacists to promptly communicate with physicians plays a crucial role in enhancing prescription accuracy and ensuring patient safety. By establishing effective channels of communication, pharmacists can seek clarification or address any discrepancies that may arise during the prescription filling process. This proactive approach enables pharmacists to promptly resolve any potential issues, thereby minimizing the risk of medication errors and enhancing patient well-being. The implementation of a streamlined communication process has been found to facilitate effective collaboration between pharmacists and physicians. This collaborative approach has been shown to have a positive impact on patient outcomes, as well as a reduction in medication-related issues. By optimizing the exchange of information and promoting seamless communication, pharmacists and physicians are able to work together more efficiently and effectively. This research highlights the importance of establishing a streamlined communication process in healthcare settings, as it can significantly enhance the quality of patient care and contribute to improved overall healthcare outcomes (33).

2.11.2 Collaborative Efforts in Promoting Rational Antibiotic Use

E-prescription systems have emerged as a valuable tool for facilitating collaborative efforts between pharmacists and physicians in the promotion of rational antibiotic use. The utilization of real-time patient information empowers pharmacists to detect cases of inappropriate antibiotic

prescribing and participate in proactive interventions. In the realm of healthcare, professionals have the ability to make recommendations regarding the use of narrow-spectrum antibiotics in situations where it is deemed suitable. These recommendations are based on evidence-based guidelines, ensuring that the advice provided is grounded in scientific research and best practices. Furthermore, healthcare providers may also propose alternative treatment options that do not involve the use of antibiotics for viral infections. This approach aims to optimize patient care by considering various factors and tailoring the treatment plan accordingly (48). E-prescription systems commonly incorporate clinical decision support tools. These tools serve the purpose of notifying physicians about potential drug interactions, dosing errors, and the appropriateness of antibiotics. The implementation of these alerts serves as a catalyst for physicians to reassess their prescription choices, thereby fostering a culture of deliberate antibiotic prescribing decisions (49).

2.11.3 Enhancing Interprofessional Relationships through E-prescription

The utilization of e-prescription systems has been found to have a positive impact on the interprofessional relationships between pharmacists and physicians. These systems enable seamless communication and collaboration between the two healthcare professionals, leading to improved patient care and outcomes. One key advantage of e-prescription systems is the ability to transmit accurate and legible prescriptions electronically. This eliminates the potential for errors that can occur with handwritten prescriptions, such as misinterpretation of dosage instructions or medication names. The utilization of a widely adopted digital platform enables healthcare professionals to access and contribute to a centralized repository of patient information. This practice fosters a collaborative approach to patient care, where responsibility is shared among the healthcare team. According to research, physicians can rely on pharmacists to have access to precise and current medication histories. This access enables them to make better-informed decisions regarding medication-related matters (50). Furthermore, the implementation of e-prescription systems has been found to have the potential to enhance the process of medication reconciliation during various care transitions, including hospital admissions and discharges. Pharmacists possess the ability to assess electronic medication histories and work alongside physicians in order to establish a smooth and uninterrupted flow of

care, thereby mitigating the occurrence of medication-related errors and adverse events. The promotion of effective interprofessional relationships is a key factor in the enhancement of communication, coordination, and patient care outcomes through the implementation of e-prescription systems (51).

2.12 Patient Perspectives on E-prescription Systems and Antibiotics

2.12.1 Patient Understanding and Acceptance of E-prescription

The level of patient comprehension and willingness to adopt e-prescription systems exhibits variability, influenced by factors including age, digital literacy, and prior encounters with healthcare technologies. In general, it has been observed that a significant number of patients exhibit a positive attitude towards e-prescription systems once they have gained a comprehensive understanding of the advantages associated with such systems. According to research, patients have expressed a positive reception towards electronic prescriptions due to their legibility and accuracy. This feature significantly mitigates the potential risks associated with medication errors. In addition to other factors, individuals also place significant importance on the convenience associated with electronically transmitting their prescriptions to their preferred pharmacy. This process eliminates the necessity of physically carrying paper prescriptions, thereby streamlining the overall prescription fulfillment experience (52).

2.12.2 Patient Preferences for Electronic versus Paper Prescriptions

The preferences of patients regarding the use of electronic prescriptions as opposed to paper prescriptions are influenced by a multitude of factors. According to research, a significant number of patients express a preference for e-prescriptions, citing reasons such as convenience and efficiency. These individuals find that the electronic format of prescriptions offers them a more streamlined and hassle-free experience. By eliminating the need for physical paper prescriptions, e-prescriptions allow patients to easily access and manage their medication orders. Additionally, the electronic nature of these prescriptions enables healthcare providers to transmit them directly to pharmacies, reducing the risk of errors or delays. E-prescriptions offer the convenience of easy refills without the requirement of a physical copy. Additionally, patients can

benefit from automated reminders for medication pickups and refills. According to research, individuals who actively engage with digital health tools and exhibit a preference for a more efficient and simplified healthcare journey are inclined towards utilizing electronic prescriptions (53).

2.12.3 Impact of E-prescription on Patient Adherence to Antibiotic Regimens

E-prescription systems have been found to have a positive impact on patient adherence to antibiotic regimens through various mechanisms. The primary advantage of electronic prescriptions lies in their ability to enhance clarity and accuracy, thereby minimizing the occurrence of medication errors. This improvement in precision ensures that patients are administered the correct antibiotics, along with the appropriate dosages and instructions. The implementation of precision medicine strategies has been shown to have a positive impact on patient understanding and adherence to their prescribed treatment plan. By tailoring medical interventions to the specific characteristics of each individual patient, precision medicine aims to optimize treatment outcomes and improve patient satisfaction. This approach recognizes that each patient is unique, with distinct genetic, environmental, and lifestyle factors that can influence their response to treatment. One key advantage of precision medicine is its ability to provide patients with a deeper understanding of their condition and the rationale behind their treatment plan. By incorporating genetic testing In addition, e-prescription systems commonly incorporate automated medication reminders and instructions, thereby assisting patients in adhering to their antibiotic regimen. The delivery of reminders to patients regarding medication adherence can be facilitated through various communication channels, including email, text messages, and patient portals. These reminders serve the purpose of prompting patients to adhere to their prescribed medication regimen (54).

2.14 Regulatory and Policy Framework for E-prescription in Pakistan

2.14.1 Government Initiatives and Support for E-prescription Implementation

The government of Pakistan has demonstrated an increasing dedication to advancing the utilization of e-prescription systems in order to improve healthcare delivery within the nation.

The commitment to advancing e-prescription technology is evident through various significant initiatives and policies that have been put in place. The Digital Pakistan Vision, initiated by the government, aims to revolutionize the country's economy by incorporating digital technologies into different sectors. One such sector is healthcare, where the implementation of e-prescription systems is expected to have a significant impact (55). In addition, it is worth noting that the Ministry of National Health Services, Regulations, and Coordination has devised an E-Health Strategy with a primary focus on the advancement and incorporation of electronic health systems, such as e-prescription, in order to enhance healthcare services on a national scale. In addition, it is worth noting that Pakistan has implemented several Health Information Exchange (HIE) initiatives. These projects aim to enhance the efficient sharing of patient information among healthcare providers and systems (56). As part of this interconnected healthcare ecosystem, e-prescription systems are anticipated to play a significant role. In addition, it is worth noting that the government is actively advocating for the establishment of public-private partnerships as a means to facilitate the successful implementation of e-prescription systems. This recognition stems from the understanding that such collaborations have the potential to harness the respective expertise of both the public and private sectors, thereby effectively driving the adoption and implementation of e-prescription technologies. The government's commitment to enhancing healthcare accessibility and quality in Pakistan is evident through various initiatives and policies aimed at harnessing the potential of e-prescription systems. These efforts reflect a proactive approach towards leveraging technology to improve healthcare services in the country (56).

2.15 E-prescription and Healthcare Digitalization in Pakistan

2.15.1 Integration of E-prescription in the Wider Healthcare System

The integration of e-prescription in the wider healthcare system is a key component of healthcare digitalization in Pakistan. To achieve seamless integration, e-prescription systems must be compatible with various electronic health information systems and healthcare facilities across the country. This requires developing interoperability standards and ensuring that e-prescription platforms can communicate with electronic health records (EHRs), pharmacy systems, and other digital health tools. Integrating e-prescription with the wider healthcare system allows for

real-time data exchange between healthcare providers, pharmacies, and laboratories. This connectivity enhances collaboration, streamlines care coordination, and improves overall patient outcomes. For example, when a physician prescribes antibiotics electronically, the prescription can be instantly accessed by the pharmacist, reducing the time taken to dispense medications and minimizing errors (55).

2.15.2 Synergy between E-prescription and Electronic Health Records (EHRs)

The synergy between e-prescription and electronic health records (EHRs) is a powerful combination that supports comprehensive patient care. EHRs store a patient's complete medical history, including past diagnoses, allergies, medications, and lab results. When integrated with e-prescription systems, EHRs provide valuable context for healthcare providers when prescribing medications, including antibiotics. For instance, if a patient has a known allergy to a specific antibiotic, the EHR can alert the prescribing physician, preventing the prescription of an inappropriate medication. Additionally, the EHR can inform healthcare providers about the patient's medical history, ensuring that prescribed antibiotics do not interact negatively with other medications the patient is taking. The integration of e-prescription with EHRs enables healthcare professionals to make more informed decisions, enhances patient safety, and promotes evidence-based antibiotic prescribing (57).

2.15.3 Digital Health Infrastructure and Readiness for E-prescription

To fully embrace e-prescription and advance healthcare digitalization, Pakistan must conduct a comprehensive assessment of its digital health infrastructure and readiness. Key factors to consider include ensuring the availability of reliable internet connectivity and electronic devices across regions to facilitate equitable access to e-prescription services. Establishing and adhering to standardized data exchange formats and protocols is essential for seamless interoperability between e-prescription systems and other healthcare information systems. Robust cybersecurity measures and adherence to data protection regulations are vital to safeguard the security and privacy of patient data in e-prescription systems. Moreover, healthcare professionals, pharmacists, and administrative staff require adequate training and capacity building to effectively utilize e-prescription systems and leverage their benefits for patient care. Educating

the public about e-prescription systems, their advantages, and data security measures is equally crucial to enhance patient acceptance and trust in these technologies. By addressing these factors, Pakistan can significantly improve its digital health infrastructure and readiness for e-prescription, paving the way for a more efficient, patient-centered healthcare system. Embracing e-prescription systems not only enhances patient care and medication management but also contributes to better health outcomes while driving forward the country's broader digital health initiatives (58).

2.16 E-prescription and Pharmacy Information Systems in Pakistan

2.16.1 Integration of E-prescription with Pharmacy Information Systems

The integration of e-prescription with pharmacy information systems is a critical step in optimizing medication management and enhancing patient care in Pakistan. By seamlessly connecting e-prescription platforms with pharmacy systems, the entire prescription process, from receiving the prescription to dispensing medications, becomes more efficient and accurate. Integration allows for direct transmission of electronic prescriptions from healthcare providers to pharmacies, eliminating the need for manual entry and reducing the risk of transcription errors. Pharmacists can access patient prescription details in real-time, ensuring they have the most up-to-date information, including any medication changes or updates. Furthermore, integration with pharmacy information systems enables automatic drug interaction checks and alerts, improving patient safety by identifying potential drug-drug interactions or allergies before dispensing the medication. This level of automation and information sharing facilitates a smoother prescription fulfillment process, benefiting both patients and pharmacists (39).

2.16.2 Streamlining Antibiotic Dispensing through E-prescription Integration

The integration of e-prescription systems with pharmacy information systems has been found to have numerous advantages in the dispensing of antibiotics. This integration has been shown to promote rational antibiotic use and enhance medication safety. By seamlessly connecting these two systems, healthcare providers are able to streamline the prescribing and dispensing process, leading to improved patient outcomes. One of the key benefits of integrating e-prescription

systems with pharmacy information systems is the promotion of rational antibiotic use. With this integration, healthcare providers have access to real-time information about a patient's medication history, including any previous antibiotic prescriptions. This allows them to make more informed decisions when prescribing antibiotics, taking into account factors such as the patient's previous antibiotic use, allergies, and potential drug interactions (59).

CHAPTER 3. METHODOLOGY

3.1 RESEARCH DESIGN:

The research design employed in this study was a mixed-methods approach, combining both quantitative and qualitative methods.

3.2 Mixed-Methods Design:

The present study utilized a mixed-methods design, which entailed the integration of qualitative and quantitative research methodologies. The qualitative component of this study involved the implementation of in-depth interviews with a sample of 30 pharmacists who were currently employed in community pharmacies located throughout Balochistan (Pakistan). In order to gather comprehensive data, a quantitative survey was conducted simultaneously alongside the research study. This survey was administered to a sample of 200 pharmacists who worked in community pharmacies located throughout Pakistan. By including this survey, the research aimed to obtain a broader perspective on the topic at hand and gather additional insights from professionals in the field.

3.3 QUALITATIVE STUDY:

3.3.1 Participants and Sample:

In this qualitative study, a deliberate selection process was employed to choose a group of 30 pharmacists who were carefully curated to ensure a wide range of opinions and a comprehensive representation. The purposive sampling technique was deliberately utilized in order to guarantee that the sample included individuals from different geographic regions and types of pharmacies throughout Pakistan. This approach was chosen to enhance the study's findings by incorporating a diverse range of perspectives and ideas. In order to accomplish this objective, a methodical approach was developed to carefully choose individuals from diverse geographical areas, such as Balochistan, as well as a range of pharmacy environments, encompassing both community and hospital settings.

The initial phase of the selection procedure was the identification of prospective participants via established professional networks, local pharmacy groups, and healthcare facilities. This measure guaranteed that the sample was not only geographically diverse but also included a variety of pharmacists working in various healthcare settings. The study sought to include individuals from Balochistan in order to gather distinct perspectives from a location that may pose distinct problems and opportunities in the implementation of an E-prescription system.

The primary aim of this sampling approach was to collect a diverse array of viewpoints in order to augment the credibility and thoroughness of the study's results. The study sought to achieve a comprehensive understanding of pharmacists' perspectives on E-prescription systems and their involvement in antibiotic dispensing by incorporating diverse representation from several locations, including Balochistan. This approach aimed to capture the complexities of local settings and experiences that could potentially shape these opinions. The utilization of this methodology enabled a comprehensive comprehension of the topic at hand and permitted the examination of probable divergences in viewpoints depending on geographical region and type of pharmacy.

Details of participants

Participant ID	Gender	Age	Marital Status	Province	Designation	Education	Experience (Years)
01	Male	33	Married	Balochistan	Hospital Pharmacist	Mphil	5
02	Male	28	Single	Balochistan	Community Pharmacist	Bachelor's	3
03	Male	40	Married	Balochistan	Community Pharmacist	Master's	10
04	Male	25	Single	Balochistan	Community Pharmacist	Bachelor's	2
05	Male	35	Married	Balochistan	Community Pharmacist	Master's	8
06	Male	31	Single	Balochistan	Community Pharmacist	Bachelor's	4
07	Male	29	Single	Balochistan	Community Pharmacist	Bachelor's	3
08	Male	27	Single	Balochistan	Community Pharmacist	Bachelor's	2
09	Male	33	Married	Balochistan	Community Pharmacist	Master's	7
10	Male	26	Single	Balochistan	Community Pharmacist	Bachelor's	3
11	Male	36	Married	Balochistan	Community Pharmacist	Master's	9
12	Male	30	Single	Balochistan	Community Pharmacist	Bachelor's	4
13	Male	42	Married	Balochistan	Community Pharmacist	Master's	12
14	Male	24	Single	Balochistan	Community Pharmacist	Bachelor's	1
15	Male	38	Married	Balochistan	Community Pharmacist	Master's	10

16	Female	29	Single	Balochistan	Community Pharmacist	Bachelor's	5
17	Female	31	Married	Balochistan	Community Pharmacist	Master's	6
18	Female	34	Married	Balochistan	Hospital Pharmacist	Mphil	7
19	Male	27	Single	Balochistan	Hospital Pharmacist	Bachelor's	3
20	Female	36	Married	Balochistan	Hospital Pharmacist	Mphil	9
21	Female	30	Single	Balochistan	Hospital Pharmacist	Bachelor's	5
22	Female	39	Married	Balochistan	Hospital Pharmacist	Mphil	11
23	Male	32	Single	Balochistan	Hospital Pharmacist	Master's	6
24	Male	37	Married	Balochistan	Hospital Pharmacist	Mphil	10
25	Male	29	Single	Balochistan	Hospital Pharmacist	Bachelor's	4
26	Female	41	Married	Balochistan	Hospital Pharmacist	Mphil	12
27	Male	28	Single	Balochistan	Hospital Pharmacist	Bachelor's	3
28	Female	35	Married	Balochistan	Hospital Pharmacist	Mphil	8
29	Male	26	Single	Balochistan	Hospital Pharmacist	Bachelor's	2
30	Male	33	Married	Balochistan	Hospital Pharmacist	Mphil	6

3.3.2 Data Collection:

The data collection for this research involved the use of semi-structured in-depth interviews. The purpose of conducting these interviews was to delve into the intricacies of pharmacists' perspectives on E-prescription systems and the difficulties they encountered in their daily professional routines. The themes and subthemes are attached as *Annexure-I*.

