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Master Thesis

eHealth for the Bedouin Population in Southern Israel- Barriers and Proposed Solutions

Author: Ohad Daniel (2700251)

1st supervisor: Dr. Anna Bon
2nd reader: Prof. Dr. Hans Akkermans

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"Questions you cannot answer are usually far
better for you than answers you cannot question."
From 21 Lessons for the 21st Century, *by Yuval Noah Harari*

Abstract

This study investigates the barriers to eHealth access among Bedouin communities in Southern Israel and proposes culturally sensitive solutions. The research, funded by the Israel National Institute for Health Policy Research, involved a literature review, surveys, and interviews. Researchers from Ben-Gurion University (BGU), fluent in the local Bedouin-Arabic dialect, played a crucial role in data collection. The study focused on context analysis and identified key barriers such as limited digital literacy, inadequate infrastructure, language barriers, and mistrust in digital systems. These findings highlight significant disparities in eHealth access for the Bedouin communities. To address these challenges, the study proposes culturally tailored solutions, including comprehensive translation and cultural adaptation of eHealth platforms, instructional videos, simplified sign-in procedures, and a smart healthcare assistant chatbot. These solutions aim to enhance digital literacy, improve infrastructure, build trust, and increase the accessibility and usability of eHealth services for the Bedouin community. By addressing these barriers, this research aims to improve healthcare accessibility and health outcomes for the Bedouin population in Southern Israel, with potential applications for other marginalized communities globally.

Acknowledgements

I would like to express my sincere gratitude to my collaborators from Ben-Gurion University of the Negev, without whom this project could not have been completed. Special thanks to Dr. Haneen Shibli, who generously shared her data and knowledge on Bedouin culture. This study was conducted with support from the Israel National Institute for Health Policy Research.

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Introduction and Background

As technology becomes increasingly widespread in the medical field, significant advancements have transformed the accessibility to traditional healthcare (1, 2). These innovations have introduced improved administrative tools, such as online appointment scheduling, diagnostic methods, and better patient care. Technology has made healthcare more accessible and efficient for many. However, this increased accessibility is not universal. While some groups benefit greatly from these advancements, others are left behind, creating or widening the gap of social disparity (3). This research aims to contribute solutions to improve accessibility to digital healthcare services for an underprivileged population. In doing so, it addresses the third goal of the United Nations Sustainable Development Goals, which focuses on ensuring healthy lives and promoting well-being for all ages (4). The population discussed in this paper is the Bedouin community in the northern Negev region in Israel.

The history and demographics of the Bedouins as well as their socio-economical data are presented to introduce the culture and current situation of the community. As the paper discusses accessibility to eHealth services, the Israeli health system along with its eHealth services is presented to help give a better understanding of the context in which the research takes place. The research aims to apply the findings of Bon and Akkermans, who emphasize the importance of user-centered and context-aware methods for digital inclusion (5). By understanding the context and user needs, the goal is to adapt current eHealth technologies to the needs of the Bedouin population through user-centered design and co-creative innovation, rather than expecting users to adapt to the technologies themselves.

This research was made possible thanks to researchers from Ben-Gurion University of the Negev (BGU) that speak the local Bedouin-Arabic dialect and have extensive knowledge about the topic and the population.

This chapter details the background and motivation for the research along with the problem definition, the research questions and the contribution of the research.

1.1 The Bedouin Community in Israel

The Bedouin community, situated in the Negev Desert, is rich in traditions and a captivating history. Traditionally, these nomadic tribes wandered the landscapes of the Negev and the Sinai Peninsula, sustained by the sparse resources of the desert. Their lifestyle was one of mobility, resilience, and complex social structures centered around extended family clans (6).

In the past century, the Bedouin population has undergone a significant transformation, shifting from a nomadic lifestyle to a more settled existence. After the establishment of the State of Israel in 1948, the pace of change quickened as the Israeli government initiated policies to settle the Bedouins into fixed locations accompanied by the legalization of spontaneous settlements. This transition from nomadism to sedentarization marked a significant shift in their way of life (6, 7).

The Israeli government's urbanization policy, starting in 1969, aimed to relocate the Bedouins into newly established towns. While these urban centers were designed to integrate the Bedouin population into the state's social and economic fabric, they often clashed with traditional Bedouin lifestyles. For many Bedouins, the move to urban towns meant adapting to a new way of life that did not always align with their cultural and economic needs. As a result, a division emerged within the Negev Bedouin community. Many members of the Bedouin population reside in recognized towns, benefiting from better infrastructure and access to services. However, the other half lives in unrecognized villages, where they face significant challenges. These villages often lack basic amenities such as electricity, running water, and proper healthcare, reflecting a harsh disparity in living conditions. Gender roles have historically been well-defined, with men participating in public life and managing external affairs, while women were the custodians of the home and family. However, as the Bedouins settled into more permanent residences and engaged with a market-oriented economy, the societal fabric began to change and adapt(8).

The advancement of formal education and the penetration of modern technologies have been pivotal in this transformation. Younger generations, exposed to new ideas through schooling and digital media, are increasingly adopting values that differ from those of their elders. Younger generations are increasingly embracing values challenging traditional norms and sparking a gradual but noticeable shift in societal dynamics.

The Bedouin population in southern Israel is a minority within the overall Arab Muslim minority in Israel. This population is characterized by unique economic, social, and cultural traits. The social structure of the Bedouin population in that region is considered traditional, conservative, and tribal (9). It is regarded as one of the most disadvantaged populations in Israel, even compared to other minority groups. All Bedouin settlements in the Negev are ranked at the bottom of the socio-economic ladder in Israel (10). The eligibility rate for high school graduation among Bedouin students in the region was 48.1%, against 69.7% for students in the overall education system in Israel (11). The Bedouins constitute around 3% of the total population in Israel, with approximately 300,000 individuals and about 38% of the total population of the Negev (12). The growth rate of the Bedouin population in the Negev region is particularly high. Between 2000 and 2019, their population in the Be'er Sheva district grew by 144%, while the rest of the Negev population grew by 29% during the same period. The proportion of children and young people (under 18) among the Bedouins in the Negev is higher compared to all other groups in Israel with 54% versus 34% in the general population. The proportion of the elderly population (over 65) is only 2%, in comparison to 12% in the overall population (12). Only 34% of Bedouin households are connected to the internet. The connection rate in the nearest city of Be'er Sheva stands at 78.9% (13). Approximately 80,000 Bedouins, accounting for approximately 26% of their population live in settlements unrecognized by the Israeli government. In these settlements, the internet connection is even lower. This could potentially widen inequalities in skills or exposure to computers and the internet, deepening the existing digital divide (12, 14). The environmental conditions that the Bedouin communities live in have significant health implications, especially for the inhabitants of unrecognized villages in the Negev (15). The distinct characteristics of this population emphasize the importance of the need to improve accessibility to online health services as a means to advance the Bedouin community to allow for more equal opportunities and help integration into Israeli society.

1.2 eHealth

The World Health Organization described eHealth as the use of information and communication technologies (ICT) for health purposes (16). In recent years, technological progress led to an increase in the use of technological means for providing health services (17). These services are enabled using data transferring and communication systems using the internet. One main change in this field in Israel is the increased use of smartphone apps

and video chats for online medical services such as renewing prescriptions of medicines and receiving online medical advice (18). Another significant aspect of eHealth includes the use of a variety of applications such as medical information websites, interactive online health portals, online applications to assist in health-related decision-making, and more (19). The social distancing measures implemented during the COVID-19 pandemic led to an unprecedented increase in the digitization of various health services, particularly for non-life-threatening health conditions (20). One example of this unprecedented rise is a study conducted among pediatricians in Israel that showed a rapid increase in telephone appointments within a few days, from zero to 2,000 appointments per day. After the end of the lockdown, when physical appointments were allowed again, the volume of telephone appointments continued to grow, reaching around 3,000 telephone appointments per day (21). The increased use of technology for medical purposes poses a challenge, the most significant being the digital divide between various populations. The digital divide refers to the gap between individuals who have access to information and communication technologies and know how to use them effectively, and those who lack either access, knowledge, or both (22). Therefore, the two main components of this divide are lack of access to the internet, phones, computers and electricity, and lack of skills to use the technological devices efficiently. This divide affects mostly populations of low socioeconomic status, ethnic minorities and older populations (22).

1.3 Healthcare in Israel

Israel's healthcare system is a universal coverage model, ensuring access to healthcare services for all citizens through four health maintenance organizations (HMOs) by law. These HMOs are responsible for providing a comprehensive range of medical services, including preventive care, primary care, specialist consultations, hospitalizations, and prescription drugs. The system is funded through a combination of public and private sources, with public funding primarily coming from taxation (23).

Israel has made significant strides in healthcare, achieving a high life expectancy compared to other developed countries. This achievement is attributed to various factors, including advancements in medical technology, a focus on preventive care, and a well-established primary care system. Considering its levels of wealth, education, inequality, health system characteristics, and overall demographic profile, the country's life expectancy surpasses expected estimates (24).

Despite these achievements, the Israeli healthcare system faces significant challenges. A shortage of hospital beds and nurses has led to overcrowding and a high rate of hospital-acquired infections. This is particularly concerning given Israel's aging population, which is expected to increase the demand for healthcare services in the coming years. Additionally, the system is struggling with rising costs, which are putting pressure on both public and private healthcare expenditures. While Israel's national healthcare expenditure as a percentage of GDP appears relatively low, it is higher than most OECD countries when adjusted for the age of the population. This suggests that the system may not be as efficient as it seems and that reforms may be needed to ensure its long-term sustainability (25).

One of the key challenges facing the Israeli healthcare system is the increasing demand for services due to the growing and aging population. This demographic shift requires more resources and necessitates innovative solutions to ensure the sustainability of the system. Additionally, there are concerns about the equitable distribution of healthcare resources. Disparities in access to care have been observed between the central regions and the periphery of the country (26). Efforts are underway to address these disparities through initiatives aimed at improving infrastructure and increasing the availability of medical professionals in underserved areas.

1.4 eHealth Access of the Bedouin Population

The accessibility of healthcare services is a fundamental aspect of public health, ensuring that individuals have equitable access to essential medical services. However, disparities in healthcare access remain widespread among disadvantaged populations worldwide (27). These communities face numerous barriers to accessing eHealth services, including limited infrastructure, limited digital literacy and cultural factors. According to Zakaria *et al.* (28), even with training and incentives, if a new technology is deployed in a manner that contradicts cultural norms, its adoption may still be inadequate.

The Bedouin population in southern Israel faces significant challenges in accessing eHealth services. Despite national mandates for equitable healthcare delivery, many conditions are not met for this community, leading to disparities in healthcare access. The Bedouin population in southern Israel encounter technical, infrastructure, and cultural obstacles when trying to access essential medical care. Specifically, there is a deficiency in infrastructure and skills for utilizing internet-related technologies for healthcare purposes. The unique challenges and barriers faced by the Bedouin community in accessing healthcare services

remain inadequately identified. There is a need to evaluate the existing barriers preventing the effective utilization of eHealth systems. Cultural characteristics of the Bedouin population in southern Israel must be considered to ensure cultural sensitivity throughout the analysis.

1.5 Research Questions

In this section, the research questions of this study are presented, explained, and motivated.

1.5.1 Research Question 1.1

What are the current characteristics and main barriers to the use of online health services among the Bedouin population in Southern Israel?
This research question is designed to examine the current characteristics and main barriers to the use of online health services among the Bedouin population in southern Israel, with the objective of deriving insights that can inform current problems or potential solutions.

1.5.2 Research Question 1.2

What are the main characteristics of subgroups experiencing accessibility gaps to the use of eHealth services within the Bedouin communities in the South of Israel?
This research question aims to identify the characteristics of subgroups within the Bedouin communities in the Northern Negev region. This divide into subgroups can help in identifying common characteristics that are important for the proposal of possible solutions and will highlight the barriers of disadvantaged groups within the community.

1.5.3 Research Question 2

What are important aspects of designing solutions for improving online and remote healthcare services for the Bedouin population in Southern Israel?
The focus of this research question is to identify and assess important aspects of designing solutions for improving online and remote healthcare services for the Bedouin population in the southern part of Israel. Experts and people within the community will be interviewed to identify and evaluate the selected aspects. The preceding sub-questions are formulated to aid in addressing this research question.

1.6 Contribution of the Research

The contribution of the research lies in its comprehensive approach to addressing eHealth accessibility challenges within Bedouin communities in the northern Negev region of Israel. By conducting literature reviews, surveys, and exploratory and expert interviews, this study aims to identify barriers to accessing eHealth services in these communities and propose solutions to mitigate them.

