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تأثير الكوفيد 19 على التحول الرقمي في المملكة العربية السعودية
في قطاع الرعاية الصحية:دراسة حالة للمستخدمين النهائيين في
مدينة تبوك

إعداد الطالب/

تهاني مؤنس العنزي

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**The Impact of COVID-19 on Digitalization in
Saudi Arabia (Health Care Sector): A Case Study
of End User Experience in Tabuk City.**

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Abstract:

The global COVID-19 crisis has expedited the integration of digital innovations across diverse sectors, particularly in healthcare. Saudi Arabia's Vision 2030 prioritizes incorporating digital solutions to elevate the standard and accessibility of healthcare. This investigation, conducted in Tabuk City, seeks to analyze the influence of these advancements on user interactions within healthcare establishments. The transition to virtual healthcare provision, prompted by the pandemic, has underscored the necessity for technological progress in healthcare infrastructures. Telemedicine, remote monitoring, and electronic health records have emerged as indispensable resources for sustaining healthcare services amidst the pandemic's challenges.

Saudi Arabia's commitment to digital health technologies under Vision 2030 has facilitated the implementation of national programs encouraging the use of information technology in healthcare delivery. The transformation to digital healthcare in Tabuk City has involved remote consultations, telemedicine services, and electronic health record systems. Continuous education on technology for providers and consumers has been emphasized to enhance the quality and accessibility of healthcare services.

The importance of this study resides in its contribution to the scientific community through the provision of empirical evidence regarding the factors that influence the adoption of digital health technologies within a particular cultural context. The practical significance of this research lies in the provision of insights that can be utilized by policymakers, healthcare providers, and technology developers to enhance the implementation and acceptance of digital health technologies, thereby improving healthcare services in Tabuk City and potentially other regions in Saudi Arabia.

The study aims to gauge the reception and effectiveness of digital health technologies among healthcare professionals and Citizens in Tabuk City. It seeks to analyze the impact of these technologies on healthcare delivery and to devise recommendations for enhancing their utilization. The study's participants consist of healthcare providers and patients in Tabuk City, with a sample size of 500 individuals chosen through stratified random sampling to ensure a comprehensive cross-section of the population.

Research methodology encompasses the utilization of structured questionnaires to acquire data on technology utilization, satisfaction levels, and perceived benefits and barriers. The study substantiates hypotheses pertaining to cultural influences, digital literacy, technological infrastructure, and political backing that impact the adoption of digital health technologies. Suggestions encompass augmenting sample sizes, broadening regional contexts, and employing a mix of data collection techniques to surmount constraints and enhance the effectiveness of digital health technologies in healthcare provision.

Keywords: COVID-19, Digitalization, Healthcare, m Health, Medical Services, Digital Health, Tabuk city, MOH app, user experience, COVID-19 aftermath, Healthcare provider.

المخلص :

لقد سرعت الأزمة العالمية لجائحة كوفيد-19 من دمج الابتكارات الرقمية عبر مختلف القطاعات، وخاصة في مجال الرعاية الصحية. وقد أولت رؤية 2030 في المملكة العربية السعودية أهمية كبيرة لدمج الحلول الرقمية وذلك بهدف رفع مستوى الرعاية الصحية وزيادة إمكانية الوصول إليها. تسعى هذه الدراسة، التي أجريت في مدينة تبوك، إلى تحليل تأثير هذه التطورات على تجربة المستخدمين داخل المنشآت الصحية. وقد أظهرت الدراسة أهمية التحول الرقمي في الرعاية الصحية ، الذي فرضته الجائحة، وايضا التقدم التكنولوجي في البنى التحتية الصحية. إذ أصبحت خدمات الرعاية الصحية بكافة انواعها عن بُعد، أدوات أساسية لاستمرار خدمات الرعاية الصحية في ظل التحديات التي أحدثتها الجائحة.

لقد أسهم التزام المملكة العربية السعودية بموجب رؤية 2030 في تنفيذ برامج وطنية تشجع على استخدام تكنولوجيا المعلومات في تقديم الرعاية الصحية. وقد شمل التحول إلى الرعاية الصحية الرقمية في مدينة تبوك الاستشارات عن بُعد، وخدمات الرعاية الصحية عن بُعد، وأنظمة السجلات الصحية الإلكترونية. وتم التأكيد على أهمية التعليم المستمر حول التكنولوجيا لكل من مقدمي الرعاية والمستفيدين لتحسين جودة الرعاية الصحية وإمكانية الوصول إليها. تكمن أهمية هذه الدراسة في مساهمتها للمجتمع العلمي من خلال تقديم أدلة تجريبية حول العوامل التي تؤثر على اعتماد تقنيات الصحة الرقمية في سياق ثقافي معين. كما تتمثل الأهمية العملية لهذا البحث في تقديم رؤى يمكن أن يستفيد منها صانعو السياسات ومقدمو الرعاية الصحية ومطورو التكنولوجيا لتعزيز تنفيذ وقبول تقنيات الصحة الرقمية، مما يساعد على تحسين خدمات الرعاية الصحية في مدينة تبوك وربما في مناطق أخرى من المملكة العربية السعودية.