This qualitative study delves into the perspectives of pharmacists from diverse regions, including Balochistan, a province known for its unique geographical and sociocultural attributes within Pakistan. Balochistan's participation in the study was instrumental in providing insights into the challenges and opportunities that emerge in a distinct regional context. Through the thematic analysis, six overarching themes and their corresponding sub themes emerged, reflecting the viewpoints of pharmacists from various locations within Balochistan and other parts of the country. Balochistan's inclusion not only lends geographical diversity to the study but also offers a lens into the intricacies that may arise due to varying healthcare infrastructures, patient demographics, and cultural factors. Pharmacists from Balochistan shed light on their experiences with handwritten prescriptions, the potential benefits of E-prescription systems, and the region-specific factors contributing to antibiotic resistance. By incorporating perspectives from Balochistan, the study expands its scope beyond urban centers and acknowledges the realities faced by pharmacists in remote and underserved areas. The findings contribute to a holistic understanding of E-prescription systems' potential to address healthcare challenges and antibiotic resistance across diverse settings. The insights garnered from pharmacists in Balochistan underscore the need for context-sensitive approaches when implementing strategies to enhance healthcare practices and combat antibiotic resistance in regions with unique characteristics.

3.3.3 Audio Recording and Transcription:

In order to facilitate the interview process, a software known as "diktafon" was utilized. This software was a smartphone application specifically designed for secure audio recording. It offered the capability to directly store the recorded audio files in a protected service called TSD (service for student data). This ensured the confidentiality and safety of the recorded interviews.

The utilization of this particular approach ensured the protection of interview data and upheld the privacy of the participants.

3.3.4 Data Analysis of Qualitative study:

The method of thematic analysis, facilitated by NVivo, was employed to comprehensively analyze the transcribed interview data. Thematic analysis, a widely used approach in qualitative research, involves identifying and analyzing patterns, themes, and categories within the data. This approach aimed to gain a deeper understanding of the participants' perspectives and experiences as expressed in the interview transcripts. Thematic analysis was conducted in several steps. First, the researchers familiarized themselves with the interview data by reading and re-reading the transcripts. Then, initial codes were generated, highlighting specific segments of data that captured key concepts and ideas related to E-prescription systems and their impact on the pharmacist's role. These codes were applied systematically across the dataset using NVivo's coding features.

Subsequently, codes were grouped into potential themes based on their similarities and connections. Themes were refined and defined, ensuring they accurately captured the essence of the data. This involved constant comparison between codes and themes, as well as discussions among the research team to validate the emerging themes. Throughout the analysis process, NVivo's data management capabilities allowed for efficient organization and retrieval of coded segments. Thematic analysis enabled a systematic and rigorous examination of the data, leading to the identification of recurring themes and the extraction of meaningful insights from the interviews. This approach contributed to the overall research objective by facilitating a comprehensive comprehension of the attitudes held by pharmacists towards E-prescription systems.

3.3.5 Ethical Considerations:

The present study strictly adhered to established ethical guidelines for conducting research involving human subjects. The participants received detailed information regarding the purpose of the study as well as a comprehensive explanation of their rights. Participants in this study

were required to provide voluntary informed consent prior to their participation. It was crucial to ensure that participants fully understood the purpose, procedures, and potential risks involved in the study before giving their consent. Moreover, the identities of the participants were strictly protected and kept confidential throughout the entire duration of the research. This confidentiality measure aimed to safeguard the privacy and anonymity of the participants, thereby maintaining the integrity and ethical standards of the study.

3.4 QUANTITATIVE STUDY (SURVEY)

3.4.1 Study Setting, Procedure, and Duration:

The study was conducted across various community pharmacies throughout Pakistan. The data collection period spanned three months, from March 2023 to June 2023. During this time, pharmacists were invited to participate in the online survey through various professional networks and associations.

3.4.2 Data Collection and Study tool:

To collect data for this research, an online survey was conducted using Google Forms. This method was chosen due to its efficiency and convenience, as it allowed pharmacists to easily respond to the questionnaire. The survey questions aimed to collect data regarding the preferences, attitudes, and challenges of pharmacists in relation to the integration of E-prescription systems into their practice. The utilization of Google Forms for conducting an online survey offered numerous advantages in terms of collecting structured data. This platform enabled researchers to efficiently gather information from participants, ensuring that the data collected was organized and easily analyzable. The survey consisted of a combination of closed-ended questions, such as multiple-choice and Likert scale questions, as well as open-ended questions. This approach allowed for the collection of both quantitative and qualitative data.

3.4.3 Analysis for Quantitative study:

The collected data were imported into the Statistical Package for the Social Sciences (SPSS) for analysis. Descriptive statistics were employed to summarize and characterize the distribution of responses to closed-ended questions, facilitating insights into prevailing trends.

3.5. Ethical Considerations:

In this study, it was important to address the ethical considerations that arose from conducting research involving human participants. The principles of respect for autonomy.

3.6 Informed Consent:

Informed consent was a crucial ethical requirement in the research study. Prior to their participation, all potential participants received comprehensive information regarding the study's objectives, methodologies, and any potential risks that may arise from their involvement. This process ensured that individuals had a clear understanding of what they were consenting to and allowed them to make an informed decision about their participation. By providing participants with this information, researchers upheld the principles of autonomy and respect for individuals' rights, promoting transparency and ethical conduct throughout the study. The participants were requested to provide voluntary informed consent, thereby ensuring that they possessed a comprehensive understanding of their rights and retained the freedom to withdraw from the study at any given point without facing any adverse consequences.

3.7 Confidentiality and Anonymity:

Confidentiality and anonymity were crucial considerations in this research study. To ensure the privacy and protection of participants' information, all data gathered from both the interviews and the survey were handled with utmost confidentiality. The data underwent a transcription and analysis process, during which personal identifiers were eliminated to safeguard the anonymity of the participants. The accessibility of the data was limited to the research team exclusively, ensuring strict confidentiality. Furthermore, any outcomes derived from the study were

disseminated in a consolidated and de-identified format, safeguarding the privacy of individuals involved.

3.8 EXPECTED OUTCOMES:

3.8.1 Insights into Pharmacists' Perspectives and Preferences:

The mixed-methods design provided a comprehensive understanding of pharmacists' perspectives and preferences concerning E-prescription systems. The in-depth interviews offered rich qualitative data, while the survey provided quantitative insights into the broader pharmacist community's opinions.

3.8.2 Challenges in Implementing E-prescription Systems in Pakistan:

The qualitative data analysis uncovered the challenges faced by pharmacists in adopting and implementing E-prescription systems in the context of Pakistan's healthcare system. Understanding these challenges helped identify potential barriers to successful implementation.

3.8.3 Implications for Policymakers and Healthcare Professionals:

The study's findings could have significant implications for policymakers, healthcare professionals, and researchers in Pakistan. The insights gained from this research may have informed the development of strategies to potentially improve the integration of E-prescription systems and enhance the rational use of antibiotics, potentially contributing to the advancement of healthcare practices in the country.

CHAPTER 4. RESULTS

I. QUALITATIVE FINDINGS

The findings of this study were classified into six distinct categories.

4.1 Challenges of Handwritten Prescriptions and Advantages of E-prescriptions

4.2 Antibiotic Resistance in Pakistan and Contributing Factors

4.3 Patient Perspectives on E-prescriptions

4.4 Patient Behavior Regarding Antibiotic Prescriptions

4.5 E-prescriptions as a Tool to Combat Antibiotic Resistance

4.6 Barriers to E-prescription Implementation in Pakistan

4.7 benefits of e-prescription to patients and healthcare providers in Pakistan

4.8 suggestions for antibiotic resistance

4.1 Challenges of Handwritten Prescriptions and Advantages of E-prescriptions

Implementing an e-prescription system in Pakistan can enhance patient safety and convenience by streamlining the prescription process, reducing errors, and increasing efficiency. The primary factors contributing to antibiotic resistance in Pakistan are overprescribing, inadequate infection control practices, counterfeit or substandard antibiotics, self-medication, and a lack of stringent regulations. E-prescription systems have been found to have potential benefits in enhancing the rational use of antibiotics, improving documentation, tracking, and control over prescriptions, as well as facilitating monitoring and surveillance. Barriers to implementing e-prescription include various factors such as limited technology infrastructure, digital literacy, resistance to change, concerns regarding data security, and the need for financial investments. In order to effectively combat antibiotic resistance, it is crucial to prioritize various strategies, including enhancing public awareness, promoting education, implementing evidence-based prescribing guidelines,

emphasizing infection prevention measures, and fostering collaboration with policymakers. These multifaceted approaches are considered indispensable in tackling the growing threat of antibiotic resistance.

4.1.1 Difficulties with Deciphering Handwritten Prescriptions

Deciphering handwritten prescriptions is challenging due to language, terminology, legibility, abbreviations, errors, and mistakes. Technology and artificial intelligence have been explored to improve accuracy and reduce errors. Researchers are developing systems like ANN and CRNN to improve legibility and reduce errors.

“... it can be challenging to interpret the handwriting, especially if it is poorly written. In such cases, I usually consult with the prescribing healthcare provider to clarify any ambiguities and ensure accurate dispensing of medication ...” (Participant 1)

When handwriting is unclear, especially on medical prescriptions, understanding it can be difficult. To address this issue, consulting the prescribing healthcare provider is often necessary. This ensures that any uncertainties are resolved, leading to the accurate dispensing of medication and minimizing the potential for errors that might affect patient wellbeing.

“... deciphering handwritten prescriptions can be challenging and prone to errors ...” (Participant 3)

Participant 3 emphasizes the challenge of understanding handwritten prescriptions due to unclear or messy handwriting, highlighting the need for accurate communication and finding ways to mitigate these challenges in the healthcare sector.

“... If there are any unclear or illegible parts, I consult with the prescribing healthcare provider or reach out to them for clarification. Ensuring accuracy in deciphering the information is crucial to prevent any errors or misunderstandings when dispensing medications ...” (Participant 2)

Participant 2's statement emphasizes their method of handling unclear medical documentation, particularly prescriptions, by seeking clarification from the healthcare provider, aiming to ensure precision, prevent mistakes, and maintain patient safety.

4.1.2 Potential Errors and Ambiguities in Handwritten Prescriptions

The utilization of handwritten prescriptions in the medical domain presents a substantial hazard in terms of potential errors and ambiguities. Illegible penmanship has the potential to give rise to misinterpretations, inaccurate dosages, or even the administration of incorrect medications to patients, thereby posing the risk of adverse outcomes. Furthermore, the utilization of abbreviations and the presence of ambiguous instructions have the potential to generate perplexity among pharmacists and healthcare providers, thereby resulting in the occurrence of medication errors. In order to address these potential hazards, it is imperative to implement electronic prescribing systems and promote the use of clear, standardized handwriting techniques. These measures are essential for improving patient safety and guaranteeing precise medication delivery.

“... When I come across handwritten prescriptions, I carefully review them and try to decipher any unclear or illegible information. It is crucial to ensure accurate interpretation to prevent any medication errors during dispensing ...” (Participant 3).

Participant 3 meticulously reviews handwritten prescriptions, focusing on interpreting difficult parts to avoid potential mistakes and maintain patient safety, emphasizing the importance of precise comprehension in the medication dispensing process.

“... Handwritten prescriptions can sometimes pose challenges due to unclear or illegible information...” (Participant 4).

Participant 4 emphasizes the importance of clear, legible handwritten prescriptions for effective communication in healthcare, preventing complications and errors, especially when the information is unclear or illegible.

“... Handwritten prescriptions have the potential to be misinterpreted, which can lead to medication errors. Patients are encouraged to make sure their writing is legible and to reach out to us if they have any questions or need further clarification...” (Participant 8).

Participant 8 warns of the risk of misinterpreting handwritten prescriptions, leading to medication errors. To prevent this, patients should use clear, easy-to-read handwriting and communicate with healthcare providers for clarification, emphasizing the importance of legibility and effective communication.

4.1.3 Benefits of E-prescription System in Modernizing Healthcare

The implementation of the E-prescription system presents notable advantages in the process of modernizing healthcare. The utilization of electronic prescribing systems contributes to the improvement of patient safety by mitigating errors resulting from illegible handwriting and facilitating access to comprehensive medication histories, thereby ensuring the provision of accurate and personalized prescriptions. Furthermore, it enhances workflow efficiency through the optimization of the prescription process, resulting in time savings for healthcare providers and patients alike. Improved collaboration between healthcare professionals and pharmacies results in the expedited dispensation of medications through E-prescriptions, thereby mitigating treatment delays. Overall

“...As a pharmacist, I believe that e-prescriptions play a crucial role in minimizing errors and enhancing patient safety. By eliminating the need for handwritten prescriptions, e-prescriptions significantly reduce the chances of misinterpretation or illegible writing, which can lead to medication errors. This digital method of prescribing also ensures that the prescription is accurately transmitted to the pharmacy, eliminating any potential errors that may occur during the manual transcription process. Overall, e-prescriptions are a valuable tool in improving patient safety and preventing medication errors...” (Participant 19).

Participant 19 highlights the importance of electronic prescriptions (e-prescriptions) in pharmacy, arguing that they reduce errors and enhance patient safety by replacing handwritten prescriptions. E-prescriptions reduce risks of misinterpretation and unclear handwriting, which

can lead to medication errors. The digital nature of e-prescriptions ensures accurate transmission of prescription information, eliminating potential errors during manual transcription. They conclude that e-prescriptions are a valuable asset in enhancing patient safety and preventing medication-related mistakes.

“...I believe that patients greatly benefit from the convenience of accessing their medication history and receiving timely reminders for prescription refills through E-prescriptions...”

(Participant 1).

Participant 1 emphasizes the benefits of e-prescriptions for patients, stating that they provide convenience, easy access to medication history, and timely reminders, enhancing engagement and adherence to treatments, ultimately improving health outcomes.

4.1.4: Improving Efficiency and Patient Safety with E-prescriptions

E-prescriptions play a pivotal role in improving efficiency and patient safety in healthcare. By eliminating the need for handwritten prescriptions, the system reduces the risk of errors caused by illegible handwriting or misinterpretation. With access to complete medication histories, healthcare providers can make informed decisions, ensuring accurate and appropriate prescriptions. The streamlined process facilitates quicker communication between providers and pharmacies, expediting medication dispensing and minimizing delays in patient treatment. Ultimately, E-prescriptions offer a technology-driven solution that enhances both operational efficiency and patient care, fostering a safer and more effective healthcare experience.

“...I believe that e-prescriptions have greatly improved efficiency in medication management. They have significantly reduced processing times and streamlined the prescription workflow...”

(Participant 2).

Participant 2 highlights the positive impact of electronic prescriptions on medication management efficiency, reducing processing times and optimizing workflow. This streamlined approach benefits healthcare providers and patients, enhancing operational aspects and patient care.

“... The digital nature of E-prescriptions allows for real-time communication between healthcare providers and pharmacies, which promotes seamless coordination and improves patient safety. ...” (Participant 22).

Participant 22 highlights the benefits of electronic prescriptions in healthcare, highlighting their digital nature for instant communication between providers and pharmacies, enhancing patient safety and promoting efficient collaboration among healthcare stakeholders.

“... E-prescriptions have been instrumental in reducing the risk of errors commonly associated with handwritten prescriptions. This advancement in technology has greatly enhanced patient safety by minimizing the chances of misinterpretation or illegible handwriting. ...” (Participant 26).

Participant 26 highlights the positive impact of electronic prescriptions on reducing errors, mitigating risks associated with handwritten prescriptions. This technological advancement improves patient safety by reducing misinterpretation and unclear handwriting issues, highlighting its importance in modern healthcare practices.

4.1.5: Patient Acceptance and Perception of E-prescriptions

Patient acceptance and perception of E-prescriptions have become increasingly positive in modern healthcare. With the convenience and efficiency it offers, patients appreciate the ease of receiving prescriptions directly sent to their chosen pharmacies, eliminating the need for paper prescriptions. Moreover, E-prescriptions inspire confidence in accuracy and safety, as healthcare providers can access comprehensive medication histories, reducing the likelihood of errors and adverse reactions. The digital nature of E-prescriptions aligns with the tech-savvy nature of today's patients, fostering a sense of empowerment and active involvement in their healthcare decisions. As patients witness the benefits of this system firsthand, their acceptance continues to grow, contributing to a more seamless and patient-centric healthcare experience overall.

“... At first, patients might have mixed feelings about E-prescriptions since it signifies a shift from the conventional paper-based system...” (Participant 12).

Participant 12 acknowledges patients may initially experience conflicting emotions when using electronic prescriptions, highlighting the transitional nature of these shifts from traditional paper-based systems to a new technological approach.

“... Once patients understand the advantages, such as faster processing, reduced errors, and increased convenience, they generally embrace E-prescriptions as a positive development in healthcare delivery...” (Participant 17).

Patient attitudes towards electronic prescriptions change over time. Initially, they may have reservations due to the shift from paper-based systems. However, as they become aware of benefits like faster processing and convenience, they embrace e-prescriptions.

“... I believe that patient acceptance of E-prescriptions is greatly influenced by their awareness of the system’s benefits. It is crucial for us to actively engage with patients and address any concerns or doubts they may have in order to ensure their acceptance of E-prescriptions...” (Participant 1).

Participant 1 emphasizes the significance of patient acceptance of electronic prescriptions, stating that understanding the benefits of the system is crucial. Active engagement, effective communication, and patient education are essential for a positive reception of technological changes in healthcare.

“... I want to highlight the patient-centric approach of E-prescriptions. It is crucial for us to prioritize the safety and well-being of our patients when implementing this advanced technology. We aim to reassure patients that their needs and concerns are at the forefront of our decision-making process...” (Participant 9).

Participant 9 emphasizes the patient-centered approach to electronic prescriptions, prioritizing safety and well-being. This ethical responsibility aligns with healthcare advancements, ensuring the technological shift benefits patients and aligns with their best interests.

4.2 Antibiotic Resistance in Pakistan and Contributing Factors

Antibiotic resistance in Pakistan is primarily driven by overprescribing and inappropriate use of antibiotics, lack of public awareness, inadequate infection control practices, counterfeit or substandard antibiotics, self-medication, and lack of strict regulations on dispensing. Addressing this issue requires a multifaceted approach, including public education, improved prescribing practices, and enhanced infection control measures. Overprescribing and inappropriate antibiotic use contribute to the development of resistant bacteria. Insufficient public awareness and education about proper antibiotic usage leads to misuse and non-adherence. Poor infection prevention and control practices in healthcare settings further exacerbate the problem.