This research adds to the existing literature by highlighting the technical, infrastructural, and cultural barriers that the Bedouin population faces in accessing eHealth services. It identifies specific challenges that hinder the effective use of eHealth systems, which have not been fully explored in previous studies. By taking into account the cultural characteristics of the Bedouin community, the study provides culturally sensitive insights that can guide future efforts in similar contexts.

Furthermore, the proposed solutions for improving healthcare accessibility for the Bedouin population in Israel, based on analysis of data collected from the population in the form of surveys and interviews and validated by relevant experts, have the potential to enhance the quality of life for Bedouin communities in the region. By addressing these barriers, this research aims to promote equitable access to healthcare services and support the advancement of public health initiatives for marginalized populations.

2

Research Strategies and Research Methods Design

This chapter provides a description of the research strategy, the data collection and data analysis methods and a reason for using each method for this research.

2.1 Research Methodology

The research methodology is structured into three sequential phases, each contributing to a better understanding of the healthcare accessibility barriers and challenges faced by the Bedouin population in southern Israel. Given that the study population primarily speaks a Bedouin dialect of Arabic, data collection for the first two phases was conducted by two Ben-Gurion University researchers who are native speakers of this dialect. The raw data was generously shared with me, then translated into English, anonymized, and analyzed by me.

The first phase of the research involved understanding the context of the study. This part included a literature review and exploratory interviews. Section 2.1.1 below provides an in-depth look at the exploratory interviews, detailing their design and the analysis of the results.

The second phase focused on the analysis of quantitative data collected through surveys conducted by the above-mentioned two researchers from BGU who are native Bedouin Arabic speakers. Section 2.1.2 below delves into the details of the survey, its design its execution and the analysis of its results.

Building on the insights gained in phases one and two, the third phase focuses on creating technological solutions to address significant barriers preventing eHealth access for the

Bedouin population in southern Israel. The proposed solutions were evaluated through in-depth expert interviews and a comprehensive analysis of key findings. Section 2.1.3 provides a detailed examination of the expert interviews, covering their design and the analysis of the results.

The following subsections explain each phase, detailing the methodologies and processes involved. Each phase is broken down to give a comprehensive understanding of how the research was conducted.

2.1.1 Phase 1: Understanding the Context

This phase involved a dual approach to gain a comprehensive understanding of the context surrounding eHealth adoption among Bedouin communities in southern Israel.

Literature and Background Review

A systematic review of relevant literature and governmental data was conducted. This includes academic studies on eHealth adoption in similar cultural contexts, reports on healthcare and its disparities in Israel, and demographic data specific to the Bedouin population in the Negev region. The literature review can be found in chapter 1 above. The objectives were to identify barriers to eHealth adoption, comprehend the unique socio-cultural context of the Bedouin community, evaluate the current state of healthcare infrastructure and service utilization in the region, and identify distinct subgroups within the population.

Exploratory Interviews

To better understand the context of the research, semi-structured interviews were conducted with a purposive sample of local health experts and community members within the Bedouin population in the Negev. Participants were selected based on their extensive knowledge and practical experience in healthcare delivery and the utilization of technology or healthcare services within the Bedouin community. This targeted sampling ensured that the perspectives gathered were deeply informed and relevant to the research objectives. The interview was designed by the research group at BGU. The interview guide can be found in Appendix A.1. The summary of the transcripts, summarized by me, can be found in Appendix A.2.

The interviews were designed to gather rich qualitative data, focusing on five key areas:

(a) Characteristics of eHealth Service Utilization: Participants were asked to describe the general utilization patterns of eHealth services among the Bedouin population.

This included insights into how these services are accessed, the frequency of use, and the types of eHealth services most commonly utilized.

(b) Challenges in Accessing Online Healthcare Services: The interviews aim to uncover the specific barriers that the Bedouin population faces when accessing eHealth services. These challenges could range from technological and infrastructural issues to socio-cultural and economic barriers.

(c) Challenges Faced by Healthcare Providers: In addition to understanding the user perspective, the interviews also explored the difficulties that healthcare providers encounter in delivering online health services to the Bedouin population. This provided a comprehensive view of the systemic and operational obstacles in eHealth service delivery.

(d) Variability in Benefits across Subgroups: The interviews investigated whether existing eHealth services are more beneficial for certain subgroups within the Bedouin population, such as residents of recognized villages or men. Participants were encouraged to discuss which groups might benefit the most and the least from these services and why.

(e) Recommendations for Improvement: Lastly, participants were asked to provide their insights and suggestions on how to enhance the provision of online healthcare services for the Bedouin population. This included potential policy changes, technological enhancements, and culturally tailored interventions.

2.1.2 Phase 2: The Surveys and Analysis of its Quantitative Data

A comprehensive survey was administered to 601 participants from Bedouin communities in southern Israel. The survey was designed and conducted by the research group at the Center for Emergency Response Research at BGU. While most participants completed the survey digitally, an option to fill out a paper form was also available. Additionally, research assistants from the Bedouin community assisted illiterate participants by reading the questions to them and recording their answers. These researchers later transferred all data from the paper surveys to an online format using Qualtrics. The English translation of the survey, conducted by me, can be found in the Appendix A.3. Among the 601 participants, 481 (80%) participants who completed over 75% of the questionnaire were included in the final analysis. The survey instrument was designed to gather a wide range

of data, including demographic information, technology proficiency, and eHealth utilization patterns.

The questionnaire aimed to capture essential demographic variables such as gender, age, and type of residency (city, recognized village, unrecognized village). It also assessed participants' language proficiency to understand potential language barriers to technology use.

To evaluate the technological landscape, the survey included questions about the availability of relevant infrastructure, such as internet access and the presence of digital devices within households. Participants' technological skills were assessed through questions measuring their proficiency in using various digital tools and platforms.

eHealth proficiency was a critical focus of the survey, with specific questions designed to assess participants' familiarity with and usage of online health services. This included their ability to navigate health-related websites, use health apps, and their general comfort level with digital health technologies.

All data collection procedures were conducted with full consent, adhering to ethical guidelines set forth by Ben-Gurion University. Participants were assured of their anonymity, and the collected data was securely stored to protect their privacy. The survey was conducted using Qualtrics, which facilitated efficient data collection and management.

This extensive dataset included 65 data points per participant and provides valuable insights into the intersection of demographic factors, technology proficiency, and eHealth utilization within the Bedouin communities of southern Israel.

Data Analysis

The primary tools utilized for the analysis of the collected data analysis included SPSS Statistics by IBM and Python, with the use of the Pandas library. These tools were selected for their capability to handle large datasets and their capacity to perform detailed statistical analyses.

(a) Descriptive Statistics:

Initial data analysis involved the use of descriptive statistics to summarize the socio-demographic characteristics of the participants. This included detailing variables such as gender, age, type of residency (city, recognized village, unrecognized village), and Hebrew and Arabic language proficiency. Additionally, descriptive statistics were employed to examine technology access and usage patterns, providing a foundational understanding of the collected data. The use of descriptive statistics provided a

better understanding of subgroups within the Bedouin population and helped identify potential barriers to the use of eHealth. To investigate the data, frequency tables were used for descriptive purposes, Chi-Square tests assessed relationships between categorical variables and t-tests and ANOVA were employed to compare continuous variables and group means.

(b) eHEALS Score Analysis:

The eHEALS (29) is an 8-item measure of eHealth literacy developed to measure combined knowledge, comfort, and perceived skills at finding, evaluating, and applying electronic health information to health problems. The current study population differed from the one used in the development of the eHealth tool, which comprised 664 teenagers from 14 different high schools in a major Canadian city. Therefore, an internal consistency reliability test was necessary, and the Cronbach's alpha test was used for this purpose. Cronbach's alpha evaluates reliability by quantifying the ratio of shared variance (covariance) among the items in an instrument to the total variance (30). Each item in the eHeals uses a 5-point Likert scale to answer a question with response options ranging from "to a very large extent" (5) to "not at all" (1). For the eHEALS data, each survey item was converted to a numerical value ranging from 1 to 5. A total eHEALS score was then calculated for each participant, providing a measure of their eHealth literacy. The mean eHEALS score for the study population was computed and compared to the established threshold of 26 to assess the overall level of eHealth literacy within the community. This comparison was critical in identifying the digital divide and understanding the extent of eHealth literacy among the Bedouin population. The implementation of the eHEALS can be observed in the translated survey in Appendix A.3.

(c) Visualization and Reporting:

The results of the analysis were visualized using tables created with SPSS Statistics by IBM. These visual aids illustrate the key findings and make the data more accessible. Detailed reports were generated to document the statistical findings ensuring transparency.

2.1.3 Phase 3: Solutions Design and Evaluation

Building on the findings from the previous phases, this phase concentrated on developing and evaluating potential solutions to enhance eHealth adoption among the Bedouin

community.

Solutions Design

Following the identification of barriers and user needs in previous phases, a comprehensive set of potential solutions was proposed. The proposed solutions were based on key findings from the literature review and interviews conducted in phase one, as well as the data analysis of the survey results from phase two. For each suggested solution, the proposed method of implementation, associated risks, and underlying motivation are explained, demonstrating how it addresses one or more of the previously identified barriers.

Solutions Evaluations

Three in-depth interviews were conducted with a diverse panel of experts, all of whom requested anonymity. The experts interviewed consisted of a key figure from a major healthcare provider, a Bedouin expert in technology with deep community ties, and an innovator specializing in technological solutions. The semi-constructed interview guide can be found in Appendix A.4. The summaries of the interview transcripts can be found in Appendix A.5. The objectives of these interviews included:

(a) Feedback Gathering:

The findings of the research were presented to the experts, who were then asked to provide feedback regarding the identified barriers. Afterwards, solutions were suggested and detailed feedback was collected on the proposed solutions in order to understand their potential effectiveness in the eyes of the experts and areas for improvement from their diverse viewpoints.

(b) Feasibility and Acceptability Assessment:

Furthermore, the consulted experts provided valuable insights on the practical implementation of the solutions within the community, as well as potential barriers to acceptance among different population segments.

(c) Identifying Challenges of the Solutions:

Highlighting any potential unintended consequences or challenges that might arise during the implementation phase, ensuring a proactive approach to mitigating these issues. This part also included the ethical considerations of the proposed solutions.

By integrating the comprehensive literature review, exploratory interviews, a large-scale survey, and in-depth expert interviews, this research methodology aimed to provide a holistic understanding of the barriers to eHealth adoption among Bedouin communities in

southern Israel. The study also sought to identify at-risk subgroups within the community and propose solutions to mitigate the identified barriers. The ultimate goal was to propose effective, culturally sensitive solutions that significantly improve healthcare accessibility and adoption of eHealth services within the discussed Bedouin communities.

Figure 2.1 below provides a visual representation of the various phases of the experiment, outlining the specific components and resources utilized in each phase.

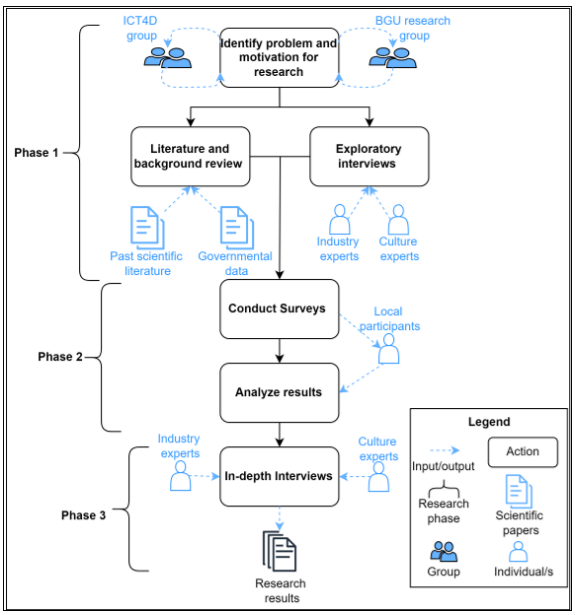

Figure 2.1: Overview: Methodology [illustration with diagrams.net]

This schematic outlines the methodological progression, showing how each phase builds upon the previous one, ultimately leading to the research findings. The figure details the research methodology, as elaborated in the preceding section 2.1.

2.2 Research Strategies

This research employed a mixed-methods approach, integrating both qualitative and quantitative research strategies to gain a comprehensive understanding of the research problem. Qualitative methods, including literature review and inductive reasoning-based interviews, were employed to explore the unique experiences, perspectives, and cultural factors influencing eHealth adoption among the Bedouin community. These methods provide rich, contextual data that complements the quantitative findings.