تهدف الدراسة إلى قياس مدى استقبال وفاعلية تقنيات الصحة الرقمية بين المهنيين الصحيين والسكان في مدينة تبوك. وتسعى إلى تحليل تأثير هذه التقنيات على تقديم الرعاية الصحية وتقديم توصيات لتحسين استخدامها. يتكون المشاركون في الدراسة من مقدمي الرعاية الصحية والمرضى في مدينة تبوك، حيث تم اختيار عينة مكونة من 500 فرد باستخدام طريقة العينة العشوائية الطبقية لضمان تمثيل شامل للسكان. تشمل منهجية البحث استخدام استبيانات منظمة لجمع البيانات حول استخدام التكنولوجيا، ومستويات الرضا، والفوائد المتصورة، والعقبات. تؤكد الدراسة على فرضيات تتعلق بالتأثيرات الثقافية، ومحو الأمية الرقمية، والبنية التحتية التكنولوجية، والدعم السياسي التي تؤثر على اعتماد تقنيات الصحة الرقمية. تتضمن الاقتراحات زيادة أحجام العينات، وتوسيع السياقات الإقليمية، واستخدام مزيج من تقنيات جمع البيانات لتجاوز القيود وتعزيز فعالية تقنيات الصحة الرقمية في تقديم الرعاية الصحية.

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Table of Contents

Abstract.....	iii
الملخص.....	iv
Acknowledgment	v
Table of Contents	vi
List of tables.....	x
List of Figures	x
List of terminology.....	xi
Chapter 1: The general framework of study	1
1.1 Introduction.....	1
1.1.1 Background information.....	1
1.2 Problem Statement	4
1.3 Significance of the Stud	5
1.3.1 Scientific Importance	5
1.3.2 Practical Importance.....	6
1.3.4 Objective and Results of National Studies.....	8
1.4 Study Objectives	8
1.5 Research Questions	9
1.6 Study Hypothesis	10
1.7 Theoretical Model of Study.....	10
Chapter 2: Literature Review	13
2.1 Introduction.....	13
2.2.1 International Studies.....	15
2.2.2 Comment on International Studies	18
2.2.3 National Studies	18
2.2.4 Comment on National Studies.....	24
2.2.5 Current Study in comparison to the previous studies.....	25

2.2.6 Conclusion	26
2.3 Theoretical Framework	27
2.3.1 Theoretical Premises of Study	29
Chapter 3: Research Methodology	31
3.1 Introduction.....	31
3.2 Research Design.....	31
3.3 Population of the study.....	32
3.4 Data Collection Methods.....	33
3.5 Method of Analysis	34
3.5 Integration of Findings	34
3.6 Ethical Considerations.....	35
3.7 Data collecting procedure.....	35
3.8 Study Boundaries	36
3.8.1 Geographical Boundaries	36
3.8.2 Temporal Boundaries.....	37
3.9 Scope and Limitations.....	37
3.9.1 Scope.....	37
3.9.2 Limitations	37
Chapter 4: Practical Study.....	39
3.1 Introduction.....	39
3.2 Survey Data Analysis	39
3.2.1 Survey Adjustments.....	39
3.2.2 Survey Judges.....	40
3.3 Data Analysis	40
3.3.1 1 st survey with Tabuk citizens and healthcare services beneficiaries	40
A. Demographic Analysis	40
B. Awareness and Usage of Ministry of Health's Electronic Applications and Service	41

C. Satisfaction with the Ministry of Health’s Electronic Services	41
D. Most Widely Used Services.....	42
E. Recommendation	42
3.3.2 1 st Survey Findings.....	42
3.3.3 Recommendations of 1 st survey.....	44
3.3.4 Impact During and After COVID-19	45
3.3.5 2 nd survey with health care providers	45
A. Age Range and Specialty Distribution:.....	45
B. Health Services & Applications	45
Challenges.....	46
D. Role of Government & Institutions	46
E. Measuring ICT Impact.....	46
F. Innovations in ICT	47
3.3.6 Agreement on Statements.....	47
3.4 Hypothesis approved for the study	49
3.5 Research Finding.....	50
3.6 Comparison with Previous Studies	51
3.7 Suggestions	52
3.8 Study Limitation.....	53
3.9 Recommendation.....	54
References.....	56
1. National references.....	56
2. International references	61
Appendixes	65
Surveys	66
QUESTIONNAIRE BOOKLET	66
Survey 1: Tabuk citizens	67