4.2.1: Causes of Antibiotic Resistance in Pakistan

Antibiotic resistance in Pakistan stems from a combination of factors, including the overuse and misuse of antibiotics, inadequate access to healthcare facilities leading to self-medication, and the unregulated sale of antibiotics without prescriptions. Additionally, limited awareness among the general public and healthcare professionals about the consequences of antibiotic misuse further exacerbates the problem. The improper disposal of antibiotics and lack of proper sanitation practices also contribute to the spread of drug-resistant bacteria. Addressing these multifaceted causes is crucial to combat antibiotic resistance and preserve the effectiveness of these life-saving medications.

“... Yes, the unrestricted availability of antibiotics without a prescription is a significant problem. It allows people to self-medicate and obtain antibiotics inappropriately, without the proper diagnosis and guidance from healthcare professionals...” (Participant 2).

Participant 2's statement highlights the dangers of unrestricted antibiotic access without a prescription, highlighting the potential for antibiotic resistance and ineffective treatment, emphasizing the need for proper medical oversight.

“... One common misconception is that antibiotics can treat all infections, including viral ones. Patients often demand antibiotics for viral illnesses like the common cold, and some healthcare

providers may prescribe them unnecessarily. This misuse of antibiotics accelerates the development of resistance...” (Participant 5)

Participant 5 argues that the misconception that antibiotics can treat all infections, including viral ones, is a significant issue. This leads to inappropriate use of antibiotics, contributing to antibiotic resistance, and underscores the need for proper antibiotic usage.

“... Public awareness is paramount. By engaging in awareness campaigns and educational initiatives, pharmacists can help raise awareness about antibiotic resistance and the importance of responsible antibiotic use. When patients are informed, they are more likely to take an active role in safeguarding their health and the efficacy of antibiotics for future generations...”. (Participant 27).

Participant 27 emphasizes the importance of public awareness in combating antibiotic resistance, suggesting pharmacists can contribute by conducting awareness campaigns and educational programs. This educates patients about responsible antibiotic usage, promoting health and future generations' health protection.

4.2.2: Overprescribing and Inappropriate Use of Antibiotics

The issue of overprescribing and inappropriate utilization of antibiotics presents a substantial obstacle within the healthcare sector. It is possible for medical practitioners to prescribe antibiotics inappropriately for ailments caused by viral agents, rendering the treatment ineffective due to the lack of antibiotic efficacy against viruses. This practice can contribute to the development of antibiotic resistance. Furthermore, it is not uncommon for patients to exhibit a tendency to request antibiotics for minor ailments or to prematurely discontinue the entire prescribed regimen, thereby facilitating the proliferation of antibiotic-resistant bacteria. Additionally, the utilization of antibiotics in the agricultural and livestock sectors is also a contributing factor to the emergence and proliferation of antibiotic-resistant strains. In order to effectively tackle the problem of antibiotic resistance and safeguard the efficacy of these crucial medications for future generations, it is imperative to address these concerns by means of appropriate education, guidelines, and responsible antibiotic stewardship.

“... Overprescribing and inappropriate use of antibiotics are significant concerns in healthcare. These practices contribute to antibiotic resistance, making it challenging to treat infections effectively...” (Participant 30).

Participant 30's statement emphasizes the importance of addressing overprescribing and inappropriate use of antibiotics in healthcare to prevent antibiotic resistance, highlighting the need for responsible antibiotic usage practices to maintain effective infection treatment.

“... Inappropriate use includes patients not completing their full antibiotic course as prescribed. Additionally, sharing antibiotics or using leftover medication from a previous illness can lead to suboptimal treatment and foster resistance...” (Participant 1).

Participant 1 emphasizes the importance of responsible antibiotic use, highlighting the need for patients to complete prescribed courses, avoid sharing antibiotics, and avoid sharing or using leftover medication from previous illnesses, to prevent suboptimal treatment and antibiotic resistance.

“... Pharmacists can actively engage in patient education. We can counsel patients on the proper use of antibiotics, the importance of adherence, and the potential consequences of overuse. Moreover, we can collaborate with healthcare providers to promote antibiotic stewardship practices...” (Participant 11).

Participant 11 emphasizes the importance of pharmacists in patient education and antibiotic stewardship. They can educate patients on appropriate antibiotic use, emphasize adherence, and promote responsible practices, thereby preventing misuse and combating antibiotic resistance.

4.2.3 Lack of Public Awareness and Education on Antibiotic Usage

Lack of public awareness is a significant issue we encounter regularly. Many patients don't fully understand the implications of antibiotic misuse and overuse. They may not be aware that antibiotics are ineffective against viral infections, leading to unnecessary demand for these medications.

“... As frontline healthcare professionals, we take every opportunity to educate patients about antibiotics. We provide detailed counseling on the importance of taking antibiotics as prescribed, completing the full course, and not sharing or self-medicating with leftover antibiotics...” (Participant 19).

Participant 19's statement highlights the proactive role of frontline healthcare professionals in educating patients about antibiotics. They emphasize that they utilize every available opportunity to provide patients with comprehensive guidance. This includes counseling on crucial aspects such as the significance of following the prescribed antibiotic regimen, completing the entire course, and refraining from sharing or self-medicating with leftover antibiotics. The statement underscores the commitment of healthcare professionals to fostering responsible antibiotic usage by ensuring patients are well-informed about the appropriate practices to prevent antibiotic resistance and optimize treatment outcomes.

“... I would suggest that we could utilize various strategies to raise awareness about antibiotic resistance and responsible usage. These may include displaying informative posters and brochures, conducting awareness campaigns, and engaging in one-on-one discussions with patients. These efforts can effectively spread knowledge and educate individuals about the importance of using antibiotics responsibly...” (Participant 28).

Strategies to raise awareness about antibiotic resistance and responsible usage include displaying posters, conducting awareness campaigns, and engaging in patient discussions.

4.2.4 Inadequate Infection Control Practices in Healthcare Settings

Inadequate infection control practices in healthcare settings can significantly contribute to the spread of infections and antibiotic resistance. Failure to adhere to proper hand hygiene, lack of isolation protocols for infected patients, and improper sterilization of medical equipment can lead to the transmission of harmful pathogens. Moreover, overcrowding and poor ventilation in healthcare facilities may exacerbate the risk of infections. Implementing strict infection control measures, educating healthcare personnel, and promoting a culture of patient safety are essential

in reducing healthcare-associated infections and curbing the emergence of antibiotic-resistant organisms.

“... One challenge is the high patient volume in busy healthcare facilities, making it difficult to ensure that everyone follows infection control measures consistently. Additionally, limited resources and time constraints can impact the implementation of comprehensive infection control protocols...” (Participant 5)

Participant 5 highlights the challenges of infection control measures in busy healthcare settings, including high patient volume, limited resources, and time constraints, which can make it difficult to consistently adhere to infection prevention efforts.

“... In our capacity, we reinforce the importance of infection control practices to patients during counseling sessions. We advise them on hand hygiene, proper disposal of medications, and the need to follow healthcare facility guidelines to protect themselves from infections...” (Participant 18).

Participant 18 emphasizes the importance of infection control practices in counseling sessions, advising patients on proper hand hygiene, medication disposal, and adhering to healthcare facility guidelines, aiming to educate and empower patients to actively protect themselves from infections.

4.2.5 Availability of Counterfeit or Substandard Antibiotics

The availability of counterfeit or substandard antibiotics poses a serious threat to public health. In many regions, including developing countries like Pakistan, the presence of fake or low-quality antibiotics in the market is a significant concern. These counterfeit drugs often lack the active ingredients or have incorrect dosages, leading to treatment failure and the development of antibiotic resistance. Moreover, patients may unknowingly consume these substandard antibiotics, further complicating their health conditions and compromising the effectiveness of genuine antibiotics when they are truly needed. Stringent regulatory measures, increased surveillance, and public awareness campaigns are crucial in combating this issue and ensuring access to safe and effective antibiotics.

“... Yes, unfortunately, we have come across such cases. The availability of counterfeit or substandard antibiotics is a concerning issue in Pakistan. These medications pose serious risks to patient health and can contribute to the development of antibiotic resistance...” (Participant 1).

Participant 1 highlights Pakistan's issue of counterfeit or substandard antibiotics, posing a significant risk to patient health and antibiotic resistance. They emphasize the need for improved medication quality, regulation, and patient safety in healthcare systems.

“... One challenge is the sophistication of counterfeit medications. Some counterfeit drugs may closely resemble genuine products, making it difficult to detect without specialized equipment and expertise. Moreover, a lack of proper regulation in certain areas can contribute to the presence of such drugs in the market...” (Participant 4).

Counterfeit medications pose a challenge due to their sophistication, which can be difficult to detect without specialized equipment and expertise, and the lack of proper regulation in certain areas.

4.2.6 Self-medication and Absence of Strict Regulations on Antibiotic Dispensing

The impact of self-medication and the lack of stringent regulations on the dispensing of antibiotics are key factors that contribute significantly to the development and spread of antibiotic resistance. In regions with limited healthcare access, such as Pakistan, individuals frequently engage in self-diagnosis and self-prescription practices, resulting in the inappropriate utilization of antibiotics. In addition, the accessibility of antibiotics without a valid prescription fosters a culture of misuse and overutilization. The absence of stringent regulations facilitates the unregulated commerce and dissemination of antibiotics, thereby exacerbating the emergence and proliferation of drug-resistant bacteria. The implementation of more stringent regulations regarding the dispensing of antibiotics, as well as the promotion of awareness regarding the risks associated with self-medication, are imperative in the fight against antibiotic resistance and the preservation of the effectiveness of these vital medications.

“... Yes, self-medication with antibiotics is unfortunately common in Pakistan. Some patients may purchase antibiotics without a prescription, leading to inappropriate use and potential risks to their health...” (Participant 11).

Participant 11 acknowledges the prevalence of self-medication with antibiotics in Pakistan, highlighting the potential risks of inappropriate use and antibiotic resistance. They call for increased awareness and education on responsible antibiotic use to combat this trend and promote patient safety, highlighting the need for proper medical guidance.

“... Pharmacists can actively discourage self-medication with antibiotics by educating patients about the importance of seeking proper medical advice. We can explain the risks associated with improper antibiotic use and encourage patients to consult healthcare providers for accurate diagnosis and treatment...” (Participant 25).

Participant 25 emphasizes the importance of pharmacists in preventing self-medication with antibiotics. They emphasize the need for pharmacists to educate patients about the importance of seeking medical advice and the risks associated with incorrect antibiotic usage. This approach promotes safe and effective healthcare practices.

“... To enforce stricter regulations, policymakers can consider implementing electronic surveillance systems to track antibiotic sales and ensure compliance with prescription requirements...” (Participant 30).

Participant 30 proposes electronic surveillance systems to monitor antibiotic sales and ensure prescription requirements are followed. This strategy could create a more controlled environment for antibiotic access, reducing inappropriate use and promoting responsible prescription practices. It highlights the role of technology in enhancing regulatory measures against antibiotic misuse and public health.

4.3 Patient Perspectives on E-prescriptions

The prevailing sentiment among patients regarding E-prescriptions has been overwhelmingly positive, indicating a notable increase in the adoption of technological advancements within the

healthcare sector. The electronic transmission of prescriptions to pharmacies has gained significant popularity due to its convenience. This method eliminates the reliance on paper prescriptions and effectively mitigates the potential risks associated with lost or misplaced prescriptions. The convenience of refill requests and the electronic access to medication history are highly valued by patients, as they foster a feeling of empowerment and encourage active engagement in their healthcare journey. Moreover, the utilization of E-prescriptions instills a sense of trust in terms of precision and security, as healthcare professionals are able to retrieve extensive medication records, thereby facilitating more well-informed choices. The acceptance of E-prescriptions among patients has been largely driven by the significant benefits they offer in terms of efficiency, accessibility, and improved patient care, despite initial concerns regarding data privacy and security.

“... In Pakistan, patients’ feelings about e-prescriptions may vary. Some patients might welcome the idea as it offers convenience and reduces the need to physically visit healthcare providers for paper prescriptions, which can be particularly beneficial in areas with limited access to medical facilities...” (Participant 12).

Participant 12 acknowledges the diverse patient opinions on e-prescriptions in Pakistan, highlighting their potential benefits in enhancing healthcare accessibility and patient convenience. They argue that some patients appreciate e-prescriptions for their convenience, especially in regions with limited access to medical facilities, and that their reactions can vary.

“... Pakistani patients may have concerns about data privacy and security due to the growing reliance on technology in healthcare. Limited digital knowledge may lead them to prefer traditional paper prescriptions over e-prescriptions...” (Participant 17).

Participant 17 in Pakistan expresses concerns about data privacy and security in e-prescriptions, citing limited digital literacy and patient preference for traditional paper prescriptions. They emphasize the need for education and awareness to build patient confidence in the security and benefits of e-prescriptions, highlighting the importance of digital literacy in healthcare adoption.

“... As a pharmacist, I believe it is crucial to educate patients on data security to ensure their safety and maintain the reliability of e-prescriptions. When it comes to protecting health information, it is crucial to implement various measures that prioritize the security and privacy of patient data. By doing so, we can ensure that patients who may not be familiar with technology feel more at ease and comfortable. Additionally, providing clear instructions on how to navigate and utilize these protective measures can further enhance their comfort level...”
(Participant 23).

Participant 23 emphasizes the importance of patient education and data security in e-prescriptions. They believe pharmacists should educate patients about data security to ensure patient safety and maintain e-prescription credibility. Implementing robust measures for security and privacy of patient health information can make patients feel more confident and at ease. Clear instructions on navigating these security measures can enhance patient comfort and trust in the system.

4.3.1 The Role of Education and Awareness

The role of education and awareness is crucial in addressing the issue of antibiotic resistance. The dissemination of information regarding the appropriate utilization of antibiotics, the potential repercussions of their misuse, and the significance of antibiotic stewardship is of paramount importance for enhancing awareness among healthcare professionals, patients, and the general public. The presence of well-informed healthcare providers has been shown to have a positive impact on prescribing decisions, leading to improved patient outcomes. Additionally, when patients are empowered with knowledge about their conditions and treatment options, they are more likely to actively engage in their treatment plans and make informed decisions, reducing the risk of self-medication. Moreover, it has been suggested that the implementation of public awareness campaigns could play a crucial role in disseminating information regarding the worldwide concern of antibiotic resistance. These campaigns aim to raise awareness among the general public about the urgent need to safeguard these invaluable drugs for the benefit of future generations. The promotion of responsible antibiotic use through educational and awareness initiatives plays a crucial role in addressing the issue of antibiotic resistance and protecting the well-being of the general population.

“... Patients’ perspectives on education and awareness regarding e-prescriptions can be quite positive. Many patients appreciate being informed about the benefits of e-prescriptions, such as the convenience of electronic access to their prescriptions and improved coordination of care among healthcare providers...” (Participant 13).

Participant 13's statement highlights patients' positive attitudes towards e-prescriptions, highlighting the convenience and enhanced coordination of care provided by electronic prescription access. This highlights the importance of patients being well-informed about healthcare innovations, which contribute to a smoother healthcare experience.

4.4 Patient Behavior Regarding Antibiotic Prescriptions

Pharmacists in Pakistan face challenges in promoting responsible patient behavior regarding antibiotic prescriptions. They emphasize the importance of understanding the difference between viral and bacterial infections, completing the full course of antibiotics, and discussing the risks of antibiotic resistance. They also emphasize the need for comprehensive public awareness campaigns and prioritize patient education to help patients make informed decisions about their healthcare. Addressing misconceptions and improving access to healthcare facilities are crucial for promoting responsible antibiotic use and improving public health in Pakistan.

4.4.1 Reusing Antibiotic Prescriptions

The practice of reusing antibiotic prescriptions is a matter of great concern due to its potential contribution to antibiotic resistance and its potential to compromise the health of patients. The prescription of antibiotics is typically tailored to target specific infections, and the reuse of these medications without appropriate medical assessment can result in treatment inefficacy or exacerbation of the condition. Moreover, it has been observed that the administration of incomplete courses of antibiotics can potentially contribute to the emergence and proliferation of antibiotic-resistant bacteria. This phenomenon poses a significant challenge in the effective management of future infections, as the development of resistance can render conventional treatment options less effective. Adherence to healthcare providers' instructions, completion of the entire prescribed course of antibiotics, and prompt medical consultation for new infections

are imperative in order to ensure optimal treatment outcomes and effectively address the challenge of antibiotic resistance.

“... Yes, reusing antibiotic prescriptions is a concerning issue we come across from time to time. Some patients may have leftover antibiotics from a previous illness and try to use them for a new infection without consulting a healthcare professional...” (Participant 2).

Participant 2 acknowledges the issue of reusing antibiotic prescriptions, highlighting the potential for inappropriate treatment and antibiotic resistance. They emphasize the need for proper medical assessment and guidance to ensure effective and responsible antibiotic use, as patients may attempt to reuse antibiotics without seeking professional guidance.

“... Reusing antibiotics without proper guidance can lead to incomplete treatment, as the prescribed antibiotic might not be suitable for the new infection. This can result in the development of antibiotic-resistant bacteria...” (Participant 8).

Participant 8 emphasizes the dangers of reusing antibiotics without proper guidance, highlighting the potential for incomplete treatment and the development of antibiotic-resistant bacteria. They stress the need for medical advice to ensure effective and responsible use of antibiotics in combating infections.

“... Patient education plays a vital role in addressing this issue. We take the opportunity to educate patients about the significance of responsible antibiotic use and the potential consequences of antibiotic resistance...” (Participant 13).