Quantitative methods, primarily involving the analysis of data from a large-scale survey, were used to examine technology access, usage patterns, and eHealth literacy levels. This data was analyzed using statistical techniques to identify patterns, correlations, and disparities within the community. Combining qualitative and quantitative approaches provides a more robust and holistic understanding of the problem and its current barriers, thereby informing the proposal of tailored solutions.

Furthermore, the research adopts a multi-phase design, progressing from descriptive and analytical stages to a design-oriented approach. The initial phases focus on describing and analyzing the characteristics of the study population and identifying the barriers to eHealth adoption. The final phase shifts towards designing and evaluating potential solutions, incorporating feedback from community members and healthcare experts to ensure the cultural relevance and feasibility of the proposed interventions. This iterative process enhances the applicability and effectiveness of the research findings in real-world settings.

2.3 Key Ethical Aspects

Ethical considerations are paramount in this research, especially given the unique cultural and social context of the Bedouin community in southern Israel. This study adhered to an ethical framework to ensure the protection of participants and the integrity of the research. The following subsections discuss the key ethical principles and measures implemented throughout the study.

Cultural Sensitivity and Respect

Cultural sensitivity was essential in this research, as it acknowledged the unique cultural context of the Bedouin community. The study utilized culturally appropriate language and respected local customs and traditions throughout the data collection process. Researchers from the Bedouin community, fluent in the local dialect and familiar with cultural nuances, played a key role in engaging with participants respectfully and effectively. This cultural alignment ensured that the research processes were not only respectful but also relevant to the community's context.

Informed Consent and Transparency

Securing informed consent was essential according to the ethics committee approval obtained from BGU. Participants were informed about the study's purpose, procedures, potential risks, and benefits in both Arabic and Hebrew to accommodate their language preferences. Detailed explanations ensured that participants understood their voluntary

involvement and their right to withdraw from the study at any point without any repercussions. Transparency in communicating the study's intentions fostered trust and facilitated informed decision-making among participants.

Anonymity and Confidentiality

Maintaining the confidentiality and anonymity of participants was a top priority. All collected data were anonymized by substituting personal identifiers with unique codes to ensure the privacy of individuals, especially for data transferred from BGU for this research. Both digital and physical records were securely stored, accessible only to authorized personnel, thereby protecting the data from unauthorized access and potential breaches.

Ethical Approval and Continuous Oversight

Before commencing the study, ethical approval for conducting the research was obtained by Ben-Gurion University of the Negev. The research proposal underwent rigorous review to ensure compliance with ethical standards. Throughout the study, continuous oversight was maintained to promptly address any ethical concerns that emerged. This proactive approach helped safeguard the participants' rights and well-being.

This research followed ethical principles to protect the dignity, rights, and well-being of all participants. This approach enhanced the study's validity and provided valuable insights into improving eHealth access for the Bedouin community.

3

Data Analysis and Interpretation

This chapter presents the data collected throughout the first two phases of this research, along with its comprehensive analysis and interpretation. It highlights key findings from the exploratory interviews, provides a detailed examination of the survey results, and discusses intriguing insights and patterns identified within the data.

3.1 Key Results from Exploratory Interviews

The findings from the exploratory interviews indicate that enhancing access to eHealth services among the Bedouin population in Israel necessitates addressing barriers related to language, culture, technology, and trust. Effective strategies should include personalized assistance for first-time users, active community engagement, investments in infrastructure, and cultural competency training for service providers. By prioritizing these aspects, healthcare organizations can promote health equity and improve health outcomes among minority populations. In this section, each key insight from the exploratory interviews is presented, explained, and discussed. The summaries of the interviews can be found in Appendix A.2. Additional information regarding the design and conduct of the survey can be found in section 2.1.

3.1.1 Language and Cultural Adaptation

Interviewees emphasized the critical importance of understanding the cultural nuances of the Bedouin community to effectively implement digital health initiatives. Current technological eHealth solutions for the Bedouin communities often suffer from inadequate translations. Interviewees stressed that simply translating content into Arabic is insufficient to communicate effectively with the Bedouin population. Interviewee A, from the Bedouin

community, noted that sometimes, even when Arabic translations are available, they are much shorter than the original Hebrew texts, which can create a sense of mistrust and inferiority. This highlights an approach of minimal translation without the intention of providing the same quality of service as that offered to the general population. Interviewee B mentioned that the translations must not only be linguistically accurate but also culturally appropriate, aligning with the Bedouin population's cultural and lifestyle preferences and customs to enhance engagement with eHealth services.

3.1.2 Digital Literacy and Education

A recurring theme in all interviews was the necessity for tailored digital literacy programs that address the specific needs and preferences of the Bedouin community. Practical skills and confidence-building should be prioritized to enhance comfort with digital platforms. Interviewee C, part of the team developing the digital health platform for the Bedouin population, highlighted a general reluctance to use the app for the first time. However, after receiving instructions from authoritative figures such as nurses, doctors, or administrative workers, individuals gained the confidence to use it independently. Interviewee B noted that many older adults in the community struggle with basic digital literacy, which significantly impacts their ability to use eHealth services without guidance or support. This interviewee also emphasized the importance of ongoing support and education to help community members become more proficient with digital tools.

3.1.3 Trust in the Bedouin Culture

Trust emerged as a crucial theme from all the key insights. While some interviewees suggested a general lack of trust in governmental services among the Bedouin community, others disagreed. However, all emphasized the importance of trust in Bedouin culture. Trust between patients and healthcare workers is particularly significant, with increased trust noted in face-to-face interactions (Interviewee B). Interviewee A mentioned that the lack of professional and culturally appropriate translations contributes to a lack of trust in current digital health services. Patients often call to ensure that the files they filled online have reached their doctor or come to the clinic even for telephone appointments, indicating their mistrust of digital systems (Interviewee C). Interviewee D highlighted that involving members of the Bedouin community in the design and development process of digital health platforms is essential to accurately reflect their cultural preferences and values, thereby increasing their trust in the service. Additionally, several interviewees

mentioned the importance of transparent communication and consistent follow-up to build and maintain trust (Interviewee A, Interviewee B, Interviewee D).

By understanding and addressing these key insights through targeted strategies, this study aims to improve the accessibility and effectiveness of eHealth services for the Bedouin population in southern Israel. These insights provide a foundation for developing culturally sensitive and community-specific solutions that can overcome identified barriers and foster greater trust and engagement with digital health platforms.

3.2 Survey Results

A detailed explanation regarding the design and execution of the survey is found in section 2.1.2. Of 599 surveyed, 481 (80%) people completed above 75% of the questionnaire. This was defined as the study population.

3.2.1 Socio-Demographics and Residence Type of Participants

As can be seen in Table 3.1 below, the majority of participants reside in formally recognized towns or villages (372 individuals, 77.3%), whereas 109 individuals (22.7%) live in unrecognized villages. This differentiation is significant due to the limited infrastructure and resources available in the unrecognized villages. When compared to the data indicating that 26% of the Bedouin population resides in unrecognized villages (12), the results show that the geographical distribution of the survey participants closely matches the actual distribution. The majority of respondents were female (n=293, 61%). Most respondents were married (n=309, 64%). The average number of people living in the same household is 7.4 persons per participant (standard deviation of 3.4). The mean age of respondents was 37.3 years, with a standard deviation of 14.95 years. 11.4% of respondents, which translates to 53 individuals, reported having no proficiency at all or limited proficiency in reading Hebrew.

	recognized town/village		unrecognized village		Total	
	Count	% within Do you live in	Count	% within Do you live in	Count	% within Do you live in
Yes	271	72.8%	81	74.3%	352	73.2%
No	101	27.2%	28	25.7%	129	26.8%
Total	372	100.0%	109	100.0%	481	100.0%

Table 3.1: Mobiles with Internet Connection Per Type of Residency

As shown in Table 3.2 below, the proportion of households with wireless access in unrecognized villages was significantly lower, with only 9.2% of households having wireless access compared to 65.6% in recognized towns and villages. Interestingly, as presented in Table 3.1, the proportion of participants with wireless access on their mobile phones did not differ significantly between types of residence. In recognized villages, 72.8% had wireless access compared to 74.3% in unrecognized villages. The analysis of these characteristics was conducted to identify the most suitable technological solutions for addressing the identified problems and gaps while considering the resources available to the Bedouin community in the Northern Negev region.

	recognized town/village		unrecognized village		Total	
	Count	% within Do you live in	Count	% within Do you live in	Count	% within Do you live in
Yes	244	65.6%	10	9.2%	254	52.8%
No	128	34.4%	99	90.8%	227	47.2%
Total	372	100.0%	109	100.0%	481	100.0%

Table 3.2: Wireless Connection At Home Per Type of Residency

3.2.2 General access and use of technology for accessing healthcare

Among the participants, 254 individuals, accounting for 53% of the sample, reported having wireless internet access at home, whereas 47% did not. This figure which is significantly lower than the Israeli ratio of 90% of the population having such access (31). Nevertheless, 73% of the population reported having internet access on their mobile phones. 108 participants (23.5%) reported they never or rarely use the internet for health-related issues. Another 36.4% (175 people) sometimes do. Together, these figures represent 59.9% of the participants. When asked about their level of proficiency in using search engines for seeking information using Google, Yahoo or a similar search engine service, 23% reported having no proficiency or very small proficiency in doing so. More than half of the population has no or little ability to conduct Zoom or video calls.

3.2.3 Analysis of the eHEALS Scale

Information regarding the eHEALS scale and the motivation for using it can be found in section 2.1.2. As mentioned before, an internal consistency reliability test of the questionnaire was conducted to ensure its reliability. The internal consistency reliability of the questionnaire, represented by Cronbach's Alpha value, was high (α= 0.956). This score indicates a high level of reliability. Given that the current study population differed significantly from the one used in the development of the eHealth tool, this test was crucial to ensure the validity of the instrument as explained in section 2.1.2. Each item in the eHeals uses a 5-point Likert scale to answer a question with response options ranging from "strongly agree" (5) to "strongly disagree" (1). The total eHeals score was calculated for the study population resulting in a mean score of 27.5 (std 8.09). This score is considered to be above the threshold of 26 mentioned in the literature as the cutoff between low and high literacy.

Do you live in	N	Mean	Std. Deviation	Std. Error Mean
recognized town/village	342	28.10	8.01	0.433
unrecognized village	102	25.47	8.049	0.796

Table 3.3: eHeals Scale Analysis

Table 3.3 above illustrates the mean eHEALS scores for individuals residing in recognized towns or villages compared to those living in unrecognized villages, along with the corresponding standard deviation and standard error of the mean. This table illustrates the mean eHEALS scores for individuals residing in recognized towns or villages compared to those living in unrecognized villages, along with the corresponding standard deviation and standard error of the mean.

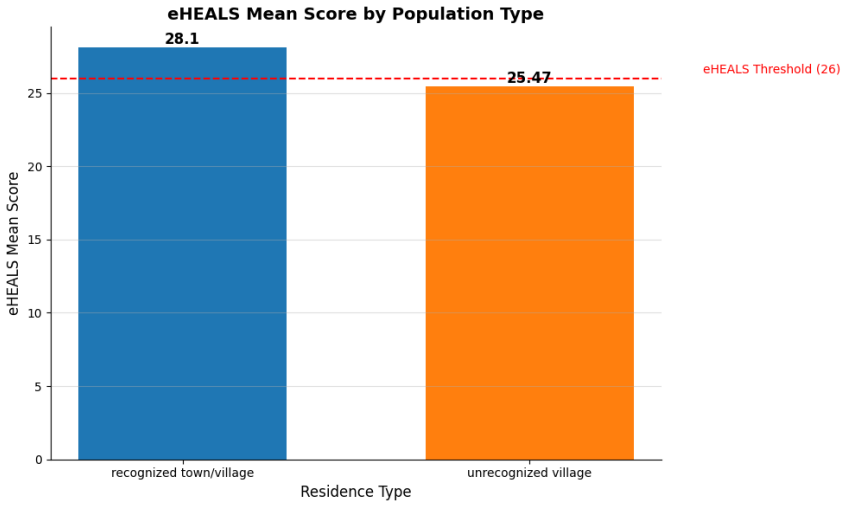

Figure 3.1: eHEALS Mean by Population Plot

It is important to highlight that the mean score for individuals in unrecognized villages is slightly below the threshold, at 25.4. Figure 3.1 visualizes the mean eHEALS score by type of residency, emphasizing the difference between individuals residing in recognized and unrecognized villages in this regard. The threshold found in the literature (29) is also presented in this figure.