Survey 2: Tabuk Health care providers.....	68
The Impact of COVID-19 on Digitalization in Saudi Arabia (Health care sector): Case Study of End User Experience in Tabuk City.	71

List of tables

Table 1-1: The table below summarizes the most popular apps used during and after COVID-19 in the healthcare sector	3
Table 2-3: Population of the study	33
Table 3-3: Age Distribution	40
Table 4-3: Gender Distribution.....	40
Table 5-3: Chronic Diseases	40
Table 6-3: Awareness	41
Table 7-3: How Learned	41
Table 8-3: Usage	41
Table 9-3: Ease of Use.....	41
Table 10-3: Frequency of Use.....	41
Table 11-3: Availability and Ease of Teaching	42
Table 12-3: Development and Digital Transformation	42
Table 13-3: Most Widely Used Services	42
Table 14-3: Recommendations of m-Health services	42
Table 15-3: Age Range and Specialty Distribution	45
Table 16-3: Health Services & Applications	46
Table 17-3: Challenges.....	46
Table 18-3: Role of Government & Institutions	46
Table 19-3: Measuring ICT Impact.....	47
Table 20-3: Innovations in ICT	47
Table 21-3: Cost Reduction & Productivity.....	48
Table 22-3: Positive Impact on Patient Experience	48
Table 23-3: Quality Improvement	48
Table 24-3: Impact of Training	49

List of Figures

List of terminology:

1. MOH: Ministry of Health.
2. DH: Digital Health.
3. GDP: Gross domestic product.
4. DOI theory: The diffusion of innovation.
5. TAM: Technology acceptance model.
6. IT: information technology.
7. DH technologies: A method used to securely exchange or establish secret keys across an insecure network.
8. SMH: The efficient market hypothesis.
9. SMART: Self-Monitoring Analysis and Reporting Technology.
10. VAS: Value Added Service.
11. HC: Health Care.
12. E-Health: Electronic health is the health care services provided electronically via the internet.
13. PRISMA-P: Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols.
14. GDPR: General Data Protection Regulation.
15. TOE framework: Technology-Organization-Environment framework is a theoretical framework that was developed in the field of information systems.
16. DHT: Digital Healthcare Technologies.
17. WHO: World Health Organization.
18. IMSS: Infrastructure Management & Security Services
19. HIMSS: The Healthcare Information and Management Systems Society.
20. HW/SW: Hardware/Software integration.
21. IRB: Institutional review board.
22. ICT: Information and communication technology.
23. ITOA: Intelligent IT Operation Analytics.
24. ITES: Information Technology Enabled Services.

- 25. DT: Digital technology.
- 26. Sehhaty: My Health.
- 27. Mawid:Appointment.
- 28. Wasfaty: my prescription.
- 29. Asafny:Ambulance.

Chapter 1: The general framework of study

1.1 Introduction:

The introduction provides the background on which a discussion about using digital health technologies in Tabuk City, Saudi Arabia, is based, with particular emphasis on challenges produced by COVID-19. This section will present background information on the role of digital health solutions in revolutionizing healthcare and enhancing access to care for various groups.

1.1.1 Background information:

The COVID-19 pandemic has boosted the advancement of digital solutions across different industries globally, with the healthcare industry most affected. The measures that called for adaptation entailed actions that ensured there would be as little interaction as possible, but services had to go on. Saudi Arabia's Vision 2030 goals stated that the healthcare sector largely incorporated the use of digital to enhance both the quality and availability of the healthcare sector. The study is set in Tabuk City, and it endeavors to find out how these developments affect the end-user interaction in the health facility, as posited by *White et al. (2022)*. The pandemic also exposed the weaknesses of the conventional healthcare systems, thus pushing a business organization to adapt to the new normality. Thus, the growing use of technology has named the way to respond to these challenges, and Saudi Arabia has sufficient digital policies to implement them. Therefore, this study seeks to investigate the changes in Tabuk City to assess the efficiency of the changes in raising the level of service provision and user satisfaction (*White et al., 2022*). At the beginning of the year 2020, the outbreak of COVID-19 ensured that the traditional face-to-face method

of healthcare delivery shifted online. The pandemic highlights how the existing frameworks function and rattled the global automation tendencies. Thus, expecting that the contact between a patient and a healthcare provider should be minimized and socially distant, telemedicine, home monitoring, and remote record keeping were introduced. These measures were satisfying in preserving the steadiness of healthcare services during the pandemic (*Siswati et al., 2023*).