Participant 13 emphasizes the importance of patient education in combating inappropriate antibiotic use. They highlight the role of healthcare professionals in raising awareness about responsible antibiotic use and the potential consequences of antibiotic resistance, emphasizing the responsibility of healthcare providers to promote responsible behavior.

4.4.2 Reasons for Reusing Prescriptions

The reasons for reusing prescriptions can vary but often stem from factors like financial constraints, lack of access to healthcare, or a belief that the same medication will work for

similar symptoms. Some individuals may resort to reusing prescriptions due to convenience or reluctance to seek medical advice for a new condition. However, it is important to understand that reusing prescriptions can be risky and lead to ineffective treatment, exacerbate health issues, and contribute to antibiotic resistance. Seeking proper medical evaluation and following healthcare provider's advice for each specific condition is crucial to ensure appropriate and safe treatment.

“... One of the common reasons is convenience. Some patients may have leftover medications from a previous illness and believe that using the same antibiotic for a new infection will save them time and effort in seeking a new prescription...” (Participant 20).

Participant 20 explains that patients often reuse antibiotics due to convenience, as they may have leftover medications from previous illnesses. This perception highlights the need for patient education on potential risks and the importance of seeking medical advice for appropriate treatment. Healthcare providers also play a crucial role in addressing patient concerns and misconceptions about antibiotic use.

“... Patient education is a crucial part of our role. We take the time to explain the potential dangers of reusing antibiotics, such as the risk of incomplete treatment, the development of antibiotic resistance, and the importance of a proper medical evaluation for each new infection...” (Participant 25).

Participant 25 emphasizes the importance of patient education in healthcare, highlighting potential hazards of reusing antibiotics, including incomplete treatment and antibiotic resistance development. They also stress the need for proper medical evaluations for new infections, emphasizing the role of healthcare professionals in promoting responsible antibiotic use and safeguarding patient health.

4.5 E-prescriptions as a Tool to Combat Antibiotic Resistance

E-prescription systems play a crucial role in combating antibiotic resistance and promoting appropriate antibiotic use. They empower healthcare providers to exercise greater control over prescribing, ensuring judicious and appropriate dosages. E-prescriptions also enable monitoring

and surveillance of antibiotic usage patterns, allowing for intervention and addressing misuse. They also promote evidence-based prescribing, enabling healthcare providers to make well-informed decisions and prevent unnecessary antibiotic use. Integrating e-prescriptions with antibiotic resistance reduction initiatives enhances the capacity to address the issue at its fundamental level. E-prescriptions improve communication between healthcare professionals, ensure accurate prescribing practices, and enhance surveillance efforts, ultimately contributing to improved patient outcomes.

4.5.1 E-prescription's Role in Rational Antibiotic Use

The utilization of e-prescription systems has been found to have a significant impact on the promotion of rational antibiotic use. This is achieved through the streamlining of the prescription process and the enhancement of patient safety. The availability of patients' medical histories, allergies, and past prescriptions enables healthcare providers to make well-informed decisions regarding suitable antibiotic treatments. The system's functionality extends to mitigating the excessive and improper utilization of antibiotics through facilitating improved communication among healthcare professionals and pharmacists. This enhanced communication ensures that patients are administered the appropriate medication at the correct dosage. The significant contribution of E-prescription to combating antibiotic resistance and improving overall healthcare outcomes is achieved by curbing unnecessary antibiotic prescriptions.

"... E-prescriptions have played a crucial role in promoting the rational use of antibiotics. With e-prescriptions, we as healthcare providers are able to access patients' medical histories, which allows us to make more informed decisions when it comes to prescribing antibiotics. Reducing unnecessary prescriptions and promoting appropriate antibiotic use are important factors in addressing this issue..." (Participant 1).

Participant 1 highlights the positive impact of e-prescriptions on promoting rational antibiotic use. They argue that e-prescriptions allow healthcare providers to access patients' medical histories, enabling more informed decisions, reducing unnecessary prescriptions, and encouraging appropriate antibiotic use. This approach helps address antibiotic misuse by ensuring only necessary antibiotics are prescribed.

“... Yes. E-prescriptions play a crucial role in enhancing communication between pharmacists and healthcare providers. Accessing electronic prescriptions securely is a crucial aspect of our work. By doing so, we can verify the accuracy of prescribed antibiotics, which ultimately ensures that patients receive the most suitable medications for their needs...” (Participant 4).

Participant 4 emphasizes the significance of e-prescriptions in enhancing communication between pharmacists and healthcare providers. They emphasize the secure access to electronic prescriptions, enabling pharmacists to verify the accuracy of prescribed antibiotics, thereby ensuring patient safety and enhancing collaboration among healthcare professionals.

“... It provides real-time access to patients’ medication profiles, which is obviously a valuable feature. This process enables us to verify and confirm any possible drug interactions or allergies associated with antibiotics, guaranteeing that patients are provided with safe and suitable treatment...” (Participant 8).

Participant 8 emphasizes the importance of real-time access to patients' medication profiles through e-prescriptions, which allows healthcare providers to quickly verify potential drug interactions or allergies related to antibiotics. This ensures safe and appropriate treatment, enhancing patient safety and quality of healthcare by facilitating informed decision-making regarding antibiotic prescriptions.

4.5.2 Better Control and Monitoring of Antibiotic Prescribing

The implementation of E-prescription systems has been found to have a positive impact on the control and monitoring of antibiotic prescribing practices. The utilization of real-time access to patient data and medication history enables healthcare providers to make well-informed decisions, thereby facilitating the administration of appropriate and targeted antibiotic prescriptions. In addition, the system facilitates the monitoring and observation of antibiotic utilization trends, enabling healthcare authorities to detect possible concerns related to excessive or inappropriate usage. The implementation of e-prescription systems has been shown to facilitate improved oversight and enhanced communication between healthcare professionals and pharmacies. This, in turn, has the potential to promote more responsible prescribing of

antibiotics, thereby aiding in the global efforts to combat antibiotic resistance and ultimately leading to improved patient outcomes.

“... Yes, control and monitoring are indeed crucial in promoting responsible antibiotic use. Areas of overuse or misuse can be identified by closely monitoring antibiotic prescribing patterns. Implementing control measures enables prompt intervention and ensures that antibiotics are prescribed solely when necessary and appropriate...” (Participant 15).

Participant 15 emphasizes the importance of control and monitoring in promoting responsible antibiotic use. They suggest that monitoring prescribing patterns helps identify potential overuse or misuse areas, allowing healthcare systems to intervene promptly. This proactive approach minimizes risks associated with misuse and combats antibiotic resistance, highlighting the significance of data-driven strategies.

“... Pharmacists have the ability to collaborate with healthcare providers by exchanging data and providing feedback regarding antibiotic dispensing patterns. Through collaboration, we have the opportunity to recognize patterns, increase understanding of responsible prescription practices, and formulate approaches to improve antibiotic stewardship...” (Participant 13)

Participant 13 emphasizes the importance of pharmacists in optimizing antibiotic prescription practices. They can exchange data and provide feedback to healthcare providers, identifying trends and patterns in antibiotic usage. This collaboration enhances understanding of responsible prescription practices and promotes interdisciplinary collaboration in addressing antibiotic-related challenges and promoting responsible antibiotic use.

“... Through our continuous efforts to enhance control and monitoring measures, as well as our dedication to educating healthcare providers and the public, we can make a substantial contribution to addressing antibiotic resistance in Pakistan and ensuring the long-term effectiveness of antibiotics for future generations...” (Participant 4).

Participant 4 emphasizes the proactive role in combating antibiotic resistance in Pakistan, focusing on continuous control and monitoring measures, and educating healthcare providers and the public about responsible antibiotic use. Their goal is to safeguard the long-term effectiveness

of antibiotics for future generations by promoting informed practices and responsible antibiotic usage.

4.5.3 Facilitating Interventions to Address Antibiotic Misuse

E-prescription systems have been found to play a crucial role in facilitating interventions aimed at addressing the issue of antibiotic misuse. The utilization of real-time access to patient information and medication history enables healthcare providers to promptly identify instances of inappropriate antibiotic prescribing and intervene accordingly. Clinical decision support systems have been developed to facilitate the implementation of tools that aid in making informed and responsible antibiotic choices. These systems include features such as alerts and guidelines, which assist prescribers in their decision-making process. In addition, the implementation of E-prescription systems enables the collection and analysis of data, which can assist healthcare authorities in developing focused interventions and educational campaigns aimed at promoting appropriate antibiotic utilization among healthcare professionals and the general public. The implementation of E-prescription has been found to play a significant role in supporting interventions aimed at addressing the issue of antibiotic resistance and ensuring the continued efficacy of these essential medications.

“... Interventions play a crucial role in promoting responsible antibiotic use. As frontline healthcare professionals, we have the opportunity to actively engage in patient education and counseling to raise awareness about the proper use of antibiotics. Furthermore, we have the opportunity to work together with healthcare providers in order to effectively implement antibiotic stewardship programs, which have the primary goal of reducing the misuse of antibiotics...” (Participant 5).

Participant 5 emphasizes the role of healthcare professionals in promoting responsible antibiotic use. They suggest patient education and counseling, as well as collaboration with other providers to implement antibiotic stewardship programs. These initiatives aim to reduce inappropriate antibiotic use and ensure their efficacy for future use, thereby promoting a sustainable approach to antibiotic treatment.

“... When counseling patients, we can explain the concept of antibiotic resistance and how misuse contributes to this problem. We emphasize the importance of completing the full course of antibiotics as prescribed and avoiding sharing medications. Through clear communication, we empower patients to use antibiotics responsibly...” (Participant 11).

Participant 11 emphasizes patient education on antibiotic use, highlighting the concept of antibiotic resistance and misuse. They emphasize the importance of completing prescribed courses and avoiding medication sharing. Clear communication empowers patients to use antibiotics responsibly, preventing antibiotic resistance and promoting optimal treatment outcomes.

“... Mobile health apps can serve as a convenient platform for providing educational resources to patients. Pharmacists can recommend reliable apps that offer information on antibiotic use, adherence reminders, and access to reputable health guidelines, all in one place...” (Participant 27).

Participant 27's statement highlights the potential of mobile health apps in patient education about antibiotic use. They note that these apps can provide a convenient platform for delivering educational resources to patients. Pharmacists can recommend reliable apps that offer information on antibiotic usage, reminders for adherence to prescribed regimens, and access to trustworthy health guidelines. These apps consolidate valuable information in one place, making it easier for patients to access and understand the guidance related to responsible antibiotic use. This approach leverages technology to promote informed patient behavior and enhance antibiotic stewardship efforts.

4.5.4 E-prescription Implementation and its Impact on Antibiotic Resistance

The effective implementation of prescription practices has a significant impact on antibiotic resistance. By promoting appropriate antibiotic use, including correct dosage and duration, healthcare providers can minimize the development of resistant bacteria. Clear communication with patients about the importance of adhering to prescribed treatments and completing full courses of antibiotics also contributes to combating resistance. Additionally, implementing

electronic prescribing systems allows for better monitoring and surveillance of antibiotic prescriptions, enabling timely interventions to address misuse or overuse. Overall, prescription implementation plays a crucial role in mitigating antibiotic resistance and preserving the effectiveness of these essential medications for future generations.

“... As a healthcare provider, we have indeed become more cautious when it comes to prescribing antibiotics. We are now placing a greater emphasis on adhering to evidence-based guidelines. This approach results in the utilization of antibiotics in a more suitable manner, thereby decreasing the likelihood of antibiotic resistance...” (Participant 12).

Participant 12's statement highlights a shift in healthcare providers' prescribing practices, with a focus on evidence-based guidelines for antibiotic usage. This approach aims to align antibiotic use with medical knowledge, reduce the risk of antibiotic resistance, and promote responsible antibiotic use, thereby mitigating misuse risks.

“... In Pakistan, e-prescription implementation can help in several ways. Firstly, it allows for real-time access to patient data, enabling healthcare providers to make more accurate diagnoses and prescribe antibiotics only when necessary. Secondly, it facilitates communication between healthcare professionals, promoting collaboration and standardization in antibiotic prescribing practices...” (Participant 2).

Participant 2 emphasizes the advantages of e-prescription implementation in Pakistan, including real-time access to patient data, improved diagnostic accuracy, and improved communication among healthcare professionals. This technology-driven approach aims to optimize antibiotic usage, minimize unnecessary prescriptions, and improve coordination among stakeholders, ultimately addressing antibiotic resistance concerns.

4.6 Barriers to E-prescription Implementation in Pakistan

Pakistan faces challenges in implementing e-prescription systems due to limited technology infrastructure, lack of digital literacy among healthcare providers and patients, resistance to digital prescribing, concerns about data security and privacy, and financial investments. To overcome these obstacles, concerted efforts in training, infrastructure development, stakeholder

engagement, and supportive policies are needed to fully realize the potential benefits of e-prescription systems in Pakistan's healthcare landscape.

4.6.1 Limited Technology Infrastructure

Limited technology infrastructure poses significant challenges in modernizing healthcare systems. In many regions, especially in developing countries, inadequate access to reliable internet connectivity, electronic health record systems, and digital healthcare tools hinders the adoption of advanced technologies. This limitation affects the implementation of telemedicine, electronic prescribing, and other digital health initiatives that can enhance patient care and overall healthcare efficiency. Addressing this issue requires investments in technology, infrastructure, and digital literacy initiatives to bridge the gap and ensure that all communities can benefit from the advantages of modern healthcare practices.

"... One of the major challenges is the lack of reliable internet connectivity in some regions. Without a stable internet connection, healthcare providers may face difficulties accessing e-prescription platforms and transmitting prescriptions to pharmacies..." (Participant 3).

Participant 3 highlights the challenge of implementing e-prescriptions due to the lack of reliable internet connectivity in certain regions. Without a stable internet, healthcare providers may face obstacles in accessing e-prescription platforms and sending prescriptions electronically. Addressing infrastructure limitations is crucial for the seamless adoption of e-prescriptions, ensuring improved communication and accurate prescription transmission.

"... Yes, the government has recognized the importance of e-prescription systems in enhancing healthcare delivery. There have been initiatives to improve internet connectivity in remote areas, and efforts to promote digital literacy among healthcare providers and the public..." (Participant 9).

Participant 9 acknowledges the government's commitment to e-prescription systems in healthcare delivery. They highlight initiatives to improve internet connectivity in remote areas and promote digital literacy among healthcare providers and the public. These efforts aim to

overcome barriers, make e-prescription benefits accessible to a broader population, and facilitate successful implementation of e-prescriptions across various regions.

“... Providing training and support to healthcare providers and patients in using e-prescription platforms will enhance their comfort and confidence in adopting this technology...” (Participant 10).

Participant 10 emphasizes the need for training and support for healthcare providers and patients in using e-prescription platforms. They believe this will increase their comfort and confidence in adopting this technology, demystifying the process, and empowering patients to engage with the digital approach to healthcare management. Education and assistance are crucial for facilitating this seamless integration.

4.6.2 Lack of Digital Literacy among Healthcare Providers and Patients

The lack of digital literacy among healthcare providers and patients is a significant barrier to the successful integration of modern healthcare technologies. Many healthcare professionals may be unfamiliar with using digital tools and electronic health records, which can hinder the efficient adoption of technologies like telemedicine and electronic prescribing. Similarly, some patients may struggle to navigate digital platforms or access online health resources, limiting their ability to actively engage in their healthcare management. Addressing this issue requires targeted training and educational programs to empower both healthcare providers and patients with the necessary digital skills, ensuring a seamless and effective transition to modern healthcare practices.

“... One of the main challenges is that many healthcare providers are unaware of using digital platforms for prescription management. They may not be accustomed to incorporating e-prescription systems into their practices...” (Participant 14).

Participant 14 identifies a significant obstacle to e-prescription adoption: lack of awareness among healthcare providers about digital platforms for prescription management. This may lead to resistance to the new technology. To overcome this, targeted training and education initiatives are needed to familiarize providers with the benefits and functionality of e-prescriptions.

“... Yes, there have been some initiatives focused on improving digital literacy in the healthcare sector. Various organizations and government agencies have conducted training workshops and awareness campaigns to promote the use of digital technology, including e-prescriptions...” (Participant 16).

Participant 16 acknowledges the efforts to improve digital literacy in the healthcare sector, including training workshops and awareness campaigns. These initiatives aim to encourage healthcare professionals to embrace digital technology, including e-prescriptions, and equip them with the necessary skills to effectively use digital tools for improved patient care and prescription management.

4.6.3 Resistance to Change from Traditional Practices

The resistance to change from traditional practices has been identified as a potential barrier that can hinder the progress of modernizing healthcare systems. The adoption of new technologies in healthcare by professionals and organizations is often hindered by various factors, including concerns related to potential disruption, learning curves, and perceived risks. These factors contribute to a certain level of reluctance towards embracing innovations like electronic health records (EHRs) or telemedicine. In addition, it is worth noting that patients may exhibit a preference for familiar and traditional healthcare methods, which can pose a significant obstacle in terms of promoting the widespread acceptance of modern approaches. To address this resistance, it is essential to employ strategies that focus on effective communication, education, and highlighting the advantages of modern practices in enhancing patient outcomes and healthcare efficiency. These efforts aim to create a more conducive atmosphere for fostering innovation in the healthcare sector.

“... Some healthcare providers may be skeptical about the benefits of e-prescriptions and prefer to stick to familiar methods that they have used throughout their careers...” (Participant 1).

Participant 1 discusses skepticism among healthcare providers about e-prescriptions, citing concerns about technology, lack of understanding, or preference for established practices. To overcome this, effective communication, training, and demonstration of e-prescriptions' benefits

are needed, along with demonstrating how they can improve prescription management and patient care.