4

Results and Proposed Solutions

This chapter presents the results from the various phases of the research, reflecting on design choices and illustrating the transition from data analysis and interpretation to the findings. It outlines the at-risk subgroups within the Bedouin population, presents the proposed solutions, and shares insights from the expert interviews regarding these proposed solutions.

The results of the research are partly incremental, as the surveys and exploratory interviews are used to identify the barriers to accessing eHealth services. From these identified barriers, solutions are designed to address the needs of the Bedouin population. The key insights from the expert interviews provide evaluations of these proposed solutions, including their feasibility, importance, and potential risks.

4.1 Most at risk Stakeholder Analysis Summary

After analyzing the collected data from the surveys, exploratory interviews and the literature, the focus was placed on five main stakeholder subgroups that are most affected by the identified barriers to the use of eHealth within the Bedouin population. Each group is not mutually exclusive, meaning that individuals who belong to multiple groups experience an increased complexity in their needs and challenges. In addressing the digital healthcare accessibility challenges among the Bedouin communities in southern Israel, it is crucial to consider the special and diverse needs of these non-exclusive subgroups. The following table categorizes these groups and outlines their specific needs.

Stakeholder Group	Specific Needs
People in Unrecognized Villages	- Mobile internet solutions - Low-cost health services - Offline health information access - Simple interface eHealth apps - Assistance with technology use - Solutions using Bedouin-Arabic dialect
Elderly in Recognized or Unrecognized Villages	- Simple interface eHealth apps - Assistance with technology use - Telemedicine services - Offline services availability - Solutions using Bedouin-Arabic dialect
Individuals with Low Digital-Literacy	- Simple interface - Intuitive design - Assistance with technology use - Telemedicine services
Women of Traditional Background	- Sensitivity to Bedouin-Muslim gender norms (32) - Community health workers support - Availability of women-specific services (e.g., pregnancy support)
Low-literate people	- Voice-based applications - Video tutorials in local languages - Community health workers support

Table 4.1: Stakeholder Analysis Summary

Table 4.1 above provides a detailed analysis of the specific needs and operational goals of the identified stakeholder groups. By focusing on these groups, the eHealth solutions developed can be more inclusive, addressing the most pressing barriers and enhancing healthcare accessibility for the Bedouin population in southern Israel. This targeted approach aims to bridge the digital divide, improve health outcomes, and foster greater equity in healthcare access across the community.

Addressing the needs of people in unrecognized villages requires innovative solutions that do not depend heavily on stable internet connectivity. For example, mobile internet solutions and offline access to health information can provide critical support where infrastructure is lacking.

For elderly individuals, technology adoption can be particularly challenging. Therefore, simplifying the interface of eHealth applications, using telemedicine services in the Arabic language and providing offline service options are vital steps to ensure they receive the care they need without the added stress of navigating complex digital tools.

Individuals with low digital literacy need eHealth services that are easy to understand and use. This includes designing intuitive user interfaces and providing hands-on help to use the services effectively. Community education programs and user-friendly guides can greatly assist this group.

Women from traditional backgrounds represent another crucial subgroup with unique healthcare needs and access barriers. Cultural norms and practices can often restrict their access to digital devices and healthcare services (32). Therefore, eHealth solutions should incorporate culturally sensitive approaches, such as providing female healthcare professionals for consultations and ensuring discreet, private access to health information. Programs designed specifically for women's health, including pregnancy and maternal support, reproductive health education, and preventive care, can significantly enhance their healthcare access and outcomes.

Finally, low-literate individuals can benefit from voice-based applications and video tutorials that cater to their specific needs. Community health workers can bridge the gap by offering personalized assistance and ensuring that these individuals understand and utilize eHealth services effectively.

By focusing on these key subgroups and tailoring solutions to meet their specific needs, significant progress can be made in improving healthcare access and outcomes for the Bedouin population in southern Israel. This stakeholder analysis summary underscores the importance of tailoring eHealth solutions to the unique needs of different groups within the Bedouin population.

4.2 Identified Barriers to the Use of eHealth by the Bedouin Population

The following section discusses the barriers to the use of eHealth services among the Bedouin population in southern Israel based on survey results, insights from exploratory interviews, and an analysis of the most at-risk subgroups.

4.2.1 Infrastructure and Access to Technology

Access to technology is a significant barrier to the adoption of eHealth services among the Bedouin population. The survey results revealed that only 53% of participants reported having wireless internet access at home, a figure that is significantly lower than the national average of 90% in Israel (31). This disparity is even more pronounced in unrecognized villages, where only 9.2% of households have wireless internet access compared to 65.6% in recognized areas. While 73% of participants reported having mobile internet access, a substantial 23.5% indicated they never or rarely use the internet for health-related issues, highlighting a gap in practical usage despite theoretical access. Exploratory interviews emphasized that the lack of reliable internet infrastructure, particularly in unrecognized villages, severely limits the ability to access eHealth services. This infrastructural gap necessitates alternative solutions such as mobile internet and offline health information access. Additionally, insights from the exploratory interviews revealed that a significant portion of the younger population actively engages with social media and frequently uses their smartphones.

4.2.2 Digital Literacy and Education

Digital literacy and education emerged as critical barriers impacting the effective use of eHealth services. The survey indicated that 23% of respondents reported having no or very little proficiency in using search engines, and more than half had little or no ability to conduct video calls, indicating a significant lack of digital skills necessary to navigate eHealth platforms. The mean eHEALS score among participants was 27.5, suggesting a marginally high eHealth literacy; however, this literacy is unevenly distributed, with significant differences between those living in recognized and unrecognized villages. Interviewees highlighted the necessity for tailored digital literacy programs that address the specific needs and preferences of the Bedouin community. Practical skills and confidence-building should be prioritized to enhance comfort with digital platforms.

4.2.3 Language and Cultural Adaptation

Language barriers and the need for cultural adaptation of eHealth services were frequently mentioned as critical issues. The survey results indicated that 11.4% of respondents had no proficiency or limited proficiency in reading Hebrew, which poses a barrier when most eHealth services are provided in Hebrew. Interview findings underscored that existing

eHealth solutions often suffer from inadequate translations. Arabic translations are sometimes shorter than the original Hebrew texts, causing mistrust among users. Effective communication requires translations that are both linguistically accurate and culturally appropriate. It is essential to consider cultural norms when designing communication materials, including the use of imagery and symbols that are culturally relevant and respectful to the Bedouin population.

4.2.4 Trust in Digital Systems

Trust in digital healthcare systems is another significant barrier to the adoption of eHealth services. The exploratory interviews indicated that trust between patients and healthcare providers is crucial, and face-to-face interactions are significant factor in the Bedouin culture. As revealed in the interviews, low digital literacy affects trust in digital systems. Building trust requires involving community leaders in the design and promotion of eHealth services. Additionally, ensuring transparency and responsiveness in digital health platforms can help enhance trust within the community. Therefore, digital health solutions should incorporate elements that resemble these personal interactions as closely as possible.

4.2.5 Specific Needs of At-Risk Subgroups

Certain subgroups within the Bedouin population face additional barriers due to their specific circumstances. The subgroups are presented in detail in Table 4.1. Residents of unrecognized villages face significant barriers due to poor infrastructure, such as limited internet access and fewer technological resources. Addressing these infrastructural gaps, possibly through mobile internet solutions and offline health information access, is crucial. Increased community engagement and involving local leaders in promoting eHealth can enhance trust. Maintaining physical support channels alongside digital ones is also crucial for these communities.

The elderly population often has lower digital literacy and finds it challenging to navigate eHealth platforms. Tailored educational programs and simpler user interfaces can help mitigate these issues. Developing highly intuitive and simplified interfaces, along with providing continuous support through helpdesks or community centers, is crucial for encouraging use among the elderly.

Cultural norms and responsibilities often restrict women's ability to access and use digital health services. Addressing these barriers involves creating supportive environments

and community outreach programs that encourage and facilitate their use of eHealth. Culturally tailored educational programs that consider the specific needs and constraints of women can help improve their digital health literacy. Including women in the design and dissemination of these programs ensures they are relevant and effective.

By addressing these barriers with targeted solutions, the adoption of eHealth services among the Bedouin population can be significantly improved, leading to better health outcomes and greater health equity.

4.3 Suggested Solutions

After understanding the research context through a literature review and current statistical data about the Bedouin population, and identifying major barriers to the use of eHealth through surveys and exploratory interviews, several targeted solutions were proposed to mitigate these barriers and address the community's needs. Each proposed solution is detailed with its motivation, implementation strategy, and potential risks or limitations. The proposed solutions are grounded in the data analyzed in the earlier stages of this research and are specifically designed to address the identified barriers effectively, with particular attention to the identified at-risk subgroups.

4.3.1 Comprehensive Translation Enhancement

To address the healthcare accessibility challenges among Bedouin communities in southern Israel, one proposed solution is the implementation of enhanced translations for all digital health pages and services offered by health providers in Israel.

This solution is based on findings from exploratory interviews, which underscored the consequences of inadequate or nonexistent translations, and from survey results that revealed a lack of Hebrew proficiency among the Bedouin population. The findings reveal that the absence of translations prevents people from accessing services and undermines trust in the system.

The solution should be implemented by employing professional translators proficient in both Hebrew and Arabic, with an understanding of the cultural context. The implementation of this solution should proceed in phases. Initially, the most frequently used features and pages would be translated and culturally adapted. This would then be gradually expanded to cover the remaining content, with a commitment to ensuring that all future updates are consistently multilingual and culturally appropriate. Regular consultations

with community representatives and users can ensure the translations are culturally appropriate and relevant. Furthermore, integrating feedback mechanisms within the digital platforms would allow users to report issues or suggest improvements, ensuring continuous refinement of the translations. Improved translations ensure that Bedouin users receive information that is understandable and relatable, building trust in the system and encouraging greater engagement with digital health platforms. However, even with high-quality translations, some members of the Bedouin community might still face difficulties due to low literacy levels in both Hebrew and Arabic. Additionally, translations alone may not fully address the deeper issues of digital literacy and mistrust in digital health services. Over-reliance on translations without accompanying educational support might result in limited improvement in the actual usage of eHealth services.

4.3.2 Culturally Sensitive Tutorial Videos

The second proposed solution involves the creation of improved tutorial videos for first-time app users. These videos, specifically designed for the Bedouin community, can enhance digital literacy by providing clear, step-by-step instructions on using the existing eHealth apps.

This solution is based on findings from exploratory interviews, which revealed that many users fear the first use of the app due to uncertainty about how to navigate it. Survey results also identified low digital literacy levels, particularly among people from unrecognized villages. Furthermore, the survey results highlighted the need to accommodate illiterate users. Implementing instructional videos can help by making reading unnecessary for completing simple tasks on the eHealth services.

To implement this, healthcare providers can collaborate with local videographers and health workers to produce content that is both informative and engaging. Including community members or respected figures in the videos can increase their relatability and effectiveness. The videos should be widely distributed through multiple channels, including social media, local health centers, and community gatherings, to ensure maximum reach. Featuring community members or healthcare workers in these tutorials can also increase trust and relatability. However, creating high-quality, culturally relevant tutorial videos requires investment in production and ongoing updates to reflect changes in the apps. The effectiveness of these videos depends on the users' willingness and ability to access and watch them. If the tutorial videos are not well-publicized or easily accessible, their impact will be limited. Furthermore, some users might still require additional support even after watching the tutorials, necessitating complementary educational initiatives.

4.3.3 Simplified Sign-In Procedure

A further proposed solution to enhance healthcare accessibility for the Bedouin communities in southern Israel is to implement a simplified sign-in process. This would use biometric authentication methods, such as facial recognition or fingerprint scanning, and utilize WhatsApp for authentication, eliminating the need for skills of using email.

This solution arises from the findings from the exploratory interviews regarding the difficulties of some people from the Bedouin population with current sign-in processes in health apps. This comes along with the survey findings regarding the digital literacy levels of the Bedouin population, especially in the unrecognized settlements. By simplifying the sign-in process through biometric authentication and leveraging popular communication tools like WhatsApp, this solution addresses a critical barrier to accessing digital health services, thus promoting greater inclusion and equity in healthcare access for the Bedouin communities.