Saudi Arabia's Vision 2030 aims for the country to find diverse revenues to grow the non-oil and GDP share and get digitalization in government services. Substantial commitments to digital health technologies under this vision were beneficial during the pandemic. In Tabuk City, national programs were cascaded to encourage the use of information technology to deliver health services. Telemedicine emerged as an urgent need, and the architecture enhanced patient record *integration* (*Siswati et al., 2023*). In Tabuk City, the transformation to digital healthcare involved remote consultations, telemedicine services, and an electronic health record system. Apart from this, they demonstrated the need for constant education and technology utilization by providers and consumers of healthcare services. Using Tabuk City, this study establishes the advantages as well as the drawbacks of digital health to advance the quality and accessibility of health care (*Siswati et al., 2023*). This research aims to establish the impact of digitalization on its end-users in the Tabuk City healthcare system. Through the study, future digital health projects will benefit from knowing the needs and expectations of the community (*Melin et al., 2020*). The implications of this research are not limited to Tabuk City alone. These insights will be useful as Saudi Arabia continues moving towards Vision 2030 to enhance its national digital health plans. The results can also contribute to understanding other regions and countries experiencing similar changes (*Melin et al., 2020*).

Table 1-1: The table below summarizes the most popular apps used during and after COVID-19 in the healthcare sector:

Name	A summary of the services	Available
Tawakkalna	“The “Tawakkalna” application aims to be the digital companion for individuals in the Kingdom and to increase the quality of life by providing a wide range of integrated and consistent services that enrich the experience of citizens, residents, and visitors.” <i>(Tawakkalna Platform, n.d.)</i>	Android, ISO, and web-based
Mwaidy (My appointment)	“‘Appointment’ is an electronic service provided by the Saudi Ministry of Health to enable the beneficiary to book his appointments in primary health care centers and manage these appointments by modifying or canceling them, as well as managing his other appointments in any hospital to which he is referred”.<i>(Mwaid, MOH, n.d.)</i>	Android, ISO, and web-based
Sehhaty (My Health)	“Sehhaty Services: • Review Sick Leave Electronically. • Appointment booking service. • Instant Medical Consultation Service. • Medical Team Selection Service (My Doctor). • Protection and Infection Control Service for Corona (Covid-19) • Health file - health record (know your numbers). • Add dependents Service. • Vaccination Follow-up Service. • Reviewing medical reports and sick leaves. • Pregnancy follow-up service for women. • Insurance approval follow-up service • Medicines and Prescriptions Review Service.	Android, ISO, and web-based

- Pre-marital Medical Examination.
- School Entry Health Exam Program «Fitness Testing».
- Exploratory Examination of Students.”

(*Sehhaty Platform, n.d.*)

Awlawia card (Priority card)	“Awlawia card is issued by patient experience departments in health facilities for specific groups of society, including (people with disabilities - the elderly over 60 years old - home health care patients - cases approved by the medical committee) Awlawia offices or patient experience departments in health facilities provide this service”. (<i>Awlawia Card, MOH, n.d.</i>)	Android, ISO
Labayh	“Labayh is a comprehensive online solution for therapeutic and well-being services, Providing 1:1 sessions, webinars, and support groups by licensed therapists” (<i>Labyeh, MOH, n.d.</i>).	Android, ISO, and web-based
Smoking Cessation Help Service	“A service that provides awareness and therapeutic practices for those wishing to quit smoking, through trained and qualified cadres in accordance with Saudi Guideline for Tobacco; to reach a role model in efficiency locally, regionally, and globally” (<i>.Smoking Cessation Help Service, n.d.</i>)	Android, ISO, and web-based

1.2 Problem Statement:

Tabuk City before the COVID-19 pandemic was a technologically and digitally backward area, and its healthcare system was struggling before the pandemic. The healthcare delivery structure mainly depended on traditional, direct-contact means of service provision that did not suffice to meet society's emerging and increasingly complex healthcare needs. These conventional approaches pose time, accessibility, and resource challenges, especially in rural and hard-to-reach facilities. Thus, there was a need for technological advancement to underpin healthcare systems' improvement. The pandemic, however, accelerated these changes by demanding

essential digital technologies in healthcare, including telemedicine, electronic health records, and distance learning for healthcare professionals. These innovations exposed the opportunities and weaknesses of the conventional healthcare system in Tabuk City. The rapid transition to online solutions highlighted the need for a reliable digital environment and stressed the need for the proper education of healthcare professionals and patients. As for the end-users in Tabuk City's healthcare industry, this research examines the various implications of this digital change. The pandemic effectively exposed the promise of telemedicine and other advanced digital health solutions, enhancing healthcare accessibility, effectiveness, and patient satisfaction. Nevertheless, it also revealed some significant issues, such as the necessity for ongoing digital education, the implementation of compatible systems, and the creation of accessible digital resources. Analyzing these dynamics, this work can reveal and assess the opportunities and risks associated with the intensification of digitalization in the sphere of healthcare services. It aims to present the picture of end users' response to these digital changes, the effectiveness of the solutions provided, and the challenges that still exist. In this way, the study aims to provide policy implications for policymakers, healthcare providers, and technology developers to ensure a better fit and finish of future digital health interventions in line with the needs of the Tabuk City community to improve the quality and availability of healthcare services.