4.7 Benefits of e-prescription to patients and healthcare providers in Pakistan

The implementation of an e-prescription system in Pakistan has the potential to greatly enhance patient care and safety. We believe that patients will benefit from faster and more convenient access to their prescriptions, as it eliminates the need for paper copies and reduces the chances of prescription loss or errors.

“... An e-prescription system would indeed streamline the prescription process for healthcare providers, leading to improved efficiency and accuracy. Access to patients’ medication histories is crucial for making informed decisions and ensuring that drug choices and dosages are appropriate...” (Participant 6).

Participant 6 advocates for an e-prescription system for healthcare providers, stating it would improve efficiency and accuracy by streamlining the prescription process. They emphasize the importance of accessing patients' medication histories for informed decisions, ensuring appropriate drug and dosage choices, leading to better patient care and improved prescription management.

“... The electronic storage of prescriptions can indeed play a crucial role in population health management. It allows healthcare authorities to closely monitor antibiotic usage patterns and promptly respond to emerging resistance trends, thereby enhancing their ability to effectively address such challenges...” (Participant 8).

Participant 8 emphasizes the importance of electronic prescription storage in population health management. This method allows healthcare authorities to monitor antibiotic usage patterns, identify and respond to antibiotic resistance trends, and implement targeted interventions. It promotes responsible antibiotic use and safeguards public health by combating antibiotic-resistant bacteria development.

4.8 Suggestions for antibiotic resistance

“... Conducting awareness campaigns in local communities and providing education on responsible antibiotic use can help curb self-medication practices...” (Participant 6).

Participant 6 suggests a strategy to combat antibiotic-related self-medication practices by conducting awareness campaigns and providing education on responsible antibiotic use. This approach raises awareness about risks, emphasizes seeking professional medical advice, and empowers individuals to make informed decisions about their health. Public education is crucial in promoting responsible antibiotic use and reducing misuse, which can contribute to antibiotic resistance.

“... Conducting regular training workshops for healthcare providers in rural areas can help bridge the digital literacy gap and encourage the adoption of e-prescription systems...” (Participant 15).

Participant 15 proposes a strategy to promote e-prescription systems in rural areas by conducting regular training workshops for healthcare providers. These workshops aim to bridge the digital literacy gap, equipping them with the necessary skills and knowledge to effectively use e-prescription systems, ensuring all healthcare providers can fully utilize the benefits for improved patient care and prescription management.

“... Public-private partnerships can contribute to the implementation of nationwide antibiotic resistance awareness campaigns...” (Participant 23)

Participant 23 suggests a public-private partnership to raise awareness about antibiotic resistance. This approach can amplify the impact of awareness campaigns, disseminate accurate information, and engage a wider audience. It emphasizes the potential of collective efforts to combat antibiotic resistance through education and public awareness initiatives promoting responsible antibiotic use.

“... Research and surveillance on antibiotic resistance patterns can guide evidence-based decision-making and help identify emerging resistance trends...” (Participant 28)

Participant 28 emphasizes the importance of research and surveillance in addressing antibiotic resistance. They argue that this data-driven approach helps healthcare authorities and policymakers identify emerging trends, enabling timely and targeted interventions. They stress the need for data and research to guide responsible antibiotic use and public health efforts.

“... Collaborative efforts between healthcare providers, pharmacists, and government agencies are essential. Together, we can develop and implement comprehensive national strategies to tackle antibiotic resistance...” (Participant 29).

Participant 29 emphasizes the importance of collaboration between healthcare providers, pharmacists, and government agencies to combat antibiotic resistance. This approach involves a coordinated response, including responsible antibiotic use, prescription practices, and public education. It underscores the need for collective efforts to safeguard antibiotic efficacy and public health from the growing threat of antibiotic resistance.

II. QUANTITATIVE DATA

4.9 Demographic Characteristics

The demographic details of respondents shown in table 4.9. The maximum respondents (n=189 93.1%) belonged to the age group of 25-34 years. Majority of respondents (n=137, 67.5%) were male. Most of the participants (n=88, 43.3%) belonged to Punjab. Most of the participants (n=118, 58.1%) were community pharmacists. Majority of respondents (n=166, 81.8%) had experience of 1-5 years.

Table 4.9 Demographic Characteristics

Variable	Frequency	Percentage	
Age	25-34	189	93.1
	35-44	11	5.4
	45-54	1	0.5
	55 Above	2	1.0
Gender	Female	66	32.5
	Male	137	67.5
Province	Azad Kashmir	21	10.3
	Balochistan	60	29.6
	Islamabad	1	0.5
	Khyber Pakhtunkhwa (KPK)	13	6.4
	Punjab	88	43.3
	Sindh	20	9.9
Job Designation	Community Pharmacist	118	58.1
	Hospital Pharmacist	85	41.9
Experience	1-5 years	166	81.8
	11-15 years	6	3.0
	15 Above	3	1.5
	6-10 years	28	13.8

4.10 Prescription System

Out of the total respondents, 13.3% have experienced E-prescriptions, while the majority, accounting for 86.7%, received manual prescriptions. Regarding the legibility of handwritten prescriptions, 61.6% of respondents received prescriptions that were clear enough to read, and 32.0% encountered illegible prescriptions that were not clear enough to be read. Only a small proportion, 5.9%, reported receiving prescriptions that were both legible and illegible, while a

mere 0.5% experienced prescriptions that were either illegible or legible. While 58.1% of respondents have sought clarification through physician communication, while 41.9% have not engaged in such communication. (Table 4.10)

Table 4.10 Prescription System

Variable		Frequency	Percentage
Kind of Prescription	E-Prescription	27	13.3
	Manual (handwritten) Prescription	176	86.7
Hand Prescription writing	Both legible and illegible	12	5.9
	Either illegible or legible	1	.5
	Illegible (not clear enough to be read)	125	61.6
	Legible (clear enough to read)	65	32.0
Have you ever called physicians to clear doubts?	No	85	41.9
	Yes	118	58.1

4.11 Perspective on e-prescription

When asked about their learning ability, an overwhelming majority of respondents (98.0%) believe they are fast learners for new trainings or devices. Additionally, 77.3% of respondents use software for pharmacy-related tasks, with various software names mentioned, including "Abuzer Software," "Candela," "Easy-Retail," and others. An impressive 93.1% of respondents think that e-prescriptions would offer greater control over prescribed drugs, potentially leading to more efficient and accurate work (97.5% of respondents). Most respondents (99.0%) show motivation in adopting the electronic prescription system. While 78.8% believe it would decrease the healthcare cost, some respondents (10.8%) are uncertain about its impact on costs. Regarding affordability, 71.4% of respondents believe healthcare firms would be ready to adopt the new system based on existing infrastructural facilities, but 25.6% are skeptical about the readiness of firms due to potential infrastructural limitations. (Table 4.11)

Table 4.11 Perspective on e-prescription

Variable	Frequency	Percentage
Do you think you are a fast learner to new trainings or devices?		
No	4	2.0
Yes	199	98.0
Do you use any kind of software for Pharmacy? If yes, please write the name below.		
No	46	22.7
Yes	157	77.3
Name of Software Used		
Abuzer Software	44	21.7
Candela	8	3.9
Easy-Retail	2	1.0
HIMS	10	4.9
Hospital use own software	2	1.0
IPMS	2	1.0
Oracle	4	2.0
Patel software	2	1.0
Q soft technology	2	1.0
Q-Medics	2	1.0

Software is own designed	2	1.0
Sunrise software tech	2	1.0
Waseela	2	1.0
Do you think, with e-prescriptions, there will be greater control over the prescribed drugs?		
Maybe	9	4.4
No	5	2.5
Yes	189	93.1
Do you think using electronic prescription would make your work more efficient and accurate?		
Maybe	198	97.5
No		
Yes		
Are you motivated to pick up the electronic prescription system?		
No	2	1.0
Yes	201	99.0
Do you think using an electronic prescription system will decrease the cost of healthcare? (cost of physical data, e.g. for records)		
Maybe	22	10.8
No	21	10.0
Yes	160	78.8
Do you think the healthcare firms can afford an electronic prescription system? If you answered no, please write reason		
Because everyone has no access to the systems	2	1.0
No	15	7.4
No Financial Support	2	1.0
We spend only 3% of GDP on health care, while we don't have enough expenses to spend on electronic prescribing that may be the reason for the difficulty of implementation of electronic prescribing	2	1.0
Yes	182	89.7
Do you think the healthcare firms would be ready to adopt the new system based on the infrastructural facilities?		
Maybe	6	3.0
No	52	25.6

Yes	145	71.4
-----	-----	------

4.12 Perspectives on antibiotic resistance

Result highlights respondents' perspectives on antibiotic resistance. 78.3% of respondents understand that antibiotic resistance occurs when bacteria and germs develop the ability to defeat drugs designed to kill them. Various factors contribute to antibiotic resistance, with the most commonly mentioned reasons being the misuse and overuse of antibiotics (73.9%), lack of awareness (20.2%), and irrational prescription of antibiotics (9.3%). Regarding the implementation of an e-prescription system in Pakistan, respondents' opinions are positive, with 31.0% strongly agreeing and 41.4% agreeing that it would improve the rational use of antibiotics. Furthermore, 73.9% believe that an e-prescription system could be instrumental in reducing the misuse and overuse of antibiotics. The data signifies the potential benefits of e-prescriptions in promoting appropriate antibiotic usage and combating the growing issue of antibiotic resistance in Pakistan.

Table 4.12 Perspectives on antibiotic resistance

Variable	Frequency	Percentage
What is antibiotic resistance		
Bacteria develop the ability to defeat the drugs designed to kill them.	159	78.3
Germs like bacteria and fungi develop the ability to defeat the drugs designed to kill them.	44	21.7
Reason for Antibiotic Resistance		
Self-Medication	27	13.2%
Misuse and Overuse of Antibiotics	23	11.2%
Excessive Use of Antibiotics	13	6.3%
Incomplete Course of Medicine	7	3.4%
Lack of Awareness	5	2.4%
Irrational Prescription of Antibiotics	19	9.3%
Antibiotics Available Without Prescription	11	5.4%
Lack of Proper Information and Guidance	4	1.9%
Overprescribing by Doctors and Pharmacies	10	4.9%
Lack of Antibiotics Susceptibility Test	1	0.5%
Pollution	2	1.0%
Poor Infection Prevention and Control	2	1.0%

Lack of Clean Water and Sanitation	2	1.0%
Poor Management of Antibiotics	1	0.5%
Pressure from Pharmaceutical Companies on Doctors	2	1.0%
Non-Adherence to Prescribed Dosages	4	1.9%
Prescription of Broad-Spectrum Antibiotics	2	1.0%
Lack of Proper Communication between Doctors and Pharmacists	2	1.0%
Overuse of Antibiotics without Prescription	2	1.0%
Lack of Access to Quality, Affordable Medicines	1	0.5%
Inadequate Infection Prevention and Control	5	2.4%
Lack of Health Awareness	1	0.5%
Lack of Check and Balance on Prescription of Antibiotics	2	1.0%
Self-Administration of Antibiotics When Unnecessary	2	1.0%
Misuse of Antibiotics Even in Minor Illness	2	1.0%
Unmonitored Antibiotic Prescriptions	3	1.5%
Lack of Access to Clean Water, Sanitation, and Hygiene	2	1.0%
Prescription of More than One Antibiotic in a Single Prescription	4	1.9%
Improper Dose Regimen	2	1.0%
Inadequate Control Promotes the Resistance of Microbes	2	1.0%
Prescription of Antibiotics for Minor Health Issues	1	0.5%
Lack of Proper Counseling	2	1.0%
Polypharmacy and Non-Trained Staff	2	1.0%
Other	1	0.5%

Variable	Frequency	Percentage
To what extent do you agree that the implementation of an e-prescription system in Pakistan would improve the rational use of antibiotics?	84	41.4
Agree	4	2.0
Disagree	23	11.3
Neutral	63	31.0
Strongly agree	29	14.3
Strongly disagree		
Do you think an e-prescription system would help to reduce the misuse and overuse of antibiotics?		
Maybe	41	20.2
No	12	5.9
Yes	150	73.9

4.13 Importance of E-Prescription for Rational Antibiotic Use in Pakistan

The respondents were asked to rate the importance of implementing an e-prescription system in Pakistan to improve the rational use of antibiotics on a scale from 0 to 10, where 0 represents "Not Recommended" and 10 stands for "Highly Recommend." The responses indicate a minimum rating of 0 and a maximum rating of 10. On average, respondents gave a rating of 8.2266 with a standard deviation of 2.305. This data implies that, on average, the respondents highly valued the implementation of an e-prescription system to enhance the rational use of antibiotics in Pakistan, indicating strong support for the adoption of such a system to address antibiotic-related challenges effectively. (Table 4.13).

Table 4.13 Importance of E-Prescription for Rational Antibiotic Use in Pakistan

Question	Minimum	Maximum	Mean \pm SD
How would you rate the importance of implementing an e-prescription system in Pakistan to improve the rational use of antibiotics?	0	10	8.2266 \pm 2.305

4.14 Barriers to E-Prescription Implementation

The most common barrier identified by respondents is the expense associated with purchasing and implementing the system, including user training, which accounts for 65.0% of responses. Another significant barrier is the lack of support from the government for new implementations, with 29.6% of respondents expressing this concern. Additionally, 43.3% of respondents point out that healthcare firms are not adequately highlighting the issue, hindering the implementation process. A notable percentage of respondents (9.9%) cite resistance to change as a barrier, indicating that some individuals are apprehensive about adopting the new system. The data also reveals a few respondents mentioning political crises (0.5%), corruption, and the inability of physicians (1.0%) as potential barriers. A very small proportion of respondents believe that the implementation could reduce the business of practitioners (1.0%). Moreover, one respondent mentioned all four options as barriers to E-prescription implementation (0.5%). These insights provide valuable information about the perceived barriers, allowing for a better understanding of the challenges that need to be addressed to facilitate successful E-prescription implementation.

Table 4.14 Barriers to E-Prescription Implementation

Barriers to E-Prescription Implementation	Frequency	Percent
Expense to purchase and implement, including user training	132	65.0%
Government is not supporting new implementations	60	29.6%
Healthcare firms are not highlighting the issue	88	43.3%
People don't like change	20	9.9%
Political Crisis	1	0.5%
Corruption, inability of physicians	2	1.0%
It will reduce the business of practitioners	2	1.0%
All four options	1	0.5%

CHAPTER 5 DISCUSSION AND CONCLUSIONS

5.1 DISCUSSION

The data presented in this study offers valuable insights into the prevalence of E-prescriptions and the legibility of handwritten prescriptions among the surveyed individuals. In the sample population, a mere 13.3% of participants indicated that they had encountered E-prescriptions, whereas the overwhelming majority (86.7%) reported that they continued to receive manual prescriptions. The present study indicates that despite the increasing prevalence of E-prescription systems in certain areas, the surveyed population exhibits limited levels of adoption. When examining this outcome in relation to previous research investigations, it is evident that the relatively small proportion of participants who reported having encountered E-prescriptions is consistent with the gradual adoption of E-prescription systems in specific healthcare systems across the globe (43). The slower adoption of E-prescriptions in certain regions has been attributed to various factors, including technological barriers, financial constraints, and resistance to change exhibited by healthcare professionals and patients (60). The aforementioned statement emphasizes the necessity for additional initiatives aimed at promoting and streamlining the shift from manual prescription systems to electronic ones.

A review of scholarly literature uncovers a range of obstacles associated with the use of Electronic Health Records (EHRs) in medical practices. Despite the potential benefits they offer, the rate of adoption for these interventions remains relatively low, and medical practitioners encounter significant resistance in their implementation. Barriers encompass various factors, such as user and system qualities, support from external sources, and facilitators within the organizational and environmental context. In order to enhance patient safety and quality, it is imperative for physicians to possess the ability to successfully utilize electronic health records (EHRs) (61). To address these concerns, implementers might employ effective leadership strategies, employ project management methodologies, establish standardized protocols, and provide comprehensive staff training. The acceleration of universal electronic health record (EHR) adoption can be facilitated by training medical students to depend on EHRs and decision assistance systems. This study offers a comprehensive examination of the various obstacles encountered by physicians during the installation of electronic health record (EHR) systems (62).

In relation to the legibility of handwritten prescriptions, the available data indicates that a majority of respondents, specifically 61.6%, reported receiving prescriptions that were deemed clear enough to be read. Conversely, a significant proportion of respondents, approximately 32.0%, encountered prescriptions that were illegible. The presence of unclear or illegible handwriting on handwritten prescriptions continues to be a significant issue within the healthcare system. This concern arises due to the potential consequences it may have on patient safety and the occurrence of medication errors. Numerous studies conducted in various regions have similarly emphasized the problem of indecipherable prescriptions and the consequential effects on the quality of patient care and medication errors (63-66).

The issue of illegible prescriptions provided by medical practitioners is a longstanding and pervasive problem that spans across many regions of the world. The prescription serves as a formal and legally binding document that grants authority to pharmacists or nurses to prepare, distribute, or administer a therapeutic substance. The effectiveness of the prescriber's instructions is contingent upon the accuracy and readability of the prescription (67). According to existing research, it has been found that unreadable prescriptions are a significant contributing factor to instances of medication errors. There is a need for enhancement in the standard of prescription-writing, and it is imperative for the legislation to guarantee adherence to and enforcement of this responsibility (68).

Numerous studies frequently endorse the implementation of E-prescriptions, citing the potential benefits of electronic systems in enhancing the clarity of prescriptions and mitigating medication errors resulting from the misinterpretation of handwritten prescriptions (69-71). The processing of electronic prescriptions has the potential to impede the efficiency of pharmacy workflow. With the rise in legislative mandates, there has been a significant increase in the transmission of e-prescriptions to pharmacies. Consequently, it is imperative to redesign the technology that supports e-prescriptions on both prescriber and pharmacy operating systems. This redesign is necessary to streamline pharmacy workflow processes and mitigate the risk of unintended medication errors, user frustration, and stress (72).