This can be achieved by integrating biometric technology into existing healthcare apps and collaborating with secure authentication service providers to ensure privacy and data security. Additionally, incorporating WhatsApp, a widely used communication tool within the Bedouin community, can streamline the authentication process by sending verification codes via the app, eliminating the need for email addresses which many community members may not possess. The primary benefit of this solution is the significant reduction in barriers to accessing digital health services. Many Bedouins, particularly the elderly and less technologically literate, find traditional sign-in processes involving email accounts cumbersome and intimidating. By using familiar and straightforward authentication methods, users can more easily access eHealth platforms, enhancing user engagement and satisfaction. Biometric authentication is user-friendly and provides a high level of security, minimizing the risk of unauthorized access. However, it requires a certain level of digital literacy from the user. Furthermore, the implementation of biometric authentication and WhatsApp-based verification presents certain challenges and limitations. The initial setup of biometric systems requires investment in technology and infrastructure, as well as ensuring that all users have compatible devices. Privacy concerns are also paramount; robust measures must be taken to protect sensitive biometric data from breaches and misuse. Additionally, while WhatsApp is popular, it relies on users having access to smartphones and stable internet connections, which might still be a limitation for some community members.

Despite these challenges, the risks associated with biometric and alternative authentication methods are manageable with careful planning and robust security protocols. The risk of data breaches can be mitigated through encryption and secure data storage practices, while community education campaigns can address privacy concerns and build trust. Pilot programs and phased rollouts, combined with continuous community feedback, can help refine the system and ensure it meets the needs of the Bedouin population effectively.

4.3.4 Smart Healthcare Assistant Chatbot

Another proposed solution is the development of an intelligent chatbot capable of scheduling appointments, renewing prescriptions, and managing various other healthcare-related tasks. While this solution is not as urgent as the previously mentioned ones, it still holds significant potential to improve healthcare accessibility for the Bedouin population. Haugeland *et al.* define chatbots as computer programs designed for text-based customer service interactions, with varying levels of sophistication from rule-based systems to AI-powered conversational agents (33).

According to Xu (34), integrating chatbots into clinical practice can complement healthcare professionals by lowering expenses, enhancing workflow efficiency, and boosting patient outcomes. This technology can enhance user experience by providing immediate assistance and allowing users to access services at any time. Additionally, the use of chatbots can reduce the need for face-to-face interactions. The chatbot should support both Arabic and Hebrew to enhance the service for all users, ensuring better accessibility and inclusivity. To further assist individuals with low literacy, the chatbot should incorporate speech-to-text technology, allowing users to speak their queries instead of typing. Furthermore, the chatbot should provide audio responses, enabling users to listen to the information rather than read it. These features would provide a more user-friendly and accessible service to a broader audience. To implement this solution, healthcare providers can partner with tech companies specializing in artificial intelligence and natural language processing to develop a chatbot tailored to the Bedouin community's needs. Ensuring the chatbot's language model is trained on a comprehensive dataset that includes regional dialects and cultural references will enhance its effectiveness. Gradual implementation with initial testing in selected communities can help identify and address potential issues before wider deployment. By automating routine tasks, the chatbot can alleviate the workload on healthcare staff, enabling them to focus on more complex patient needs. However, the effectiveness of the chatbot depends on the users' digital literacy and comfort with technology. For some

members of the Bedouin community, especially those with limited experience in using digital platforms, interacting with a chatbot might be challenging. The chatbot's responses should be culturally sensitive and accurate to avoid misunderstandings. There is a risk that a poorly designed chatbot that fails to recognize cultural nuances or provide accurate information could increase mistrust among the Bedouin population in digital systems. Technical issues, such as system downtimes or incorrect responses, could further undermine confidence in digital health services. It is important to emphasize that this solution is intended to complement medical workers, not replace them. This approach ensures that individuals who are unable to access this service do not face any disadvantage due to its availability.

In summary, addressing the barriers faced by the Bedouin community in southern Israel in accessing digital health services requires a diverse approach. Table 4.2 below summarizes all proposed solutions, along with the barriers each solution addresses and the target population it aims to help. Collectively, these solutions aim to improve the accessibility and usability of digital health services for the Bedouin communities, fostering greater health equity and inclusion.

Approach	Description	Addressed Barrier	Addressed Subgroups
Comprehensive Translation Enhancement	- Culturally appropriate - For all digital health pages and services - Improve based on user's feedback - Regularly content updates	- Language and Cultural Adaptation - Digital Literacy and Education - Trust in Digital Systems	- People in unrecognized villages - Non-Hebrew speaking users - Elderly people
Tutorial Videos	- Culturally sensitive - Assistance for first-time app users - Clear explanation for individuals with low digital literacy - Involvement of local leaders or medical professionals	- Digital Literacy and Education - Language and Cultural Adaptation - Trust in Digital Systems	- People with low digital literacy - First-time app users - Low-literate people - Elderly population - People in unrecognized villages
Simplified Sign-In Process	- Facial recognition or fingerprint scanning - WhatsApp verification - Remove the need for a password verification	- Digital Literacy and Education - Infrastructure and Access to Technology - Trust in Digital Systems - Elderly population	- People with low digital literacy - Elderly population - People in unrecognized villages
Smart Healthcare Assistant Chatbot	- Assistance with administrative tasks - Allow access to medical data - Support audio responses and speech-to-text option - Attention to cultural nuances - Human-like language	- Language and Cultural Adaptation - Digital Literacy and Education - Physical access to medical facilities	- People in unrecognized villages - People with low digital literacy - Low-literate people

Table 4.2: Summary of Proposed Solutions, Addressed Barriers, and Addressed Subgroups

4.4 Evaluation of the Proposed Solutions- Key Findings from Expert Interviews

To evaluate the feasibility and risks of the proposed solutions for improving eHealth services among the Bedouin population in southern Israel, a series of expert interviews were conducted. The following sections summarize the key findings from these interviews, focusing on the evaluation of the proposed solutions, their feasibility, associated risks, and areas of disagreement between the experts. Summaries of the interviews can be found in Appendix A.5, the questions asked can be found in Appendix A.4.

4.4.1 Comprehensive Translation Enhancement

All experts unanimously agreed on the need for comprehensive and culturally appropriate translations of all health services and content into Arabic. While translations in Arabic are available, they are often incomplete, leading to usability issues. Accurate translations, including video tutorials and real-time updates, were suggested to match the services available in Hebrew (Expert A). Expert B highlighted the issue of dialect differences within Arabic, suggesting that translations should consider local dialects to be fully effective. Expert C mentioned that achieving high-quality translations requires substantial funding from the government to ensure that the translations are accurate and continuously updated. Despite high-quality translations, some members of the Bedouin community might still face difficulties due to low literacy levels in both Hebrew and Arabic (Expert A). Additionally, maintaining continuous updates and accuracy of translations across all digital platforms requires substantial resources and ongoing effort (Expert C).

4.4.2 Culturally Sensitive Tutorial Videos

The culturally sensitive tutorial videos, specifically designed for the Bedouin community, can enhance digital literacy by providing clear, step-by-step instructions on using the eHealth apps. Expert A supported the idea of combining video and text to aid understanding and recommended tailoring the content to local dialects for better comprehension. Expert B emphasized the importance of including community members or respected figures in the videos to increase relatability and effectiveness. Expert C highlighted that the effectiveness of these videos depends on users' willingness and ability to access and watch them. Creating high-quality, culturally relevant tutorial videos requires investment in production and ongoing updates to reflect changes in the apps. Furthermore, some users might still require additional support even after watching the tutorials, necessitating complementary educational initiatives (Expert C).

4.4.3 Simplified Sign-In Procedure

The proposed solution to use biometric authentication (e.g., fingerprints) instead of passwords and simplify the sign-in process to accommodate low digital literacy levels received mixed feedback. One expert (Expert B) raised concerns about the security of using WhatsApp for sign-in due to potential hacking risks and suggested a multi-step verification process, including preliminary phone calls to verify identity before sending a code via WhatsApp. Another expert (Expert C) emphasized the need not to overly complicate the

sign-in process and recommended the use of simple identification methods like ID numbers combined with SMS codes and biometric options in a user-friendly manner. Expert A highlighted the practicality of maintaining WhatsApp for its familiarity, despite the security concerns. The initial setup of biometric systems requires investment in technology and infrastructure, as well as ensuring that all users have compatible devices. Privacy concerns are also paramount; robust measures must be taken to protect sensitive biometric data from breaches and misuse. Despite these challenges, the risks associated with biometric and alternative authentication methods are manageable with careful planning and robust security protocols.

4.4.4 Smart Healthcare Assistant Chatbot

The proposed solution to develop a smart chatbot for scheduling appointments and renewing prescriptions received positive feedback, but experts highlighted the need for careful implementation. Expert A suggested that the chatbot use simple language and local dialects to ensure better comprehension. Expert B emphasized the importance of the chatbot being intuitive and responsive, with the ability to handle common queries effectively. Expert C recommended testing different interaction methods, including voice messages and avatars, to determine what works best for the community. The chatbot should also be able to guide users through various processes with video tutorials and text support, enhancing user confidence and reducing the fear of making mistakes. However, the effectiveness of the chatbot depends on users' digital literacy and comfort with technology. For some members of the Bedouin community, especially those with limited experience in using digital platforms, interacting with a chatbot might be challenging. There is a risk that a poorly designed chatbot that fails to recognize cultural nuances or provide accurate information could create mistrust among the Bedouin population. Technical issues, such as system downtimes or incorrect responses, could further erode confidence in digital health services.

4.4.5 Addressing Infrastructure Gaps

Experts highlighted significant infrastructure gaps, particularly the disparity in internet access between recognized and unrecognized villages. Mobile phone solutions were recommended due to better penetration of mobile internet (Expert B). Ensuring reliable 4G coverage in all areas was deemed crucial to support digital health initiatives (Expert A). Expert C pointed out that even within recognized villages, internet reliability can vary significantly, suggesting that offline capabilities should also be considered. This indicates

that while mobile solutions are feasible, they must be designed to work under varying conditions of internet reliability.

4.5 Additional Remarks or Ideas Discussed

Several interesting remarks and ideas were discussed during the interviews:

- **Integration with Existing Community Structures:** Leveraging existing community structures, such as local health clinics and community centers, to facilitate the adoption of eHealth services was suggested. These structures could serve as points of contact where individuals can receive assistance with using digital health tools (Expert A, Expert C).
- **Training Programs for Community Health Workers:** Training community health workers to use and promote eHealth services was recommended. These workers can play a crucial role in bridging the gap between technology and the community by providing hands-on support and education (Expert B, Expert C).
- **Feedback Mechanisms:** Establishing feedback mechanisms where users can report issues and suggest improvements was highlighted as important. This would help in continuously improving the eHealth services and ensuring they meet the community's needs (Expert B, Expert C).
- **Financial Aid:** Expert C highlighted the critical need for governmental funding to support these projects, as the current health system lacks sufficient resources and personnel to manage them effectively. The expert suggested that the government conduct an accessibility assessment of the current services, recognize the need for improved services for the Bedouin population, and allocate specific funds to address this issue (Expert C).

The feedback from the experts underscores several critical factors in developing effective eHealth solutions for the Bedouin population. Firstly, simplicity in design and functionality is crucial to ensure that users with varying levels of digital literacy can easily navigate and utilize digital health services. This includes straightforward sign-in procedures and intuitive user interfaces that do not overwhelm the users.

Secondly, building trust within the community is essential. Trust can be enhanced by involving trusted community figures in promoting eHealth services and ensuring transparency and responsiveness in digital systems. Addressing concerns over data privacy and

providing clear, understandable information about how the systems work are vital steps in fostering this trust.

Thirdly, the design of eHealth solutions must be intuitive and user-friendly. This involves developing interfaces that are easy to understand and use, incorporating culturally appropriate content, and providing comprehensive tutorial videos and other educational resources to support users.

Additionally, reliable infrastructure is crucial for the success of eHealth solutions. Ensuring consistent and widespread internet access, particularly in unrecognized villages, is necessary to support digital health initiatives. Mobile internet solutions and offline access to health information can mitigate the issues caused by inconsistent connectivity.

Moreover, the experts emphasized the need for continuous improvement and adaptation of eHealth services. This can be achieved by integrating feedback mechanisms within digital platforms, allowing users to report issues and suggest improvements. Regular consultations with community representatives can ensure that the services remain relevant and effective.

Furthermore, addressing financial constraints is important. Expert C highlighted the necessity of governmental funding to support these initiatives. Specific funds to improve services for the Bedouin population are essential steps in this process.

By incorporating these insights, the proposed solutions can be refined to better meet the community's needs and improve digital healthcare accessibility. This holistic approach addresses the diverse challenges faced by the Bedouin population, aiming to bridge the digital divide, enhance health outcomes, and foster greater equity in healthcare access. Ultimately, these efforts will contribute to a more inclusive and effective healthcare system that serves the Bedouin communities in southern Israel.