1.3 Significance of the Study:

The relevance of this research study lies in establishing knowledge both to the scientific community and to applications in Tabuk City, KSA. Based on a literature review of Saudi Arabia, this research seeks to develop an understanding of digital health technology adoption and its impact during the COVID-19 crisis.

1.3.1 Scientific Importance:

Therefore, this study contributes to the scientific community by presenting original empirical evidence on the factors that influence the access and utility of digital health technologies in a particular region and cultural setting. Based on the studies conducted in Saudi Arabia, it presents useful findings that can be applied to other analogous environments worldwide. Specifically:

1. **Advancement of Theoretical Frameworks:** This study calibrates the TAM and DOI theories with real-life data gathered from Tabuk City to contribute to these models. For instance, *Al-Qarni et al. (2016)* examined factors that affect the use of e-health services in Riyadh, which forms the foundation on which the current study extends those models for Tabuk City.
2. **Empirical Evidence:** Consequently, this research offers insight into the specific benefits and challenges of digital health technologies from the end-users standpoint in Tabuk City. Like the study conducted by *Albarrak et al. (2021)* on the integration and implementation of telemedicine in remote parts of Saudi Arabia, this research reveals the potential and constraints of Tabuk.
3. **Literature Contribution:** The current study contributes to the literature on digital health in Saudi Arabia. For example, *Alghamdi et al. (2021)* discussed factors that influenced the effectiveness of digital health interventions amid the COVID-19 outbreak. Hence, this research provides a philosophical angle, enhancing the comprehension of digital health enhancement in crisis circumstances.

1.3.2 Practical Importance:

The applications of this type of research are profound as they present a wealth of information that may be used by policymakers, healthcare facilities, and technology creators. The findings may be useful in improving the implementation and uptake of the technologies to optimize the healthcare experience in Tabuk City and possibly other regions in Saudi Arabia. Specifically:

1. **Policy Development:** Policymakers can use the study's results to identify the measures required to strengthen digital health. For example, while discussing healthcare professionals' health information technology preparedness, *Alotaibi and Federico et al. (2017)*. It will supply localized information to recommend similar policy interventions to Tabuk's citizens.
2. **Healthcare Improvement:** Since the study established the exact gaps and difficulties experienced by healthcare providers and beneficiaries of citizens and patients, it provides a clear guideline on how best to deliver the services. For instance, *Alharbi et al. (2022)* appreciated the importance of telemedicine in improving the availability of

healthcare services in rural regions. This research also expands on how such solutions can be effectively executed in Tabuk.

3. **Technology Utilization:** These findings may be useful to technology developers who want to design more effective digital health solutions that are easier to use. *Bahkali et al. 's (2014)* investigation of the usability of health information systems in Saudi hospitals offers a starting point for analyzing and enhancing technology applications based on users' requirements.
4. **Community Benefits:** This study seeks to enhance healthcare systems in Tabuk City, especially for the rural and hard-to-reach populations. As such, the research contributes to closing digital literacy and infrastructure divides and improving the accessibility of effective healthcare. This agrees with *Al-Kahtani et al. (2022)*, who highlighted the effects of digital health on patients' involvement and satisfaction.
5. **Future Preparedness:** Healthcare systems can use the study's findings to enhance their existing digital health infrastructure and model for future emergencies. This ensures that healthcare services continue as usual during disasters, following the study conducted by *Almalki et al. (2011)* on the preparedness of health systems in Saudi Arabia.

1.3.3 Objective and Results of International Studies:

1. **Eysenbach et al. (2020):** Investigated the trends in the use of telehealth worldwide during COVID-19 and noted that the level of development significantly influenced the trend. Although this study gave a comprehensive overview of the research topic, it did not focus on regional issues or cultural barriers to adoption.
2. **Smith et al. (2021):** Explored patient satisfaction with telehealth services in the United States and established that patient satisfaction is high but that telehealth access and quality vary with income and rural/urban differences. While this study documented these differences, it failed to explain how professionals could overcome these difficulties in other cultural settings like those in Saudi Arabia.
3. **(González et al., n.d.):** They discussed the swift scale-up of telemedicine during the pandemic in Europe and the role of infrastructure and the healthcare workforce. Despite conducting the study on infrastructure and training, it failed to address patients' perceptions and their level of digital literacy, which is essential for adoption in Saudi Arabia.