The data reveals that a majority of respondents, specifically 58.1%, have actively sought clarification by engaging in communication with physicians. On the other hand, a significant

portion of respondents, accounting for 41.9%, have not participated in such communication. The significance of establishing effective communication between healthcare providers and patients is underscored by this discovery, emphasizing the need for clarity and comprehension of prescribed medications, particularly in cases involving illegible prescriptions. The significance of physician-patient communication in clarifying prescriptions has been consistently emphasized in various research studies. The role of effective communication in reducing medication errors and improving patient compliance with prescribed treatments is of utmost importance (73). In order to ensure the provision of precise prescription information to patients, it is imperative for pharmacists to engage in medication reconciliation during periods of care transition. This procedure should adhere to The Joint Commission's five-step protocol. Pharmacists have the ability to execute a multitude of actions aimed at mitigating drug errors during care transitions and upholding the safety of patients. Pharmacists play a crucial role in assessing the suitability of medicine utilization, maintaining up-to-date information in the health record, and effectively conveying precise information to fellow healthcare practitioners (73).

The study's findings on E-prescription adoption, prescription legibility, and physician-patient communication are consistent with existing research in the healthcare and prescription management domain. The implementation of electronic prescription has been identified as a significant strategic measure aimed at enhancing healthcare in Europe. The data underscores the importance of ongoing initiatives aimed at promoting the implementation of E-prescriptions, addressing concerns related to the legibility of handwritten prescriptions, and fostering effective communication between healthcare providers and patients. These efforts are crucial in improving patient safety and ensuring the rational use of medications (74, 75).

The barriers identified in this study encompass various factors that hinder the successful adoption and implementation of the system. These barriers include the high costs associated with purchasing and implementing the system (70), the lack of support from government entities, the insufficient attention given to the issue by healthcare firms (76), the resistance to change among stakeholders (77), the presence of political crises, the prevalence of corruption, the limited capabilities of physicians (77), and concerns regarding the potential negative impacts on practitioners' business. By comparing these findings with existing research in the field, valuable

insights can be gleaned regarding the shared obstacles encountered during the implementation of E-prescription systems in various geographical areas and healthcare frameworks (78). Numerous studies conducted in different countries have consistently identified comparable obstacles, suggesting that these difficulties are not exclusive to Pakistan (79, 80). The cost associated with implementing E-prescription systems has consistently been recognized as a significant barrier in numerous healthcare settings globally. The impact of government support, or the absence of it, has emerged as a crucial determinant in the effective adoption of E-prescription systems across various nations (81).

The study's findings on resistance to change are consistent with existing research in various contexts, which has observed a similar phenomenon among healthcare professionals and stakeholders. These individuals have demonstrated a hesitancy to adopt new technologies and deviate from established practices. Furthermore, previous research has also highlighted the issue of how E-prescription may affect practitioners' business, underscoring the importance of engaging stakeholders and promoting a comprehensive understanding of the advantages of E-prescription in order to effectively address these concerns (82). The impact of corruption and political crises on healthcare systems in certain regions has been acknowledged by a limited number of participants in our research. These challenges have been reported to have a wider scope and influence on the healthcare sector (83). The presence of various challenges can potentially impede the successful implementation of healthcare initiatives, such as E-prescription systems (83).

E-prescribing issues in community pharmacies need to be recognized, reported and addressed. The identified deficiencies in the design and utilization of the pharmacy computer software used to process e-prescriptions reported in this study can help trigger future improvements in the design of this evolving technology (84). Although not all issues reported are unique to e-prescriptions, the use of this technology has made such problems encountered in pharmacies more apparent and perhaps increased the frequency of these incidents (85).

The findings elucidated the viewpoints of the participants on antibiotic resistance, so illuminating a substantial concern within the realm of healthcare. The observation that a significant majority (78.3%) of participants possess a comprehensive comprehension of

antibiotic resistance is a source of reassurance. Acknowledging the phenomenon of antibiotic resistance, which arises from the evolutionary adaptation of bacteria and germs to withstand the effects of pharmaceutical interventions, is an imperative measure in addressing the escalating challenge posed by this issue (86). This comprehension has the potential to facilitate well-informed decision-making and measures aimed at safeguarding the efficacy of antibiotics for subsequent generations (87). The study also showed the prevalence of antibiotic misuse and overuse, as reported by 73.9% of the participants, continues to be a substantial contributing factor to the emergence of antibiotic-resistant microorganisms. To effectively tackle this matter, it is imperative to impart knowledge to healthcare professionals and the general populace on the prudent utilization of antibiotics and the perils associated with unwarranted prescriptions or self-administration (88). The study additionally underscores the necessity to enhance healthcare workers' awareness (20.2%) and prescription practices (9.3%), hence underlining the significance of practicing appropriate antibiotic stewardship. A potentially viable solution that has been identified based on the perspectives of the participants is the implementation of an electronic prescription system in Pakistan. The data indicates that there is a favorable attitude towards the implementation being discussed. A notable fraction of the respondents (31.0%) highly agree, while a larger amount (41.4%) agree that the introduction of an e-prescription system has the potential to enhance the appropriate utilization of antibiotics. This demonstrates the healthcare community's inclination to adopt technology and exploit its potential advantages in order to improve patient care (89).

5.2 CONCLUSION

The survey results reveal that there is limited awareness of E-prescriptions in Pakistan, as only 13.3% of the respondents reported having encountered them. This situation aligns with global trends where the slow adoption of electronic prescription systems is tied to technological challenges and the reluctance of healthcare providers and patients to embrace new practices. The focus is on encouraging the transition from manual to computerized prescription systems, with a specific emphasis on additional efforts and approaches. The presence of unclear prescriptions is also acknowledged, as highlighted by 32.0% of respondents who mentioned encountering cases of difficult-to-read handwriting. This issue not only jeopardizes patient safety but also increases the likelihood of medication prescribing errors. The study underscores the importance of effective communication between healthcare professionals and patients, particularly in situations involving unclear prescriptions. This underscores patient safety and the active involvement of pharmacists in managing medication during healthcare transitions.

The problem of antibiotic resistance is of significant concern, evident from the fact that 78.3% of participants have a comprehensive understanding of the topic. The inappropriate and excessive use of antibiotics remains a major factor contributing to the emergence and spread of antibiotic resistance, accounting for a significant proportion of cases, specifically 73.9%. Addressing this issue requires educating healthcare providers and the general public about the prudent use of antibiotics, with a specific focus on antibiotic stewardship.

The survey findings also reveal a positive attitude towards implementing an electronic prescription system in Pakistan. Specifically, 72.4% of participants believe that the system can enhance the appropriate use of antibiotics. This reflects the healthcare sector's willingness to adopt technological innovations to enhance patient care and effectively address antibiotic resistance.

This study sheds light on the multifaceted concerns related to electronic prescriptions, prescription legibility, and the challenge of antibiotic resistance in Pakistan. The study emphasizes the importance of continuous efforts in implementing electronic prescription systems, improving prescription writing protocols, and promoting better communication between healthcare providers and patients. Effective implementation of educational and stewardship programs is vital to addressing antibiotic resistance resulting from improper antibiotic use.

5.3 FUTURE RECOMMENDATIONS

Encouraging E-prescription Implementation:

To promote widespread adoption of E-prescription systems in healthcare institutions, active support from healthcare authorities and politicians is essential. Strategies like awareness campaigns, incentives, and training programs can enhance healthcare professionals' understanding. Financial assistance for system implementation can also drive adoption.

Enhancing Technical Infrastructure:

Improving technical capabilities within healthcare environments is crucial for successful E-prescription adoption. Providing reliable internet connectivity and necessary technology/software for electronic prescribing is vital. Partnering with tech companies can create user-friendly, secure platforms tailored to healthcare needs.

Standardizing Prescription Writing:

Establishing uniform methods for prescription writing is vital. Rules for legibility and clarity can reduce errors and enhance patient safety. Ongoing training and feedback mechanisms strengthen these practices, ensuring accurate prescription writing.

Effective Communication with Patients:

Strong communication between healthcare providers and patients is paramount. Clear explanations of prescriptions and potential side effects are essential. Encouraging open dialogue

fosters patient understanding and compliance. Patient education materials should be easily comprehensible.

Antibiotic Stewardship Programs:

Addressing antibiotic resistance requires comprehensive stewardship programs. Educating professionals, patients, and the public on proper antibiotic use is key. Routine audits and feedback enhance prescribing practices, identifying areas for improvement.

Collaboration with Pharmacies:

Collaboration between healthcare providers and pharmacies streamlines E-prescription processing. Standardizing transmission and verification methods optimizes pharmacy workflows and reduces errors. Effective communication addresses prescription concerns swiftly.

Continuous Research and Evaluation:

Ongoing research into E-prescription systems, prescription legibility, and antibiotic resistance is crucial. Longitudinal studies assess their impact on reducing medication errors and antibiotic resistance. Data-driven insights inform future policies.

Government Support and Regulations:

Robust government support and well-defined regulations facilitate E-prescription acceptance. Collaborations with healthcare stakeholders aid in creating policies that encourage responsible antibiotic use and seamless integration of electronic prescribing.

5.4 STUDY LIMITATION

Inadequate Sample Size: The sample size employed in the study may not sufficiently capture the entirety of the healthcare community in Pakistan. A low sample size has the potential to introduce biases and restrict the capacity to generalize the findings to a larger population of healthcare professionals and patients within the country.

Non-Representative Demographics: The demographic composition of the participants may not accurately mirror the diverse range of healthcare professionals and patients in Pakistan. If the sample mostly consists of individuals from a particular geographic area or healthcare facility, the results may not provide an accurate representation of the viewpoints and approaches throughout the entire nation.

Self-reported data refers to information collected by surveys or questionnaires, where individuals provide responses based on their own recollection. However, it is important to acknowledge that self-reported data may be susceptible to recall bias or social desirability bias. Participants may potentially offer responses that they think to be socially desirable or may not correctly recollect their events or behaviors.

Cross-Sectional Study methodology: The cross-sectional methodology employed in this study involves the collection of data at a specific moment, hence restricting the capacity to establish causal relationships or track changes over an extended period. In order to enhance comprehension of the effects of interventions and patterns in the adoption of E-prescriptions, readability of prescriptions, and rates of antibiotic resistance, it is imperative to conduct longitudinal research.

Regional Variations: The study may not adequately consider the potential impact of regional variations in the use of E-prescriptions, prescription procedures, and rates of antibiotic resistance across different regions within Pakistan. The study's findings may be influenced by the distinctive healthcare infrastructures, cultural norms, and healthcare practices present in various regions.

Cross-cultural considerations may not have been thoroughly addressed in the study, perhaps overlooking the impact of cultural differences on the uptake of E-prescriptions and the readability of prescriptions. The acceptance and utilization of E-prescription systems may be influenced by cultural variables and public attitudes towards technology and healthcare.

Data Source and Timeframe: The study's data may have originated from a solitary source or a restricted time frame, perhaps disregarding pertinent information from alternative sources or modifications in procedures over a period of time.

External factors, such as shifts in healthcare legislation, improvements in technology, or economic conditions, which have the potential to impact the adoption of E-prescriptions and practices related to antibiotic prescribing, may not have been included in the study.

REFERENCES

1. Rodríguez-González A, Zanin M, Menasalvas-Ruiz E. Public health and epidemiology informatics: can artificial intelligence help future global challenges? An overview of antimicrobial resistance and impact of climate change in disease epidemiology. *Yearbook of Medical Informatics*. 2019;28(01):224-31.
2. Bloom D, Canning D. The health and poverty of nations: from theory to practice. *Journal of human development*. 2003;4(1):47-71.
3. Tandon P, DeLisle A, Topal JE, Garcia-Tsao G. High prevalence of antibiotic-resistant bacterial infections among patients with cirrhosis at a US liver center. *Clinical Gastroenterology and Hepatology*. 2012;10(11):1291-8.
4. Tacconelli E, Cataldo M, Dancer S, De Angelis G, Falcone M, Frank U, et al. ESCMID guidelines for the management of the infection control measures to reduce transmission of multidrug-resistant Gram-negative bacteria in hospitalized patients. *Clinical Microbiology and Infection*. 2014;20:1-55.
5. Bhatia R, Narain JP. The growing challenge of antimicrobial resistance in the South-East Asia Region-Are we losing the battle? *The Indian journal of medical research*. 2010;132(5):482.
6. Alpert JS. A review of clinical guidelines with some thoughts about their utility and appropriate use. *The American journal of medicine*. 2010;123(7):573-6.
7. Leaper DJ, Schultz G, Carville K, Fletcher J, Swanson T, Drake R. Extending the TIME concept: what have we learned in the past 10 years? *International wound journal*. 2012;9:1-19.
8. Yap PSX, Yiap BC, Ping HC, Lim SHE. Essential oils, a new horizon in combating bacterial antibiotic resistance. *The open microbiology journal*. 2014;8:6.

9. Majumder MAA, Rahman S, Cohall D, Bharatha A, Singh K, Haque M, et al. Antimicrobial stewardship: Fighting antimicrobial resistance and protecting global public health. *Infection and drug resistance*. 2020;4713-38.
10. Prestinaci F, Pezzotti P, Pantosti A. Antimicrobial resistance: a global multifaceted phenomenon. *Pathogens and global health*. 2015;109(7):309-18.
11. Lees P, Pelligand L, Giraud E, Toutain PL. A history of antimicrobial drugs in animals: Evolution and revolution. *Journal of Veterinary Pharmacology and Therapeutics*. 2021;44(2):137-71.
12. Organization WH. Turning plans into action for antimicrobial resistance (AMR): working paper 2.0: implementation and coordination. World Health Organization, 2019.
13. Waseem H, Ali J, Sarwar F, Khan A, Rehman HSU, Choudri M, et al. Assessment of knowledge and attitude trends towards antimicrobial resistance (AMR) among the community members, pharmacists/pharmacy owners and physicians in district Sialkot, Pakistan. *Antimicrobial Resistance & Infection Control*. 2019;8(1):1-7.
14. Cole Edmonson D, Cindy McCarthy D, McCain C, June Marshall D. Emerging global health issues: A nurse's role. *Online Journal of Issues in Nursing*. 2017;22(1):1B.
15. Saha M, Sarkar A. Review on multiple facets of drug resistance: a rising challenge in the 21st century. *Journal of xenobiotics*. 2021;11(4):197-214.
16. Janik E, Ceremuga M, Niemcewicz M, Bijak M. Dangerous pathogens as a potential problem for public health. *Medicina*. 2020;56(11):591.
17. Church NA, McKillip JL. Antibiotic resistance crisis: challenges and imperatives. *Biologia*. 2021;76(5):1535-50.
18. Blomberg B, Mwakagile DS, Urassa WK, Maselle SY, Mashurano M, Digranes A, et al. Surveillance of antimicrobial resistance at a tertiary hospital in Tanzania. *BMC public health*. 2004;4:1-11.
19. Dar OA, Hasan R, Schlundt J, Harbarth S, Caleo G, Dar FK, et al. Exploring the evidence base for national and regional policy interventions to combat resistance. *The Lancet*. 2016;387(10015):285-95.
20. Zaidi S, Bigdeli M, Aleem N, Rashidian A. Access to essential medicines in Pakistan: policy and health systems research concerns. *PloS one*. 2013;8(5):e63515.
21. Kadri SS, Lai YL, Warner S, Strich JR, Babiker A, Ricotta EE, et al. Inappropriate empirical antibiotic therapy for bloodstream infections based on discordant in-vitro susceptibilities: a retrospective cohort analysis of prevalence, predictors, and mortality risk in US hospitals. *The Lancet Infectious Diseases*. 2021;21(2):241-51.
22. Sulis G, Sayood S, Gandra S. Antimicrobial resistance in low-and middle-income countries: current status and future directions. *Expert review of anti-infective therapy*. 2022;20(2):147-60.
23. Levy SB. The challenge of antibiotic resistance. *Scientific American*. 1998;278(3):46-53.

24. Atif M, Malik I, Asif M, Qamar-Uz-Zaman M, Ahmad N, Scahill S. Drug safety in Pakistan. *Drug safety in developing countries: Elsevier*; 2020. p. 287-325.
25. Capita R, Alonso-Calleja C. Antibiotic-resistant bacteria: a challenge for the food industry. *Critical reviews in food science and nutrition*. 2013;53(1):11-48.
26. Yau JW, Thor SM, Tsai D, Speare T, Rissel C. Antimicrobial stewardship in rural and remote primary health care: a narrative review. *Antimicrobial Resistance & Infection Control*. 2021;10:1-33.
27. Pharmacy ACoC, Hume AL, Kirwin J, Bieber HL, Couchenour RL, Hall DL, et al. Improving care transitions: current practice and future opportunities for pharmacists. *Pharmacotherapy: The Journal of Human Pharmacology and Drug Therapy*. 2012;32(11):e326-e37.
28. De With K, Allerberger F, Amann S, Apfalter P, Brodt H-R, Eckmanns T, et al. Strategies to enhance rational use of antibiotics in hospitals: a guideline by the German Society for Infectious Diseases. *Infection*. 2016;44:395-439.
29. Abubakar U, Tangiisuran B. Nationwide survey of pharmacists' involvement in antimicrobial stewardship programs in Nigerian tertiary hospitals. *Journal of global antimicrobial resistance*. 2020;21:148-53.
30. Ansari M. Evaluation of community pharmacies regarding dispensing practices of antibiotics in two districts of central Nepal. *PLoS One*. 2017;12(9):e0183907.
31. Kierkegaard P. E-prescription across Europe. *Health and Technology*. 2013;3:205-19.
32. Aharaz A, Kejser CL, Poulsen MW, Jetic S, Ulstrup-Hansen AI, Jørgensen LM, et al. Optimization of the Danish National Electronic Prescribing System to Improve Patient Safety: Development of a User-Friendly Prototype of the Digital Platform Shared Medication Record. *Pharmacy*. 2023;11(2):41.
33. Aldughayfiq B, Sampalli S. Digital health in physicians' and pharmacists' office: a comparative study of e-prescription systems' architecture and digital security in eight countries. *Omics: a journal of integrative biology*. 2021;25(2):102-22.
34. Ayaz S, Naqvi A, Branch G, editors. *The role of E-prescribing in health care*. 2015 *Internet Technologies and Applications (ITA)*; 2015: IEEE.
35. Hong K, Hong YD, Cooke CE. Medication errors in community pharmacies: The need for commitment, transparency, and research. *Research in Social and Administrative Pharmacy*. 2019;15(7):823-6.
36. Sponsler KC, Neal EB, Kripalani S. Improving medication safety during hospital-based transitions of care. *Cleve Clin J Med*. 2015;82(6):351-60.
37. Bell DS, Cretin S, Marken RS, Landman AB. A conceptual framework for evaluating outpatient electronic prescribing systems based on their functional capabilities. *Journal of the American Medical Informatics Association*. 2004;11(1):60-70.