5

Discussion

This chapter examines the findings on eHealth use among the Bedouin population in southern Israel, concentrating on the barriers to adoption, the most at-risk subgroups, and the development of effective solutions to address these barriers. This chapter discusses the research questions by combining the knowledge presented in the academic literature with the corresponding findings. It explores the implications for future research and practice, emphasizing the importance of culturally sensitive interventions. The aim is to ensure equitable access to eHealth for the Bedouin population by addressing their unique needs and culture.

5.1 Addressing the Research Questions

5.1.1 Research Question 1.1

What are the current characteristics and main barriers to the use of online health services among the Bedouin population in Southern Israel?

The findings reveal significant obstacles, including inadequate infrastructure, low digital literacy, language challenges, and mistrust in digital systems. These obstacles are consistent with those highlighted in the systematic literature analysis on the implementation of eHealth services by Schreiweis *et al.* (35). Similarly, Das and Sengar identified literacy in eHealth, lack of value for elderly people, adapting to new technologies, lack of trust, and cultural ethical challenges as major barriers to the adoption of eHealth in India (36).

The disparity in infrastructure, such as internet access, between recognized and unrecognized villages contributes to a growing digital divide. As highlighted in this research and in the study by Dopelt *et al.*, this widens healthcare inequalities, further increasing the disparity between different sections of society (37). Additionally, Shapira *et al.* identified a

significant association between energy insecurity and community resilience among Bedouins in southern Israel. Community resilience reflects a community's capacity to promote health and improve well-being (38). This further underscores the impact of infrastructural disparities. This highlights the need for targeted infrastructural improvements and educational programs. Furthermore, the lower eHealth literacy observed in unrecognized villages suggests that digital literacy programs should be a priority to bridge this gap. According to Lee *et al.*, higher eHealth literacy and technology readiness lead to reduced reliance on healthcare personnel for managing chronic diseases (39). This finding highlights the importance of tailored educational programs to increase the eHealth literacy of the Bedouin population.

The report by Yee *et al.* (40) from Mount Sinai Hospital, highlighting the lower telehealth utilization among Black patients due to lack of trust, aligns with observations about the Bedouin population in Israel. This underscores the importance of trust-building and relationship development in promoting equitable eHealth access for marginalized communities (41).

5.1.2 Research Question 1.2

What are the main characteristics of subgroups experiencing accessibility gaps to the use of eHealth services within the Bedouin communities in the South of Israel?

According to Hosman and Fife (42), in some cases, eHealth can deepen existing socioeconomic disparities tied to income, gender, age, and education. Therefore, it is crucial to identify subgroups within the Bedouin community affected by these socioeconomic disparities. The identified subgroups experiencing significant accessibility gaps include residents of unrecognized villages, the elderly, individuals with low digital literacy, Women of traditional background, and low-literate individuals. Table 4.1 outlines the specific needs of each identified subgroup, highlighting tailored solutions such as voice-based applications to enhance eHealth access for low-literate individuals within the Bedouin community. As emphasized by da Silva *et al.* (43), it is crucial that the intelligent voice application be user-centric in its design, adapting to and accommodating the diverse needs of its users. Segmenting the Bedouin population into subgroups is essential for developing targeted solutions that effectively address the unique needs and challenges of each group. Broers *et al.* demonstrated that personalized eHealth intervention tools can effectively address the specific needs of different user groups, as evidenced by their application in patients with cardiovascular disease (44).

Building on previous findings that some subgroups encounter greater difficulty accessing healthcare generally (32, 45), this study specifically examines and aims to mitigate the barriers they encounter in accessing eHealth services.

5.1.3 Research Question 2

What are important aspects of designing solutions for improving online and remote healthcare services for the Bedouin population in Southern Israel? As presented in both research questions above, a main aspect of designing solutions to improve eHealth services for the Bedouin population involves identifying the most significant barriers to accessing eHealth and the most at-risk groups within the community. The solutions should aim to mitigate these barriers and ensure that they are effective for the more vulnerable social groups within the community. All solutions, the barriers they aim to mitigate, and the at-risk populations they intend to help are summarized in Table 4.2.

According to the findings of Rasi (46), there is a clear association between inadequate language ability and the underuse of healthcare services, leading to ineffective communication, and increased use of emergency care. This highlights the importance of enhancing translations both linguistically and culturally for the Bedouin population to address similar challenges and improve their healthcare outcomes. Additionally, based on the research by Rahman and Fukuda (47), providing proactive descriptions of features and functions significantly aids users, particularly those less familiar with technology. Their findings underscore the effectiveness of using tutorial videos with animated graphics to assist these individuals. This highlights the potential of culturally sensitive tutorial videos for the Bedouin population in using eHealth apps, making the technology more accessible and user-friendly. Furthermore, the research by Svanstrom and Fredriksson (48) supports the importance of simplifying sign-in processes by highlighting the potential for improved user engagement through a human-centered design approach to onboarding. Their findings emphasize that making sign-in procedures more straightforward in eHealth apps is crucial for enhancing access, particularly for individuals with low digital literacy.

Armaou *et al.* suggest that addressing community health inequalities necessitates culturally sensitive interventions. They emphasize the importance of designing and evaluating these interventions using sampling procedures that accurately represent the characteristics of the communities involved (49). The findings of this research align with this perspective, revealing that effective eHealth solutions for the Bedouin population must consider cultural norms, digital literacy levels, local infrastructure, and trust among the community in technology. Furthermore, both Armaou *et al.* and this research advocate for involving the

target populations at every stage of the development and evaluation process for eHealth solutions.

Additionally, according to Archer *et al.*, technology and its support infrastructure are crucial success factors for eHealth services (50). This paper emphasizes the importance of improving the infrastructure in Bedouin cities and villages to enhance access to eHealth services, particularly in the unrecognized villages. This gap in infrastructure impedes healthcare for the population in unrecognized villages and widens the socioeconomic disparity.

This research utilized several key steps proposed by the framework developed by Bon *et al.* (51). It began with an in-depth understanding of the context, followed by assessing the needs of the studied population, specifying requirements for implementation, evaluating sustainability, and developing the solution. The deployment of the proposed solutions is yet to be accomplished and is suggested for future research.

5.2 Future Research

5.2.1 Implementation of Proposed Solutions

Future research should concentrate on implementing and evaluating the proposed eHealth solutions for the Bedouin population, which include comprehensive translation enhancements, culturally sensitive tutorial videos, simplified sign-in procedures, and a smart healthcare assistant chatbot. It is important to adopt a phased deployment approach, beginning with the most frequently used features and gradually expanding to cover all aspects of the proposed solutions. Engaging with the community through workshops and training programs will improve digital literacy and familiarize users with the new tools. Continuous research monitoring and evaluation are essential to assess the effectiveness of each solution, using user feedback and performance metrics to make iterative improvements. One organization that can be useful in implementing the solutions is the Israel Internet Association (ISOC-IL) (52). ISOC-IL possesses the technical infrastructure and policy influence to effectively implement digital health solutions. Their commitment to an open and accessible internet along with their ability to foster collaboration across sectors and understanding of policy dynamics, positions them as a key player in bridging the digital divide and increasing eHealth access for disadvantaged minorities in Israel. Successful implementation of the proposed solutions necessitates collaboration and active participation from Israeli healthcare organizations.

5.2.2 Cultural Sensitivity and Community Engagement

The research underscores the importance of cultural sensitivity in the design of eHealth services. Engaging community leaders and incorporating cultural nuances into digital health tools can significantly enhance their effectiveness (49). Future research should explore the long-term impacts of culturally sensitive eHealth solutions on eHealth utilization and outcomes among the Bedouin community. Additionally, if these studies demonstrate the positive impacts of culturally tailored interventions, they could inform the development of new practices for similar contexts globally.

5.2.3 Digital Literacy and Education

Improving digital literacy is critical for the successful adoption of eHealth services (39). Tailored educational programs addressing the specific needs of the Bedouin population can enhance digital skills and trust in digital systems. Similarly, Arias *et al.* found that targeted digital literacy initiatives are necessary to increase eHealth usage among low-literacy populations (53). Shibli *et al.* also suggested that health education programs should be employed to improve healthcare access for the Bedouin population, especially the elderly subgroup (45).

Therefore, future studies should employ experimental designs to evaluate the effectiveness of various educational approaches in enhancing digital literacy across the Bedouin community and its different subgroups. Comparative analyses of digital literacy programs could identify the most effective strategies for the Bedouin community and its various demographic segments. Potentially, the findings from these future experiments will be relevant for other minorities in similar contexts.

5.3 Implications for Practitioners

5.3.1 Designing User-Friendly eHealth Applications

Practitioners should prioritize the development of user-friendly eHealth applications that cater to the specific needs of the Bedouin population. Essential features include simplified interfaces, voice-based navigation, and culturally relevant content. Armaou *et al.* (49) emphasize the importance of user-centered design in enhancing the usability and acceptance of eHealth interventions. Future developments should incorporate iterative usability testing with end-users from the Bedouin community to ensure that the applications align with their

cultural norms and meet their needs and preferences. Furthermore, employing human-centered design methodologies that utilize feedback can facilitate the creation of more intuitive and accessible digital health solutions. It is important to include feedback from members of the subgroups identified in this research.

5.3.2 Building Trust and Community Support

Building trust within the Bedouin community is critical for the successful implementation of eHealth services. Lee *et al.* found a positive relationship between digital literacy and trust in governmental websites (54). This finding highlights the importance of digital literacy in the adoption of eHealth services, which require user trust due to the need to share private and sensitive information. Additionally, the Bedouin culture values interpersonal connections. Therefore, involving community leaders and healthcare providers in the design and promotion of eHealth tools can enhance trust in these services. Future initiatives should include digital literacy education programs for the Bedouin population and utilizing community engagement to build and sustain trust in the eHealth services. Evaluative research should assess the impact of trust-building measures on eHealth adoption rates and health outcomes among the Bedouins.

5.3.3 Governmental Budgeting for Infrastructure and Solutions

According to Expert C, adequate funding from governmental bodies is essential for addressing the infrastructural and educational needs of the Bedouin population A.5.3. The expert suggested that targeted governmental investments can significantly improve healthcare access and outcomes for the Bedouin community. This aligns with the findings of Archer *et al.* on the importance of infrastructure for the adoption of eHealth (50). Ghanyem (55) also highlights the importance of governmental support in mitigating the digital divide that the Arab society in Israel suffers from and proposes the establishment of a national center for digitalization specifically for the Arab community. Governmental policymakers should prioritize funding for infrastructure development and digital literacy programs in unrecognized villages, where the infrastructure is worse and digital literacy is lower compared to the general Bedouin population and significantly below the national average in Israel.

Furthermore, inadequate infrastructure remains a significant barrier to eHealth adoption (50, 55). Investment in reliable internet access and digital devices, particularly in unrecognized villages, is essential due to the importance of infrastructure on eHealth accessibility.

Future implementations should utilize innovative solutions, such as satellite internet technologies and offline health information access, to overcome infrastructural challenges in remote areas. Policymakers should be informed by empirical evidence highlighting the importance, life-saving potential, cost-effectiveness, and impact of such infrastructural investments on the Bedouin population and other minorities.

Analyses of the potential impact of these investments on improving the quality of life for the Bedouin population should be conducted to inform resource allocation and ensure sustainable impact. Strategic partnerships between governmental bodies and non-governmental organizations in collaboration with Israeli health organizations could further enhance the reach and effectiveness of these initiatives.

5.4 External Contributors to the Research

The research benefited greatly from the much appreciated support and efforts of industry and academic experts. Their profound knowledge and extensive experience provided invaluable guidance and enriched the study's depth. Moreover, the contributions of BGU researchers played a pivotal role in enhancing the research's quality through constructive feedback and critical analysis. By combining the perspectives of industry professionals, academic scholars, and the broader community, the research process became a dynamic and multifaceted effort. This cooperative approach contributed to a comprehensive exploration of the subject, ultimately leading to insightful findings.

6

Threats To Validity

It is crucial to acknowledge and address the potential threats to the validity of the findings. Validity threats can undermine the reliability and generalizability of the study's findings. This chapter discusses the various threats to validity as classified by Wohlin et al. (56), including internal validity, external validity, construct validity, and conclusion validity. Identifying and mitigating these threats ensures a more robust and credible research process.

6.1 Internal Validity

Internal validity refers to the degree to which the observed effects in a study can be attributed to the interventions tested rather than to other factors. In this study, several potential threats to internal validity were identified:

(a) **Measurement Bias**: Measurement bias could arise from the self-reported nature of survey responses, which may be influenced by social aspects or recall bias. For instance, participants might overestimate their proficiency with digital tools or underreport barriers due to cultural sensitivities. To address this, anonymity and confidentiality were ensured to encourage honest responses. Additionally, survey data were complemented with qualitative interviews to cross-verify some of the findings, providing a more nuanced understanding of the participants' experiences and perceptions.