1.3.4 Objective and Results of National Studies:

1. **Al-Qarni et al. (2016):** Examined the factors affecting e-health services usage in Riyadh and found that technological support and consumer confidence were essential. It is essential to note that this study was limited to Riyadh only and did not consider the requirements of, for instance, Tabuk City, which may not be as urbanized.
2. **Albarrak et al. (2021):** Examined the implementation of telemedicine in remote regions of Saudi Arabia and determined that while telemedicine provided better access to medical technologies, questions arose over the training of end users and their acceptance of the technology. While this research focused on the advantages of telemedicine, it did not analyze how the COVID-19 crisis influenced the use of technology.
3. **Alghamdi et al. (2021):** Explored the determinants of digital health during the pandemic and highlighted the crucial role of government support and healthcare professionals. While this study was exhaustive, it provided limited information on patient experience and satisfaction in Tabuk City.

1.4 Study Objectives:

Therefore, this research evaluates the acceptance and utility of digital health technologies by healthcare practitioners and clients in Tabuk City. Its purpose is to assess how these technologies affect the delivery of healthcare services and develop guidelines for improving the use of such technologies.

- i. To determine regional barriers and cultural factors influencing digital health technologies in Tabuk City during the COVID-19 pandemic.
- ii. To assess the patients' views and knowledge of digital technologies in Saudi Arabia's healthcare context.
- iii. To devise solutions to challenges that may be unique to the region regarding implementing digital health technologies in Tabuk City.
- iv. To define the opportunities and threats of using IT tools in healthcare and understand the possible outcomes after implementing such changes.
- v. For the review, the author proposes to outline recommendations based on the end user's perspective of digital health and healthcare services.

- vi. To define the opportunities and threats of using IT tools in healthcare and understand the possible outcomes after implementing such changes.

In this study, the following question guide will be used to assess the outcome of this Research:

- i. What factors may hinder or enhance the uptake of digital health technologies in Tabuk City during the COVID-19 pandemic?
- ii. To what extent do beneficiaries of citizens' and patients' perceptions and digital literacy influence the uptake and utilization of digital health technologies in Tabuk City during the COVID-19 encounter?
- iii. Which technological infrastructure, government support, and healthcare professional engagement challenges influence the efficacy of digital health technologies in Tabuk City during COVID-19?

1.5 Research Questions:

1. How has COVID-19 affected the view of healthcare in Tabuk City's digital landscape post-COVID-19?
 - a). Has this effect positively or negatively impacted healthcare services?
 - b). Do the healthcare providers still benefit from the digitalization post-Covid-19?
2. How does the use of Information Communication Technology influence the management of healthcare services and consumers' satisfaction in Tabuk City?
3. What do the end-users have experience with using digital health technologies and related platforms?
 - a.) How do end-users evaluate their experiences regarding using digital health technologies and related platforms?
 - b). Do end-users recommend these digital health technologies and related platforms to other users?

- c). What changes would benefit the user in the context of digital healthcare services?
- d). How frequently do the end-users use digital healthcare services daily?
- e). Have the end-users received enough education regarding digital healthcare services?
- f). Are these digital health technologies and related platforms always available?

1.6 Study Hypothesis:

Based on the above background and research questions, the study's objectives are Thus: By analyzing both foreign experience and domestic research, we hope to reveal these shortcomings and develop concrete hypotheses to help fill these gaps.

- i. **Hypothesis 1 (H1):** This study finds that cultural factors play a major role in using digital health technologies in Tabuk City amidst COVID-19.
- ii. **Hypothesis 2 (H2):** The results also revealed that digital literacy strongly indicates satisfaction with digital health technologies in Tabuk City.
- iii. **Hypothesis 3 (H3):** In Tabuk City, technological infrastructure is a key factor influencing the use of digital health technology during the COVID-19 outbreak.
- iv. **Hypothesis 4 (H4):** Politician support and healthcare workers' involvement positively impact the use of digital health technologies in Tabuk City during the COVID-19 outbreak.

1.7 Theoretical Model of Study:

This theoretical model has been developed as a checklist for evaluating the factors that influence the implementation of digital health technologies in Tabuk City during the COVID-19 pandemic. This model identifies the dependent variable, the adoption of digital health technologies, and three key independent variables: The external class comprises; regional difficulties/Cultural differences, beneficiaries' attitudes and perception towards digital tools, and available technical systems. Hence, based on the above-outlined factors, the study intends to provide the details and

hurdles in using advanced digital health technology in the context of this study.

1.7.1 Structure of Theoretical Model:

1. This study focuses on the adoption of Digital Health Technologies as the (dependent variable).

This forms the research question as it covers aspects of enabling technologies regarding their usage intensity, satisfaction, and perceived effectiveness in delivering healthcare services.