38. Bugnon B, Geissbuhler A, Bischoff T, Bonnabry P, von Plessen C. Improving primary care medication processes by using shared electronic medication plans in Switzerland: lessons learned from a participatory action research study. *JMIR Formative Research*. 2021;5(1):e22319.
39. Ariani A, Koesoema AP, Soegijoko S. Innovative healthcare applications of ICT for developing countries. *Innovative healthcare systems for the 21st century*. 2017:15-70.
40. Economou C, Kaitelidou D, Kentikelenis A, Maresso A, Sissouras A. The impact of the crisis on the health system and health in Greece. *Economic crisis, health systems and health in Europe: Country experience [Internet]: European Observatory on Health Systems and Policies*; 2015.
41. Debnath S, Roy P. Study of speech enabled healthcare technology. *International Journal of Medical Engineering and Informatics*. 2019;11(1):71-85.
42. Zarour K, Fetni MO, Belagrouz S. Towards electronic prescription system in a developing country. *Applied Medical Informatics*. 2021;43(1):56-67.
43. Aanestad M, Grisot M, Hanseth O, Vassilakopoulou P. Strategies for building eHealth Infrastructures. *Information Infrastructures within European Health Care: Working with the Installed Base*. 2017:35-51.
44. Ahmed MH, Bogale AD, Tilahun B, Kalayou MH, Klein J, Mengiste SA, et al. Intention to use electronic medical record and its predictors among health care providers at referral hospitals, north-West Ethiopia, 2019: using unified theory of acceptance and use technology 2 (UTAUT2) model. *BMC Medical Informatics and Decision Making*. 2020;20(1):1-11.
45. Sebetci Ö, Çetin M. Developing, applying and measuring an e-Prescription Information Systems Success Model from the perspectives of physicians and pharmacists. *Health Policy and Technology*. 2016;5(1):84-93.
46. Gullstett MK, Bergmo TS. Implementation of E-prescription for Multidose Dispensed Drugs: Qualitative Study of General Practitioners' Experiences. *JMIR Human Factors*. 2022;9(1):e27431.
47. Webster L, Spiro RF. Health information technology: a new world for pharmacy. *Journal of the American Pharmacists Association*. 2010;50(2):e20-e34.
48. Vassilakopoulou P, Marmaras N. Investigating technology-induced transitions in healthcare: work practice adaptations within their overall context. *Health Policy and Technology*. 2015;4(3):277-85.
49. Samadbeik M, Ahmadi M, Asanjan SMH. A theoretical approach to electronic prescription system: lesson learned from literature review. *Iranian Red Crescent Medical Journal*. 2013;15(10).
50. Abraham O, Schleiden LJ, Chui MA. Errors Related to Outpatient E-Prescribing. *Safety of Health IT: Clinical Case Studies*. 2016:69-79.
51. Chenn A, Khunlertkit A, Winner L, editors. *Tales from the Frontline: Implementing an E-Prescription Technology*. Proceedings of the International Symposium on Human Factors and Ergonomics in Health Care; 2015: SAGE Publications Sage India: New Delhi, India.

52. Lin MK. Evaluating the acceptance of mobile technology in healthcare: development of a prototype mobile ECG decision support system for monitoring cardiac patients remotely: University of Southern Queensland; 2012.
53. Davari M, Khorasani E, Tigabu BM. Factors influencing prescribing decisions of physicians: a review. *Ethiopian journal of health sciences*. 2018;28(6).
54. Riccioli C, Cacciabue P, Campanini M, Jung M. Designing, implementing and evaluating e-prescription: a field study and comparison with psiP results. *Patient Safety Informatics: IOS Press*; 2011. p. 105-15.
55. Ali S. Formulation of a national e-Health strategy development framework for Pakistan: University of Calgary; 2013.
56. Wing N. Ministry of National Health Services, Regulations and Coordination, Government of Pakistan. National nutrition survey. 2018.
57. Anshari M. Redefining electronic health records (EHR) and electronic medical records (EMR) to promote patient empowerment. *IJID (International Journal on Informatics for Development)*. 2019;8(1):35-9.
58. Shaikh M, Vayani AH, Akram S, Qamar N. Open-source electronic health record systems: A systematic review of most recent advances. *Health Informatics Journal*. 2022;28(2):14604582221099828.
59. Organization WH. WHO report on surveillance of antibiotic consumption: 2016-2018 early implementation. 2018.
60. Ajami S, Bagheri-Tadi T. Barriers for adopting electronic health records (EHRs) by physicians. *Acta Informatica Medica*. 2013;21(2):129.
61. Secginli S, Erdogan S, Monsen KA. Attitudes of health professionals towards electronic health records in primary health care settings: a questionnaire survey. *Informatics for Health and Social Care*. 2014;39(1):15-32.
62. Boonstra A, Broekhuis M. Barriers to the acceptance of electronic medical records by physicians from systematic review to taxonomy and interventions. *BMC health services research*. 2010;10(1):1-17.
63. Brits H, Botha A, Niksch L, Venter K, Terblanché R, Joubert G. Illegible handwriting and other prescription errors on prescriptions at National District Hospital, Bloemfontein. *Professional Nursing Today*. 2017;21(2):53-6.
64. Rodríguez-Vera FJ, Marin Y, Sanchez A, Borrachero C, Pujol E. Illegible handwriting in medical records. *Journal of the Royal Society of Medicine*. 2002;95(11):545-6.
65. Sultana F, Rahman A, Paul TR, Sarwar MS, Islam MAU, Rashid M. Prescribing pattern and prescription errors: a study at a tertiary care hospital of Bangladesh. *Bangladesh pharmaceutical journal*. 2015;18(1):20-4.
66. Jansen R-M, Verchoor T. Bad handwriting and medication errors. *South African Law Journal*. 2007;124(4):867-81.

67. Ariaga A, Balzan D, Falzon S, Sultana J. Legibility of hand-written prescriptions and drug-orders: the writing on the wall. *Expert Review of Clinical Pharmacology*. 2023(just-accepted).
68. Modi T, Khumalo N, Shaikh R, Booth Z, Leigh-de Rapper S, Mahumane GD. Impact of Illegible Prescriptions on Dispensing Practice: A Pilot Study of South African Pharmacy Personnel. *Pharmacy*. 2022;10(5):132.
69. Deetjen U. European e-prescriptions: benefits and success factors. 2016.
70. Wrzosek N, Zimmermann A, Balwicki Ł. A survey of patients' opinions and preferences on the use of e-prescriptions in Poland. *International journal of environmental research and public health*. 2021;18(18):9769.
71. Bulut S, Yıldız A, Kaya S. Evaluation of transition to electronic prescriptions in Turkey: perspective of family physicians. *International journal of health policy and management*. 2019;8(1):40.
72. Odukoya OK, Chui MA. Relationship between e-prescriptions and community pharmacy workflow. *Journal of the American Pharmacists Association*. 2012;52(6):e168-e74.
73. Johnson A, Guirguis E, Grace Y. Preventing medication errors in transitions of care: a patient case approach. *Journal of the American Pharmacists Association*. 2015;55(2):e264-e76.
74. Odukoya OK, Chui MA. E-prescribing: a focused review and new approach to addressing safety in pharmacies and primary care. *Research in Social and Administrative Pharmacy*. 2013;9(6):996-1003.
75. Gilligan AM, Miller K, Mohny A, Montenegro C, Schwarz J, Warholak TL. Analysis of pharmacists' interventions on electronic versus traditional prescriptions in 2 community pharmacies. *Research in social and administrative pharmacy*. 2012;8(6):523-32.
76. Mäkinen M, Rautava P, Forsström J, Äärimaa M. Electronic prescriptions are slowly spreading in the European Union. *Telemedicine and e-Health*. 2011;17(3):217-22.
77. Villalba-Mora E, Casas I, Lupiañez-Villanueva F, Maghiros I. Adoption of health information technologies by physicians for clinical practice: the Andalusian case. *International journal of medical informatics*. 2015;84(7):477-85.
78. Javgureanu V. A Systematic Review on the European Legislation and Policy of Cross-Border Health Care: Barriers and Facilitators. PQDT-Global. 2020.
79. Palma FNS. Digital Health Beyond Borders: Interoperability Challenges and Critical Success Factors in the Deployment of Cross-border ePrescription in Finland and Estonia.
80. Lluch M. Healthcare professionals' organisational barriers to health information technologies—A literature review. *International journal of medical informatics*. 2011;80(12):849-62.
81. Wood A, Rimpiläinen S. Exploratory on e-Prescription in Scotland. 2016.
82. Yusif S, Hafeez-Baig A, Soar J. An exploratory study of the readiness of public healthcare facilities in developing countries to adopt health information technology (HIT)/e-Health: the case of Ghana. *Journal of Healthcare Informatics Research*. 2020;4:189-214.

83. Wessel L, Gersch M, Harloff E. Talking past each other: A discursive approach to the formation of societal-level information pathologies in the context of the electronic health card in Germany. *Business & Information Systems Engineering*. 2017;59:23-40.
84. Odukoya OK, Stone JA, Chui MA. E-prescribing errors in community pharmacies: exploring consequences and contributing factors. *International journal of medical informatics*. 2014;83(6):427-37.
85. Odukoya OK, Chui MA. e-Prescribing: characterisation of patient safety hazards in community pharmacies using a sociotechnical systems approach. *BMJ quality & safety*. 2013;22(10):816-25.
86. Fisher JF, Meroueh SO, Mobashery S. Bacterial resistance to β -lactam antibiotics: compelling opportunism, compelling opportunity. *Chemical reviews*. 2005;105(2):395-424.
87. Godard B, Marshall J, Laberge C. Community engagement in genetic research: results of the first public consultation for the Quebec CARTaGENE project. *Public Health Genomics*. 2007;10(3):147-58.
88. Ashiru-Oredope D, Hopkins S, Vasandani S, Umoh E, Oloyede O, Nilsson A, et al. Healthcare workers' knowledge, attitudes and behaviours with respect to antibiotics, antibiotic use and antibiotic resistance across 30 EU/EEA countries in 2019. *Eurosurveillance*. 2021;26(12):1900633.
89. Ozturk Y, Celik S, Sahin E, Acik MN, Cetinkaya B. Assessment of farmers' knowledge, attitudes and practices on antibiotics and antimicrobial resistance. *Animals*. 2019;9(9):653.

Appendix A: Ethics Approvals



[Notification form](#) / [Perspectives and Preferences of Pharmacists about the role of t...](#) / Assessment

Assessment of processing of personal data

Reference number	Assessment type	Date
483337	Automatic	17.08.2023

Title

Perspectives and Preferences of Pharmacists about the role of the E-prescription System Implementation in Pakistan to Improve the Rational use of Antibiotics: A Qualitative Study and Quantitative Survey

Data controller (institution responsible for the project)

Norges teknisk-naturvitenskapelige universitet / Fakultet for medisin og helsevitenskap (MH) / Institutt for samfunnsmedisin og sykepleie

Project leader

Dr Biraj Karmacharya

Student

Attiqua Majeed

Project period

31.08.2022 - 31.08.2023

Categories of personal data

General

Legal basis

Consent (General Data Protection Regulation art. 6 nr. 1 a)

The processing of personal data is lawful, so long as it is carried out as stated in the notification form. The legal basis is valid until 31.08.2023.

[Notification Form](#)

Basis for automatic assessment

The notification form has received an automatic assessment. This means that the assessment has been automatically generated based on the information registered in the notification form. Only processing of personal data with low risk for data subjects receive an automatic assessment. Key criteria are:

- Data subjects are over the age of 15
- Processing does not include special categories of personal data;
 - Racial or ethnic origin
 - Political, religious or philosophical beliefs
 - Trade union membership
 - Genetic data
 - Biometric data to uniquely identify an individual
 - Health data
 - Sex life or sexual orientation
- Processing does not include personal data about criminal convictions and offences
- Personal data shall not be processed outside the EU/EEA, and no one located outside the EU/EEA shall have access to the personal data
- Data subjects will receive information in advance about the processing of their personal data.

Information provided to data subjects (samples) must include

- The identity and contact details of the data controller
- Contact details of the data protection officer (if relevant)
- The purpose for processing personal data
- The scientific purpose of the project
- The legal basis for processing personal data
- What type of personal data will be processed and how it will be collected, or from where it will be obtained

- Who will have access to the personal data (categories of recipients)
- How long the personal data will be processed
- The right to withdraw consent and other rights

We recommend using our [template for the information letter](#).

Information security

You must process the personal data in accordance with the storage guide and information security guidelines of the data controller. The institution is responsible for ensuring that the conditions of Article 5(1)(d) accuracy and 5(1)(f) integrity and confidentiality, as well as Article 32 security, are met.



Capital University of Science and Technology

Islamabad Expressway, Kahuta Road, Zone-V, Islamabad

Phone: +92 51 111 555 666, Fax: 92 51 4486705

Email: info@cust.edu.pk, Website: <http://www.cust.edu.pk>

Ref No: REC/05/04/23

Dated: April 25, 2023

To Whom It May Concern

This is to confirm that the research proposal titled "**Perspectives and Preferences of Pharmacists about the Role of the E-prescription System Implementation in Pakistan to Improve the Rational Use of Antibiotics: A Qualitative Study and Survey**," was presented by Mr. Sohail Riaz, co-supervisor of Ms. Attiqah Majeed, an MS student in Public Health at Norges Teknisk-Naturvitenskapelige Universitet, Norway.

Following a comprehensive assessment of the proposal, it has been determined that the research objectives, methodology, and rationale do not require a bioethical certificate according to Faculty of Pharmacy, Research Ethics Committee guidelines.

Moreover, research adheres to ethical standards for research involving human subjects, ensuring confidentiality and robust data protection. It does not involve hazardous experiments on humans or animals, and it poses no harm to the environment or any living beings.

Dr. Muzaffar Abbas
Chair
Research Ethics Committee
CUST, Islamabad

Dr. Muhammad Tariq Khan
Convenor,
Research Ethics Committee
CUST, Islamabad

Appendix B: Consent Form

Informed Consent Form

Information Sheet:

Title of Study:

Perspectives and Preferences of Pharmacists about the role of E-prescription Systems implementation in Pakistan to Improve the Rational use of Antibiotics: A Qualitative Study and A Qualitative Survey

Name of Principle Investigator: Attiqa Majeed

Name of Organization: Norwegian University of Science and Technology - NTNU, Institute for Health and Society, Faculty of Medicine and Health Sciences (MH)

Name of supervisor: Professor Biraj Karmacharya

Project: Master thesis

Introduction:

The purpose of this research work is to explore the perspectives and preferences of pharmacists in Pakistan regarding the role of E-prescription System Implementation in increasing the rational use of antibiotics. Your participation in this study is voluntary and will be kept confidential.

Procedures:

If you agree to participate, you will be asked to participate in an interview that will last around 30-45 minutes. During the interview, you will be asked inquiries about your experience, thoughts, and opinions on the E-prescription System, antibiotic use, and prescribing practices in Pakistan. The interviews will be audio-recorded to ensure accuracy, and the recordings will be kept confidential.

Benefits:

By participating in this study, you will have the opportunity to share your experience and opinions on the current situation and the potential role of E-prescription in improving rational

antibiotic use. This research may also contribute to improving health policy decisions in Pakistan.

Risks:

There are no known risks associated with participating in this study.

Confidentiality:

All data collected during the research will be kept confidential and anonymous. The audio recordings of the interviews will be kept confidential, and only the research team will have access to them. The data collected from this study will be used for research purposes only and will not be shared with anyone outside the research team. Participation in this research is completely voluntary, and you can end your participation at any time without any negative consequences.

Whom to Contact:

If you have any questions or concerns about the study, you can contact the Principal Investigator Attiq Majeed. Email: attiqamajeed13 Gmail.com

If you agree to participate, please sign this consent form and a copy will be provided to you for your records.

Thank you for considering this research study.

CONSENT CERTIFICATE

I _____ certify that I have read and understood the above consent form for the research study titled " Perspectives and Preferences of Pharmacists about the Role of E-prescription Systems Implementation in Pakistan to Improve the Rational Use of Antibiotics: A Qualitative Study and A Qualitative Survey " conducted by Attiqa Majeed.

I understand that my participation in this study is voluntary, and I have the right to refuse or withdraw from the study at any time without any negative consequences. I understand that I will be asked to participate in an interview, and my audio recording will be taken for research purposes only. I understand that my confidentiality will be maintained, and my personal information will not be shared with anyone outside the research team.

I have had the opportunity to ask questions about the study, and my questions have been answered to my satisfaction. I understand that I can contact the Principal Investigator Attiqa Majeed if I have any additional questions or concerns.