(b) **Instrumentation**: The tools used for data collection, such as surveys and interviews, might have inconsistencies or biases that affect the validity of the collected data. For

example, if some interviewers were more persuasive or empathetic, they might have elicited more favorable responses, thus affecting the results.

6.2 External Validity

External validity concerns the extent to which the results of a study can be generalized to other settings, populations, and times. Several potential threats to external validity were considered:

(a) **Temporal Validity**: The results are based on data collected at a specific point in time. Changes in technology, infrastructure, healthcare policies, or socio-cultural dynamics over time could affect the relevance and applicability of the findings. For instance, future advancements in mobile internet technology could change the accessibility landscape for eHealth services.

6.3 Construct Validity

Construct validity refers to the degree to which the operationalizations of a construct in a study reflect the true theoretical meaning of the construct. Several threats to construct validity were identified:

(a) **Operational Definitions**: The definitions and measurements of key variables must align with theoretical constructs. Any discrepancies or ambiguities in defining and measuring these variables can threaten construct validity. For example, if the term "eHealth adoption" was not clearly defined, participants of the interviews might have interpreted it differently.

(b) **Researcher Bias**: My interpretations and analysis of the qualitative data from the interviews could introduce bias. For example, in this research, there was the risk of unintentionally emphasizing positive responses over negative ones when analyzing attitudes towards the proposed solutions. Ensuring that data is analyzed objectively and consistently is critical for maintaining construct validity.

6.4 Conclusion Validity

Conclusion validity involves the degree to which conclusions we reach about relationships in our data are reasonable. Potential threats to conclusion validity in this study include

statistical power. The sample size may affect the study's ability to detect significant effects or relationships. A larger sample size could increase the statistical power and the reliability of the findings. For instance, a small sample size might miss detecting subtle but important trends in eHealth adoption for the Bedouin population.

In summary, while this study provides valuable insights into the barriers and solutions for eHealth adoption among the Bedouin population in southern Israel, it is essential to consider these threats to validity when interpreting the findings and their implications for research and practice.

7

Related Work

This chapter reviews scientific papers that are similar to this thesis in goal or methodology. Each section is dedicated to a specific paper, providing a brief description of the related paper and a clear explanation of how this thesis differs from or overlaps with the related paper, highlighting the contributions of this research. By examining these studies, the aim is to position this work within the existing literature and emphasize its unique contributions to improving eHealth access for the Bedouin population in southern Israel. The chapter includes five key papers, each analyzed in a separate paragraph.

7.1 Paper 1: "Internet in Israel's Arab Society" by Ganayem of the Israel Internet Association (55)

The paper "Internet in Israel's Arab Society" explores the multifaceted digital divide between the Arab and Jewish populations in Israel. It defines the digital divide and examines its various dimensions, including access to technology, awareness of online opportunities and risks, and digital skills. The paper presents available data on the digital divide in Israel, highlighting both areas of progress, such as increased smartphone usage, and major gaps in access to computers and infrastructure, as well as digital literacy. The report analyzes the unequal impact of the digital divide on Arab society compared to the Jewish majority in Israel, highlighting the missed opportunities for economic and social advancement faced by the Arab community due to their limited use of the internet. The paper concludes by advocating for increased investment by the Ministry of Education and the governmental Science and Technology Committee in internet accessibility and functionality, viewing this as a potential catalyst for socio-economic progress in the Arab community. Additionally,

the paper outlines several recommendations to bridge the digital divide, including the establishment of a national center for digitalization specifically focused on the needs of the Arab population in Israel. This proposed center would concentrate its efforts on infrastructure enhancements, improved government services tailored to the Arab community, digital literacy programs, fostering digital entrepreneurship within the Arab population, and continued research on the specific challenges and opportunities related to digital inclusion for this community.

Comparison with My Thesis:

Similarly to my research, the paper by Ganayem (55) aims to identify current access barriers to technology faced by a minority population in Israel. While their research focuses on the entire Arab population in Israel, my research focuses on a minority within the Arab population: the Bedouin community. The Bedouin population shares some characteristics with the general Arab population but also has unique cultural and socio-demographic differences. Furthermore, my research focuses on access barriers to eHealth services, whereas Ganayem's paper addresses access to technology in general. Both papers discuss the digital divide and propose solutions and recommendations for future improvements. Both papers highlight the necessity of governmental support for mitigating access barriers to technologies faced by the discussed minority groups.

7.2 Paper 2: "Telemedicine and eHealth Literacy in the Era of COVID-19: A Cross-Sectional Study in a Peripheral Clinic in Israel" by Keren Dopelt et al. (37)

Dopelt and colleagues conducted a cross-sectional study to examine the use of telemedicine and the relationship between eHealth literacy and satisfaction with telemedicine during the COVID-19 pandemic. The study involved 156 participants from a clinic in a peripheral community in southern Israel, using an online questionnaire. The findings revealed that while a significant majority of respondents knew how to use the internet for health information (85%), only a third felt safe using it to make health decisions. Furthermore, the study identified that young people and academics benefited more from telemedicine, leading to usage gaps and potential increases in existing health inequalities. The study recommended developing intervention programs to strengthen eHealth literacy, especially among vulnerable populations, to enhance satisfaction and reduce Skepticism towards telemedicine.

Comparison with My Thesis:

While Dopelt et al. examined a general peripheral community in Israel, my thesis investigates eHealth literacy with a specific focus on the Bedouin population in southern Israel. My research delves deeper into the unique cultural and socio-economic characteristics of the Bedouin community that influence their interaction with digital health solutions. My research is focused on the unique cultural characteristics of the Bedouin community that influence their interaction with digital health solutions. In contrast to Dopelt et al., who used an online questionnaire, my methodology incorporated a comprehensive approach, including literature reviews, surveys, exploratory interviews, and expert interviews. Although there is some overlap between the two studies in their shared goal of improving digital health services for marginalized groups, my thesis offers solutions specifically designed for the Bedouin community. The main findings and recommendations from Dopelt et al.'s paper are relevant to this research and were useful in identifying existing inequalities and gaps in access to digital health, which guided the design of the proposed solutions.

7.3 Paper 3: "Application of Telemedicine and eHealth Technology for Clinical Services in Response to COVID-19 Pandemic" by Anthony Jnr. Bokolo (57)

Bokolo's paper explores the application of telemedicine and eHealth technology for clinical services during the COVID-19 pandemic. This study uses data from existing literature to highlight the significance of telemedicine and eHealth as proactive measures to improve clinical care. The paper discusses various telemedicine platforms, including synchronous and asynchronous applications, and highlights their potential to reduce patient exposure, enhance access to healthcare, and alleviate resource strain during the pandemic. Additionally, the study reviews global policies promoting telemedicine adoption, such as regulatory adjustments and legislative actions in countries like the US, China, and Israel, which facilitated the use of telemedicine and eHealth for remote patient care and management during the health crisis.

Comparison with My Thesis:

My research shares a similar goal with Bokolo's study in enhancing healthcare delivery during challenging times by utilizing digital health solutions. Both studies emphasize the benefits of these solutions in increasing healthcare accessibility and alleviating resource strain. However, my research specifically targets a specific population, namely the Bedouin population in southern Israel, unlike Bokolo's study which reviews global policies regarding the adoption of telemedicine.

While Bokolo's study provides a broad overview of telemedicine applications and global policies during the pandemic, my research offers a detailed analysis of the Bedouin community's specific needs and current barriers in using eHealth services. Using local surveys and interviews, my research develops solutions tailored to the Bedouin population. This targeted approach allows for a deeper understanding of the unique challenges faced by this community and the creation of effective, customized eHealth interventions. My research includes a solution design element while Bokolo's study only provides a review of global policies.

7.4 Paper 4: "The Effect of Electronic Medical Records on Medication Errors, Workload, and Medical Information Availability among Qualified Nurses in Israel" by Raneen Naamneh and Moran Bodas (58)

Naamneh and Bodas' study examines the impact of electronic medical records (EMR) systems on medication errors, workload, and the availability of medical information among qualified nursing staff in Israel. The cross-sectional study collected data from 591 Israeli nurses using an online structured questionnaire, comparing the periods before and after the implementation of EMR systems. The results indicated that EMR systems significantly reduced medication errors and workload by approximately 30% each. However, the study also found that EMR systems reduced the availability of medical information by about 10%, as they required more time for documentation, detracting from patient care time. The qualitative analysis highlighted additional workload, technical faults, and issues related to the human factor, such as digital literacy among older staff members.

Comparison with My Thesis:

While Naamneh and Bodas' study focuses on the use of technology to enhance the work of nursing staff in Israeli hospitals, my thesis addresses the application of technology to improve user access to healthcare services among the Bedouin population in Israel. Their paper examines the use of electronic medical records (EMRs) to enhance the quality of work for nurses and by that improve service quality for patients. The availability of EMRs is a significant enabler for using and advancing eHealth services, making Naamneh and Bodas' findings valuable for promoting the future use of eHealth which is relevant for the solutions suggested in my research. The paper highlights the benefits and drawbacks of EMR systems, particularly in reducing errors and workload, though they focus on different

target groups. My thesis includes surveys and interviews in its methodology, contrasting with Naamneh and Bodas' use of an online structured questionnaire. Additionally, the specific focus on the Bedouin population differentiates my work from Naamneh and Bodas' broader study on nursing staff.

7.5 Paper 5: "The Potential and Paradoxes of eHealth Research for Digitally Marginalised Groups: A Qualitative Meta-Review" by Jessica A. Coetzer et al. (59)

Coetzer et al.'s meta-review critically evaluates the framing of eHealth use among digitally marginalized groups, such as individuals with low socioeconomic positions, the elderly, and people with a migrant background. The study identifies four paradoxes in current literature: eHealth is presented as a simple fix to complex problems, systemic barriers are framed as individual issues, the burden of eHealth's success falls on the users and healthcare workers it aims to help, and eHealth solutions are suggested to be tailored while treating groups as homogeneous entities. The review underscores the need for systemic change and the importance of researchers framing eHealth challenges and solutions with a focus on systemic rather than individual factors to prevent exacerbating existing health inequalities.

Comparison with My Thesis:

Coetzer et al.'s meta-review provides a broad critique of how eHealth research addresses the needs of various marginalized groups. In contrast, my thesis specifically targets the Bedouin community in southern Israel. While both works emphasize the importance of addressing systemic issues, my research offers practical, community-specific solutions developed through a mixed-methods approach, including detailed simulations and interviews. This targeted analysis not only identifies barriers but also proposes actionable, culturally sensitive interventions to enhance eHealth accessibility and effectiveness for the Bedouin population. By engaging local stakeholders and incorporating their input into the design and implementation of eHealth solutions, my thesis contributes strategies for reducing healthcare disparities. This approach highlights the importance of tailoring eHealth interventions to the specific needs of marginalized communities, thereby extending the insights from Coetzer et al.'s review to a specific, understudied group and providing concrete steps for improving digital health equity.

8

Conclusion

This research has identified and analyzed the key barriers to eHealth adoption among the Bedouin population in southern Israel, emphasizing socio-cultural and infrastructural challenges such as low digital literacy, language barriers, limited internet access, and mistrust in digital systems. By employing a mixed-methods approach, incorporating a literature review, surveys, and interviews with Bedouin community members facilitated by researchers fluent in the local Bedouin-Arabic dialect, this study provides a comprehensive understanding of the context and these barriers, underscoring the necessity for culturally sensitive solutions.

The proposed solutions, including comprehensive translation and cultural adaptation of eHealth platforms, instructional videos, simplified sign-in procedures, and a smart healthcare assistant chatbot, are designed to address the identified challenges and improve eHealth accessibility for the Bedouin community. These solutions aim to enhance digital literacy, improve infrastructure, build trust, and increase the accessibility and usability of eHealth services. Expert interviews were conducted to evaluate the feasibility and cultural appropriateness of the proposed solutions.

By addressing these barriers, this research has the potential to significantly improve healthcare accessibility and health outcomes for the Bedouin population in southern Israel. The culturally tailored solutions developed in this study offer a model for other marginalized communities worldwide facing similar challenges in accessing and utilizing digital health technologies. By adapting and implementing these strategies, healthcare providers and policymakers can work towards achieving health equity and improving the well-being of underserved populations globally.

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A

Appendix

A.1 Exploratory Interviews Questions

1. Can you please tell me about the characteristics of the Bedouin population's use of online health services?
2. What challenges does the population face in accessing online health services?
3. What challenges do service providers face in providing online health services to the Bedouin population?
4. Do existing health services help certain subgroups (e.g., women, residents of unrecognized villages, etc.) within the Bedouin population more than others? If so, which groups?
5. What changes/recommendations would you suggest to improve the provision of online health services for the Bedouin population in the Negev?