2. Challenges and Cultural-related factors (Independent Variable).

This involves being in a positive culture that embraces technological solutions, religion through which the people seek help, and the health beliefs that apply to specific regions.

3. Beneficiaries' perceptions and digital literacy levels (independent variable).

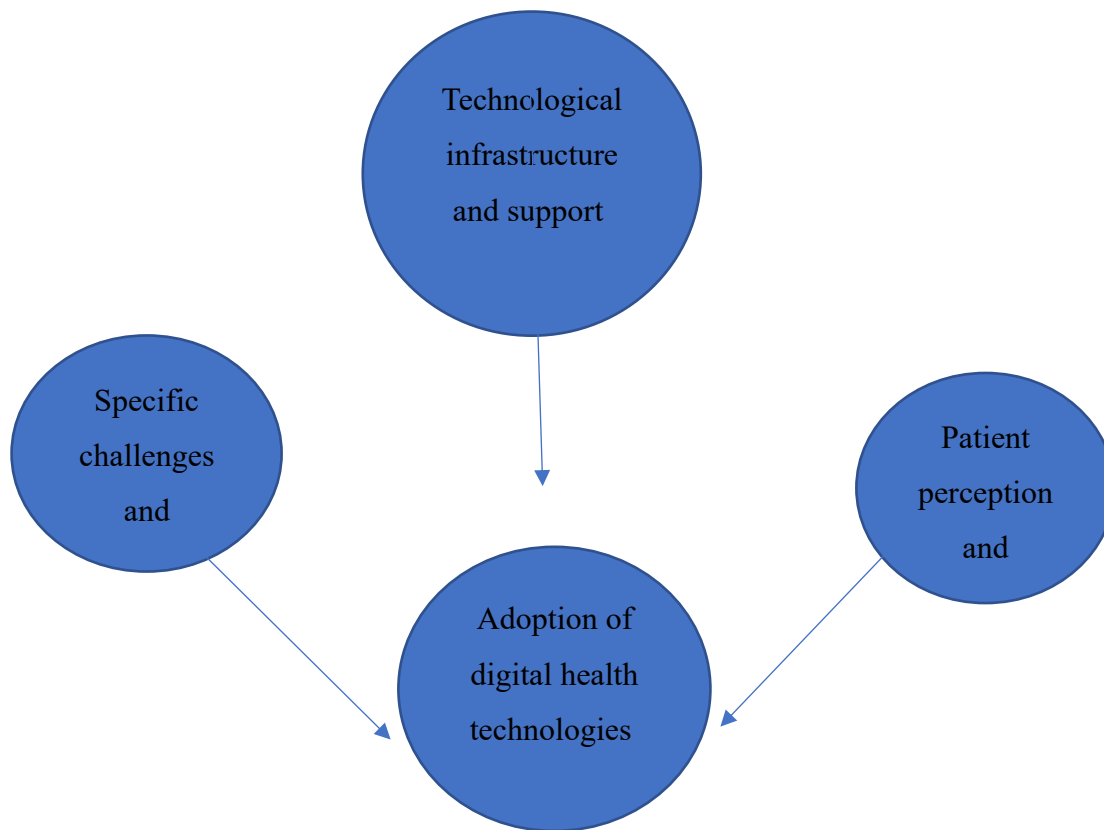
This entails beneficiaries' perception, attitude, and expectation of the key actor to participate in the digital health platforms, which are some of the effective antecedents of mass population engagement.

4. This study proposes Technological Infrastructure and Support as the (Independent Variable).

These span from connectivity, accessibility of the working internet services, government supporting policies, and the ability of the healthcare workers to adopt the promoted direct health solutions and sustain them.

In examining the proffered theoretical plan for the factors that affect the implementation of DH technologies, graphical tools are employed to represent the character of the relationship of the aforementioned independent variables. These factors are interrelated, which has explained why the uptake of technology in health facilities is not easy.

Figure 1-1 Theoretical Model



Chapter 2: Literature Review

2.1 Introduction:

The COVID-19 pandemic has exacerbated the use of digital health technology across the globe, demonstrating their applied value in the continuity of care during emergencies. The case under investigation in this study relates to using digital health technologies in Tabuk City, KSA, during the COVID-19 outbreak. Thus, this research intends to identify specific regional issues, cultural differences, beneficiaries' attitudes, digital competence, and infrastructure that would help to reveal the opportunities and limitations of implementing digital health technologies in this region.

2.1.1 Dependent Variable:

The general topic of the research is the implementation of digital health technologies in Tabuk City in the context of the COVID-19 pandemic. This dependent variable leads to a comprehensive investigation of not only the raw usage but also other parameters like user satisfaction and perceived ability to bring about the delivery of health care services. Therefore, by systematically evaluating all the dimensions, this study seeks to identify the diverse factors that enhance the integration of digital health tools in the population of Tabuk. These dimensions will give us understand how well digital health technologies have been adopted and implemented when conventional paradigms of delivering care have been disrupted.