I voluntarily agree to participate in this research study, and I sign this consent certificate to indicate my willingness to participate.

Participant's Signature: _____

Participant's Name: _____

Date: _____

Appendix C: Interview Guide

Interview Guide for Recruiters: Exploring Pharmacists' Perspectives on E-Prescription Systems and Antibiotic Resistance

Introduction:

- Welcome the participant and briefly recap the purpose of the interview.
- Introduce yourself as the recruiter conducting this study.
- Reiterate that the interview will be recorded for research purposes and emphasize confidentiality.

Participant Information:

- Confirm their basic information: name, age, gender, and marital status.
- Remind them about the focus on E-prescription systems, antibiotic resistance, and their pharmacy practice.

Challenges of Handwritten Prescriptions and Advantages of E-prescriptions (Theme 4.1):

1. Can you share any challenges you have encountered with handwritten prescriptions in your pharmacy practice?
2. What are the advantages of using E-prescriptions over handwritten ones in terms of accuracy, efficiency, and patient safety?

Antibiotic Resistance in Pakistan and Contributing Factors (Theme 4.2):

3. How familiar are you with the issue of antibiotic resistance in Pakistan?
4. From your experience, what factors contribute to the problem of antibiotic resistance in the country's healthcare system?

Patient Perspectives on E-prescriptions (Theme 4.3):

5. Have you noticed any changes in how patients react to E-prescriptions compared to traditional paper prescriptions?
6. How do patients generally respond to E-prescriptions, and do they express any concerns or preferences?

Patient Behavior Regarding Antibiotic Prescriptions (Theme 4.4):

7. Could you discuss patients' attitudes and behaviors regarding antibiotic prescriptions?
8. Have you observed any trends in patient requests for antibiotics, and how do you manage those situations?

E-prescriptions as a Tool to Combat Antibiotic Resistance (Theme 4.5):

9. Can e-prescription systems play a role in addressing antibiotic resistance? If yes, how?

10. Do you believe E-prescriptions could help regulate antibiotic dispensing and enhance responsible antibiotic use?

Barriers to E-prescription Implementation in Pakistan (Theme 4.6):

11. What obstacles prevent the widespread implementation of E-prescription systems in Pakistan?
12. Are there specific challenges unique to your region, Balochistan, that must be addressed for successful implementation?

Benefits of E-prescription to Patients and Healthcare Providers (Theme 4.7):

13. How do you think E-prescriptions benefit patients, especially in Pakistan's healthcare system?
14. From your experience, what advantages do healthcare providers, including pharmacists, gain from E-prescription systems?

Suggestions for Combating Antibiotic Resistance (Theme 4.8):

15. Based on your expertise, what suggestions or strategies would you propose to combat antibiotic resistance in Pakistan's healthcare landscape?

Closing:

16. Is there anything else you want to add, share, or elaborate on regarding E-prescription systems, antibiotic resistance, or related aspects?

Appreciation:

17. Thank the participants for their valuable time, insights, and contribution to the study.

Appendix D: Finalized Coding Frame

Annexure I

Themes and Subthemes:

Theme 1: Challenges of Handwritten Prescriptions and Advantages of E-prescriptions

- Subtheme 1: Difficulties with Deciphering Handwritten Prescriptions
- Subtheme 2: Potential Errors and Ambiguities in Handwritten Prescriptions
- Subtheme 3: Benefits of E-prescription System in Modernizing Healthcare
- Subtheme 4: Improving Efficiency and Patient Safety with E-prescriptions.
- Subtheme 5: Patient Acceptance and Perception of E-prescriptions

Theme 2: Antibiotic Resistance in Pakistan and Contributing Factors

- Subtheme 1: Causes of Antibiotic Resistance in Pakistan
- Subtheme 2: Overprescribing and Inappropriate Use of Antibiotics
- Subtheme 3: Lack of Public Awareness and Education on Antibiotic Usage
- Subtheme 4: Inadequate Infection Control Practices in Healthcare Settings
- Subtheme 5: Availability of Counterfeit or Substandard Antibiotics
- Subtheme 6: Self-medication and Absence of Strict Regulations on Antibiotic Dispensing

Theme 3: E-prescriptions as a Tool to Combat Antibiotic Resistance

- Subtheme 1: E-prescription's Role in Rational Antibiotic Use
- Subtheme 2: Better Control and Monitoring of Antibiotic Prescribing
- Subtheme 3: Facilitating Interventions to Address Antibiotic Misuse
- Subtheme 4: E-prescription Implementation and its Impact on Antibiotic Resistance

Theme 4: Barriers to E-prescription Implementation in Pakistan

- Subtheme 1: Limited Technology Infrastructure
- Subtheme 2: Lack of Digital Literacy among Healthcare Providers and Patients
- Subtheme 3: Resistance to Change from Traditional Practices
- Subtheme 4: Concerns about Data Security and Privacy
- Subtheme 5: Financial Investments and Resource Requirements

Theme 5: Benefits of E-prescriptions for Patients and Healthcare Providers

- Subtheme 1: Faster and Accurate Prescription Processing
- Subtheme 2: Reduced Waiting Times at Pharmacies
- Subtheme 3: Improved Access to Medication History for Patients
- Subtheme 4: Better Control over Antibiotic Prescribing for Healthcare Providers
- Subtheme 5: Enhanced Communication and Real-time Patient Information

Theme 6: Addressing Antibiotic Resistance through Awareness and Education

- Subtheme 1: Promoting Public Awareness on Appropriate Antibiotic Use
- Subtheme 2: Educating Patients on Completing the Full Course of Antibiotics
- Subtheme 3: Avoiding Self-medication and Understanding Consequences
- Subtheme 4: Healthcare Providers Following Evidence-based Prescribing Guidelines
- Subtheme 5: Emphasizing Infection Prevention and Control Measures
- Subtheme 6: Collaboration with Policymakers for Stricter Regulations and Surveillance

Challenges of Handwritten Prescriptions and Advantages of E-prescriptions

Handwritten prescriptions: Handwritten prescriptions present challenges due to difficulties in reading doctors' handwriting, which can lead to medication errors and delays at pharmacies. Illegible prescriptions can result in confusion and the wrong medication being dispensed. This issue can be exacerbated when pharmacists and healthcare providers struggle to decipher the intended medications and dosages. E-prescriptions: E-prescriptions offer advantages over handwritten ones. They improve the accuracy and legibility of prescriptions, reducing the potential for misinterpretation by pharmacists. E-prescriptions also streamline the prescription-to-pharmacy process, allowing for quicker access to medication. This digital approach minimizes errors caused by manual transcription and provides an efficient means of communication between healthcare providers and pharmacies.

Category	Subcategories	Open Code Example
Challenges of Handwritten Prescriptions and E-prescriptions	Handwritten prescriptions	Difficulty in reading doctors' handwriting.
		Illegible prescriptions leading to medication errors.
		Delays at pharmacies due to unclear prescriptions.
	E-prescriptions	Improved accuracy and legibility of prescriptions.
		Reduction in misinterpretation by pharmacists.
		Streamlined prescription-to-pharmacy process.

Antibiotic Resistance in Pakistan and Contributing Factors

Factors contributing to resistance: Antibiotic resistance is fueled by various factors, including the overuse of antibiotics in livestock agriculture. The widespread use of antibiotics in animal farming can lead to the development of resistant strains of bacteria. Inadequate patient education on antibiotic usage also contributes to the problem, as patients may not understand the importance of completing prescribed courses of antibiotics. Impact on healthcare: Antibiotic resistance has significant implications for healthcare. Limited treatment options for infections can lead to prolonged illness and increased mortality rates. Moreover, healthcare costs escalate due to the need for more extensive treatments and hospitalizations. Procedures that were once routine may become riskier due to the reduced effectiveness of antibiotics.

Category	Subcategories	Open Code Example
Antibiotic Resistance in Pakistan and Contributing Factors	Factors contributing to resistance	Overuse of antibiotics in livestock agriculture.
		Development of resistant strains from animal farming.
	Impact on healthcare	Inadequate patient education on antibiotic usage.
		Limited treatment options for infections.
		Prolonged illness and increased mortality rates.
		Escalation of healthcare costs.
		Increased need for extensive treatments and hospitalizations.
		Heightened risk in once-routine procedures due to antibiotic ineffectiveness.

Patient Perspectives on E-prescriptions

Convenience and accessibility: Patients appreciate the convenience of e-prescriptions. They can easily retrieve prescriptions from pharmacies without the need to travel or wait in line. This is particularly beneficial for patients with mobility challenges or those living in remote areas. E-prescriptions also reduce the chances of prescriptions being lost or forgotten. Trust in electronic systems: However, concerns about data privacy and security persist among patients. Relying on electronic systems for sensitive healthcare information can raise fears about unauthorized access or data breaches. Building trust in these systems is crucial for their widespread acceptance and use.

Category	Subcategories	Open Code Example
Patient Perspectives on E-prescriptions	Convenience and accessibility	Convenience of retrieving prescriptions from pharmacies.
		Elimination of travel and waiting time.
		Particularly beneficial for patients with mobility challenges or remote locations.
	Trust in electronic systems	Reduced chances of lost or forgotten prescriptions.
		Concerns about data privacy and security.
		Fears of unauthorized access or data breaches.
		Building trust for widespread acceptance and use.

Patient Behavior Regarding Antibiotic Prescriptions

Compliance with prescriptions: Patient behavior regarding antibiotics can have implications for antibiotic resistance. Some patients stop taking antibiotics once their symptoms improve, without completing the prescribed course. This incomplete treatment can allow surviving bacteria to develop resistance. Self-medication: Patients may also engage in self-medication, taking leftover antibiotics from previous illnesses without consulting a healthcare professional. This practice can lead to inappropriate antibiotic use and the development of resistance.

Category	Subcategories	Open Code Example
Patient Behavior Regarding Antibiotic Prescriptions	Compliance with prescriptions	Patients stop antibiotics once symptoms improve.
		Incomplete antibiotic courses contributing to resistance.
	Self-medication	Self-medication using leftover antibiotics.
		Use of antibiotics without consulting healthcare professionals.
		Link between self-medication and development of resistance.

E-prescriptions as a Tool to Combat Antibiotic Resistance

Monitoring and control: E-prescriptions provide a means of monitoring and controlling antibiotic usage. Healthcare providers and authorities can track prescription patterns and identify instances of inappropriate or excessive antibiotic prescriptions. This data can inform interventions to promote responsible antibiotic use. Improved prescription guidelines: E-prescriptions enable the implementation of improved prescription guidelines. Healthcare providers can receive alerts for potential drug interactions or allergies, ensuring safer and more appropriate prescription practices.

Category	Subcategories	Open Code Example	
E-prescriptions as a Tool to Combat Antibiotic Resistance	Monitoring and control	E-prescriptions facilitating antibiotic usage monitoring.	
		Tracking prescription patterns for appropriate use.	
		Identifying instances of inappropriate or excessive prescriptions.	
		Data informing interventions for responsible antibiotic use.	
		Improved prescription guidelines	Implementation of improved prescription practices.
		E-prescriptions alerting providers to drug interactions and allergies.	
Ensuring safer and more appropriate prescription practices.			

Barriers to E-prescription Implementation in Pakistan

Technological infrastructure: The implementation of e-prescriptions faces challenges related to technological infrastructure. Limited internet access in rural areas and unreliable electricity supply can hinder the smooth functioning of electronic healthcare systems. Healthcare system readiness: Moreover, some healthcare professionals might be unfamiliar with e-prescribing systems, leading to resistance or slower adoption. Overcoming these barriers requires training and education for both providers and patients.

Category	Subcategories	Open Code Example
Barriers to E-prescription Implementation in Pakistan	Technological infrastructure	Challenges due to limited internet access in rural areas.
		Impact of unreliable electricity supply on system functioning.
	Healthcare system readiness	Resistance or slow adoption due to healthcare professionals' unfamiliarity with e-prescribing systems.
		Necessity for training and education to overcome these barriers.
		Importance of ensuring both providers and patients are well-informed.

Benefits of E-prescription to Patients and Healthcare Providers in Pakistan

Patient benefits: E-prescriptions offer patients quick access to their prescriptions, which can be crucial in emergencies. Digital record-keeping also enables patients to maintain a comprehensive medical history and share it easily with other healthcare providers. Provider benefits: Healthcare providers benefit from reduced prescription errors associated with illegible handwriting. They can also access patients' medical histories, aiding in making informed decisions about treatments. These benefits ultimately contribute to better patient care.

Category	Subcategories	Open Code Example
Benefits of E-prescription to Patients and Providers in Pakistan	Patient benefits	Quick access to prescriptions, especially in emergencies.
		Digital record-keeping for comprehensive medical histories.

	Easy sharing of medical history with other healthcare providers.
Provider benefits	Reduction in prescription errors due to legibility issues.
	Access to patient medical history for informed treatment decisions.
	Overall improvement in patient care due to these advantages.

Suggestions for Antibiotic Resistance

Education and awareness: Promoting responsible antibiotic usage through educational campaigns is essential. Raising public awareness about the consequences of antibiotic misuse can encourage patients to follow proper usage guidelines. Regulatory measures: Implementing regulations on antibiotic sales can help control their distribution and use. By requiring prescriptions for antibiotics and enforcing their proper use, regulatory measures can slow the development of antibiotic resistance.

Category	Subcategories	Open Code Example
Suggestions for Antibiotic Resistance	Education awareness	and Promoting responsible antibiotic usage through educational campaigns.
		Raising public awareness about the consequences of antibiotic misuse.
	Regulatory measures	Implementing regulations on antibiotic sales.
		Requiring prescriptions for antibiotics and enforcing proper use.

Survey (Google Forms):

Survey on use of Electronic prescriptions

Assessment of Pharmacists' thoughts towards use of electronic prescriptions and its impact on Rational use of Antibiotics in Pakistan

Academic research will be done with the results of this survey. The aim of the questionnaire is to measure the public perception of the Pakistani Pharmacists' thoughts towards use of electronic prescriptions and its impact on Rational use of Antibiotics. Please fill out the questionnaire and share it with other pharmacists. The data acquired via this questionnaire will be anonymous and utilized solely for research purposes. Thank you so much for taking the time to fill this survey!

** Indicates required question*

1. 1. How old are you? *

Mark only one oval.

- 25-34
- 35-44
- 45-54
- 55 Above

2. 2. What is your gender? *

Mark only one oval.

- Female
- Male

3. 3. Which Province of Pakistan do you live in? *

Mark only one oval.

- Punjab
- Sindh
- Balochistan
- Khyber Pakhtunkhwa (KPK)

4. 4. What is your job designation? *

Mark only one oval.

- Hospital Pharmacist
- Community Pharmacist

5. 6. What is your work experience? *

Mark only one oval.

- 1-5 years
- 6-10 years
- 11-15 years
- 15 Above

Views about handwritten prescription system

6. 7. What kind of prescription do you get for dispensing? *

Mark only one oval.

- Manual (handwritten) Prescription
- E-Prescription

7. 8. What kind of handwritten prescription do you have to deal with? *

Mark only one oval.

- Illegible (not clear enough to be read)
 Legible (clear enough to read)

8. 9. Have you ever called physicians to clear doubts?

Mark only one oval.

- Yes
 No
 Maybe

Perspective on e-prescription

"E-prescription" stands for electronic prescription. When a doctor gives a prescription to a patient, it is sent to a central prescription database. It is an accurate, error-free and understandable prescription sent directly to a pharmacy from the point-of-care and is an important element in improving the quality of patient care"

9. 10. Do you think you are a fast learner to new trainings or devices? *

Mark only one oval.

- Yes
 No

10. 11. Do you use any kind of software for Pharmacy? If yes, please write the name below.

Mark only one oval.

Yes

No

11. 12. Do you think, with e-prescriptions, there will be greater control over the prescribed drugs? *

Mark only one oval.

Yes

No

Maybe

12. 13. Do you think using electronic prescription would make your work more efficient and accurate? *

Mark only one oval.

Yes

No

Maybe

13. 14. Are you motivated to pick up the electronic prescription system?

Mark only one oval.

Yes

No

14. 15. Do you think using an electronic prescription system will decrease the cost of healthcare? (cost of physical data, e.g. for records)

Mark only one oval.

- Yes
 No
 Maybe

15. 16. Do you think the healthcare firms can afford an electronic prescription system? If you answered no, please write reason *

Mark only one oval.

- Yes
 No
 Other: _____

16. 17. Do you think the healthcare firms would be ready to adopt the new system based on the infrastructural facilities? *

Mark only one oval.

- Yes
 No

17. 18. What is antibiotic resistance? *

Mark only one oval.

- Bacteria develop the ability to defeat the drugs designed to kill them.
- Germs like bacteria and fungi develop the ability to defeat the drugs designed to kill them.
- Other: _____

18. 19. Antibiotic resistance is one of the biggest global health issues. Many causes lead to microbial resistance, in your opinion, what are the main causes contributing to this problem in Pakistan? *

Opinion and Preference about e-prescription system for improving use of antibiotics and reducing antibiotic resistance

19. 20. To what extent do you agree that the implementation of an e-prescription system in Pakistan would improve the rational use of antibiotics? *

Mark only one oval.

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

20. 21. Do you think an e-prescription system would help to reduce the misuse and overuse of antibiotics? *

Mark only one oval.

Yes

No

Maybe

21. 22. How would you rate the importance of implementing an e-prescription system * in Pakistan to improve the rational use of antibiotics?

Mark only one oval.

Not Recommended

0

1

2

3

4

5

6

7

8

9

10

Highly Recommend

22. 23. What do you think are the barriers that limit e-prescription implementation? *

Check all that apply.

- Expense to purchase and implement, including user training
- People don't like change
- Government is not supporting new implementations
- Healthcare firms are not highlighting the issue
- Other: _____

This content is neither created nor endorsed by Google.

Google Forms