A.2 Exploratory Interviews Summaries

A.2.1 Interview 1: Interviewee A

Position: Senior position in the Ministry of Health in Israel
Seniority: 15 years
Key Findings:

- **Language and Cultural Barriers:** Advocacy materials need to be tailored specifically to Bedouin society, as there are significant differences between Bedouins and other Arab communities. Generic Arabic materials were not sufficient.

- **Digital Literacy:** There is a low level of digital literacy in the Bedouin community, necessitating tailored education programs.
- **Trust Issues:** There is significant distrust in government institutions and digital health services, partly due to historical marginalization and misinformation.
- **Technology Access:** There are large gaps in internet access between recognized and unrecognized villages, making mobile phone solutions essential.

Important Stories or Recommendations:

- Emphasized the need for culturally tailored advocacy materials.
- Recommended increasing digital literacy through targeted education programs.
- Suggested building trust through community engagement and clear, transparent communication.
- Highlighted the necessity of mobile solutions due to the disparity in internet access.

A.2.2 Interview 2: Interviewee B

Position: Key figure in a national program for digital literacy
Seniority: 4.5 years
Key Findings:

- **Social Influence:** Social group recommendations significantly impact the adoption of digital health services. Negative community perceptions can hinder usage.
- **Interface Usability:** Interfaces must be intuitive, visually supportive, and use simple language and illustrations.
- **Security Concerns:** Highlighted potential hacking risks with platforms like WhatsApp for sign-in, suggesting a multi-step verification process.

Important Stories or Recommendations:

- Stressed the influence of social groups on the adoption of digital services.
- Recommended that interfaces be designed to be user-friendly with visual aids.
- Suggested implementing multi-step security measures to address hacking concerns.

A.2.3 Interview 3: Interviewee C

Position: Senior figure in a healthcare provider, responsible for the Negev region
Seniority: 7 years
Key Findings:

- **Trust in Health System:** Trust in the overall health system is high, but digital systems are less trusted due to limited exposure and digital fluency.
- **Infrastructure:** Significant gaps in reliable 4G coverage hinder the adoption of digital health services. Physical presence and telephone support remain crucial.
- **Digital Literacy:** Initial use of digital services is intimidating for users, but trust increases once they see it works.

Important Stories or Recommendations:

- Emphasized the need for trust-building measures, including maintaining physical presence and telephone support.
- Highlighted the importance of widespread and reliable 4G coverage.
- Recommended efforts to increase digital fluency through education and hands-on support.

A.2.4 Interview 4: Interviewee D

Position: Senior marketing in the Arab society in a major healthcare provider
Seniority: 4 years in position, 14 years with the healthcare provider
Key Findings:

- **Low Usage of Digital Health Services:** The Bedouin population in the Negev has the lowest usage of digital health services compared to the general and Arab populations.
- **Preference for Face-to-Face Interaction:** Bedouins prefer face-to-face interactions for a sense of security, even if they have access to digital tools.
- **Infrastructure Challenges:** Poor internet infrastructure, especially in unrecognized villages, limits the use of digital health services.

Important Stories or Recommendations:

- Suggested maintaining face-to-face interaction options to provide a sense of security.
- Emphasized the need to address poor internet infrastructure to enable digital health service delivery.
- Highlighted the importance of understanding and addressing the community's preferences and concerns to improve digital service adoption.

A.3 Surveys

Hello,

The following questionnaire deals with various aspects related to the characteristics of your use of online services and telemedicine. The questionnaire is conducted as part of a study examining online health literacy, in order to provide vital information that can help reduce gaps in access to telemedicine. The purpose of the study is to examine the characteristics of current use of online medicine and telemedicine among the Bedouin population in the northern Negev.

There is no right or wrong answer to the questions - your feelings and perceptions are what matter.

The questionnaire is anonymous and your answers will be used for research purposes only. Participation is voluntary and you are free to refuse or stop answering the questionnaire at any time and without any consequences for you. The questionnaire completion time is estimated at about 10-15 minutes.

If you have any questions, you can contact XXXX by email: XXXX or by phone XXXX

We thank you in advance for your cooperation

Sincerely,

The research team

☐ **I hereby declare my consent to participate in the study**

Questionnaire on Accessibility to Remote Medical Services and Online Health Literacy

Part A'- Personal details:

1. **Gender**: a) Male b) Female
2. **Do you live in**: a) Permanent settlement b) Unrecognized village
3. **Where do you live**? _____(name of the settlement)
4. **What is your year of birth**? ☐ ☐ ☐ ☐
5. **Your marital status**: a) Single b) Married c) Other
6. a) **How many people live with you** (including you): |__|__|

b) **How many of them are under the age of 16** |__|__| **How many of them are over the age of 70** |__|__|

7. **Who do you live with**? (You can choose more than one option) a) Lives alone b) With a spouse c) With children d) With a caregiver e) Other
8. **Education**: a) No education b) Elementary c) High school d) Certificate studies e) Academic
9. **The average household income in Israel is currently about NIS 17,276. Is your total family income** (meaning both spouses): a) Below average b) Similar to average c) Above average
10. **Level of proficiency in Hebrew**: a) Not proficient in the language b) Low c) Good d) Very good
11. **Level of religiosity**: a) Secular b) Traditional c) Religious d) Other _____
12. **Do you suffer from chronic diseases** (such as diabetes, high blood pressure, etc.)? a) Yes b) No
13. **Do you take medication regularly to treat chronic diseases**? a) Yes b) No
14. **Do you smoke**? a) Yes b) No c) I smoked in the past
15. **Do you usually exercise**? a) Yes, I do light to extensive exercise b) I don't exercise at all
16. **How would you define your health condition**? a) Very bad b) Bad c) Good d) Very good e) Excellent

Part B'- Availability and accessibility of online services for health needs

17. **What is the source of electricity for various needs in your home**?
    a) The national electricity grid - direct connection
    b) Electricity grid - connection through another customer
    c) Solar panels and batteries (self-production) generator
    d) Wood and fuel
18. **Is there a wireless internet connection infrastructure in your area of residence**? a) Yes b) No
19. **Which of the following types of computers do you or someone in your household have**?

a) desktop computer
b) Laptop (laptop/netbook/tablet)
c) Mobile phone (with internet access)
d) None of them
e) do not know

20. [If not] Why?

a) Use the Internet elsewhere
b) Lack of knowledge or skills to use a computer
c) No need/interest
d) There is no internet connection in the area where I live
e) High costs/I can't afford it financially.
f) Concern about privacy or information security issues.
g) I don't have enough benefit from using it.
h) None of the reasons mentioned. But there is another problem __

21. What is your level of internet usage in general?

a) Never b) Rarely c) Sometimes d) Often e) Very often

22. What is your level of internet usage for health purposes?

a) Never b) Rarely c) Sometimes d) Often e) Very often

23. What is your level of control over each of the following uses:

	,1. To a very large extent	2. To a large extent	3. To a small extent	4. Not at all	not relevant
Using email					
Participating in discussion groups or forums on the Internet					
Using search engines to search for information,					

such as: Google and Yahoo					
Voice call using software (such as skype or conference call on a computer),					
Participation in a social website (such as Facebook, Twitter, Instagram, etc.)					
Creating or updating blogs or other websites					
Actions on the Internet in the field of public administration instead of going to a public institution (such as government or municipal) Searching for information about services or a public institution, downloading forms, sending emails or online forms to a					

public institution, payments, filing a complaint					
Entertainment and leisure activities such as) watching movies or videos (for example, on YouTube), listening to radio online (in real time), reading newsletters or newspapers, watching television (in real time)					
Banking activities Clarifying information (checking a check, checking savings, checking a credit card), bank transfers (payments, investments, money transfers, charging a mobile device, etc.)					

24. Do you have one or more of the following apps on your phone?

a) Clalit

b) Clalit active

c) Maccabi

d) Me'uchedet

e) Leumit

f) Another:_____

25. [If yes], what interface language do you use in the app? a) Arabic b) Hebrew c) Other

26. Do you know how to use the website of the health insurance fund you are affiliated with? a) Yes b) No

27. E-Heals

To what extent	1.not at all	2.to a small extent	3.to a medium extent	4.to a large extent	5.to a very large extent
1.I know how to find useful health information online					
2.I know how to use the internet to answer my health questions					
3.I know what sources of health information are available online					
4. I know where to find useful health information online					
5. I know how to use health information I found online					

to help me					
6.I have the tools to evaluate health information I find online					
7. I can distinguish between online sources of high-quality health information and those of low quality					
8. I feel safe when I use information from the internet to make health decisions					

We thank you in advance for your cooperation

A.4 Expert Interviews Questions

1. Besides the identified barriers, are you aware of any other significant barriers for accessibility for health-care?

2. Based on your experience, what are the main advantages and disadvantages of simplifying the sign in process? Is it manageable to overcome the risks but keeping it simple?

3. What is your opinion on utilizing a Chatbot for low digital literacy population? Is it feasible? What should be the focus when designing such system?

4. From your experience, what are methods to increase trust for people with low digital literacy in a digital platform?

A.5 Expert Interviews Summaries

A.5.1 Interview 1: Expert A

Position: Leading Bedouin Researcher and Expert to SDG 3 and 4 by the UN.

Key Findings:

- **Language and Cultural Barriers:** There is a significant issue with the availability and quality of Arabic translations for eHealth services. Even when available, translations are often incomplete.

- **Digital Literacy:** The Bedouin community has low digital literacy, requiring tailored education programs to enhance their ability to use digital health tools.

- **Trust Issues:** Trust in digital health systems is low, mainly due to concerns over data privacy and a preference for face-to-face interactions.

- **Technology Access:** There are large gaps in access to reliable internet and technology between recognized and unrecognized villages. Mobile phone solutions are crucial due to better penetration of mobile internet.

Feedback on Proposed Solutions:

- **Simplified Sign-In Process:** Biometric authentication is suggested for its simplicity and stability. Consideration for proxy use is necessary.

- **Improved Translation Services:** Comprehensive and culturally appropriate translations are essential. Including video tutorials and real-time updates will help.
- **Trust-Building Measures:** Involvement of community figures and familiar platforms like WhatsApp can enhance trust.
- **Enhanced User Interfaces:** Combining video and text to aid understanding is recommended. The chatbot should use simple language and local dialects.
- **Infrastructure:** Emphasized the need for reliable 4G coverage to support digital health services.

A.5.2 Interview 2: Expert B

Position: Leading technological innovation researcher.

Key Findings:

- **Social Influence:** Social group recommendations play a significant role in the adoption of digital health services. Negative perceptions within the community can deter usage.
- **Interface Usability:** Interfaces must be intuitive and visually supportive, using simple language and illustrations to aid understanding.
- **Security Concerns:** Highlighted potential hacking risks with using platforms like WhatsApp for sign-in. A combination of security steps is suggested.

Feedback on Proposed Solutions:

- **Simplified Sign-In Process:** A multi-step verification process that includes preliminary verification calls can enhance security.
- **Improved Translation Services:** Supported the need for comprehensive translations and intuitive interfaces.
- **Trust-Building Measures:** Transparency and responsiveness are crucial. Clear communication about system processes and social proof can build trust.
- **Enhanced User Interfaces:** Testing different interaction methods, such as voice messages and avatars, to see what works best for the community.
- **Infrastructure:** Reliable infrastructure is critical. Solutions should cater to the community's typical usage patterns, such as using voice messages.

A.5.3 Interview 3: Expert C

Position: Leading figure on the Israeli healthcare system, Medical Doctor by profession.

Key Findings:

- **Trust in Health System:** Trust in the overall health system is high, but digital systems are less trusted due to limited exposure and digital fluency.
- **Infrastructure:** Significant gaps in reliable 4G coverage hinder the adoption of digital health services. Physical presence and telephone support remain crucial.
- **Digital Literacy:** The initial use of digital services is the most intimidating for users. Once they see it works, trust increases.

Feedback on Proposed Solutions:

- **Simplified Sign-In Process:** Simple identification methods like ID numbers combined with SMS codes and biometric options are recommended.
- **Improved Translation Services:** Emphasized the need for full integration of Arabic content in health apps.
- **Trust-Building Measures:** Maintaining physical presence and telephone support is essential to bridge the trust gap.
- **Enhanced User Interfaces:** Incorporating video tutorials directly within the app can significantly aid user understanding and confidence.
- **Infrastructure:** Ensuring widespread access to 4G to support digital health services is fundamental.