2.1.2 Independent Variables:

It is consequently crucial to highlight several independent variables that are critical in the diffusion of digital health technologies in Tabuk City. Among them, the most significant ones are regional factors and cultural peculiarities. These include everything from a plethora of acceptance of digital healthcare technology in terms of religion and local perceived health culture. It is crucial to learn about such cultural differences since they influence people's choices to adopt and integrate technology in the delivery of health care services.

Moreover, there is yet another independent variable; the former comprises the citizens/beneficiary's perception and digital literacy. This facet includes the awareness, attitude, and beliefs that Tabuk City's citizens have toward digital health platforms. Assessment of these criteria will enable one to establish inherent challenges arising from low literacy on digital technologies or misconceptions about using e-health solutions. Besides, the following factors were found to have a significant impact, and thus, there is a need to find ways of minimizing their impact if m-Health is to be embraced by the region's population.

Furthermore, the technological support/facilities available in Tabuk City are the other independent variables used in the study. This also entails the evaluation of Internet readiness on which the digital health solutions major relies for service provision. In this domain, there are policies on the government's digital health strategy and the scope of healthcare professions to engage/moderate/recommend the use of digital health products. These variables set the general framework in which the application of digital health technologies will occur and by whom, both by the practitioners and by the consumers.

In this regard, this study aims to provide a deeper appreciation of these independent variables to determine the factors that may explain the level of use of DHIs in Tabuk City. Besides identifying probable threats, this approach tends to examine such factors as strengths that could be utilized in terms of infrastructure, culture, and knowledge to enhance the realization and implementation of digital health solutions in the region.

2.1.3 Review of the Past Research:

Studies from various countries have conducted comprehensive assessments of IT in EMH adoption. For instance, research from developed countries like the United States and Europe has consistently highlighted the role of digital literacy and technology in promoting digital health (*Smith et al., 2021; Johnson et al., 2020*). Saudi nationwide studies, such as those by *Alshahrani et al. (2019)*, have explored cultural factors and patients' attitudes toward diseases. However, a noticeable lack of research focused on specific geographic locations or cities, such as Tabuk, may require unique strategies. The urgency of promoting digital literacy and technology in these areas is clear, given their proven role in enhancing digital health adoption.

2.2 Previous Studies:

2.2.1 International Studies

1. Smith et al. (2021) Digital literacy and infrastructural support in the context of telemedicine in the United States:

The study intended to implement a systematic review and meta-synthesis of the current state of telemedicine adoption on a macro level in the USA, emphasizing the required digital and infrastructural preparation. In their work, they focused on how in terms of the quality of telecommunication technology and its effectiveness and usage between patients and medical professionals, disparities in digital skills may help or converse in the use and functionality of telemedicine. Furthermore, they underscored the importance of having proper infrastructural requirements, meaning a good internet connection and other related technological facilities that are significant in telemedicine cases. Like the current study, implementing the common necessities of digital literacy and infrastructural support are also being stressed to highlight the digital health solutions, focalizing these essentials in relation to Tabuk City.

Based on these aspects, the author was allowed to give more details on what might be expected while implementing modern telemedicine in the healthcare sector, especially in a country that is leading in both – technological and geographical sizes and the United States.

2. Jonassaint et al. (2015) Usability and Feasibility of an MHealth intervention for monitoring and managing pain symptoms in sickle cell Disease: The Sickle Cell Disease Mobile Application to Record Symptoms via Technology (SMART).

The feasibility of utilizing the Sickle Cell Disease Mobile Application to Record Symptoms via Technology (SMART) to assist sickle cell disease patients in monitoring and managing their symptoms is discussed in the article. Fifteen patients participated in the study and recorded their pain intensity using both traditional paper and electronic visual analog scales (VAS) on SMART. The results demonstrated a strong correlation between patient-perceived pain severity and pain intensity entries using SMART. The study revealed that approximately 75% of patients were compliant with entering their symptoms into SMART on a daily basis. Patients aged 35 and older, as well as those using an iPad for the study, exhibited higher rates of compliance. Overall, the study's findings indicated that SMART is a practical and viable method for tracking daily pain symptoms in adolescents and adults experiencing sickle cell disease-related pain. The Tabuk City study made significant contributions to the field of mobile health technology. The study provided insights into the age and device preferences of individuals with chronic conditions when it comes to using mobile health applications for symptom tracking. By demonstrating higher compliance among older participants and those using specific devices

3. Wong et al (2022). The dawn of digital public health in Europe: Implications for public health policy and practice:

In their study, they defined digital health (DH) as the following:

Digital health is framed as "the convergence of the digital and genomic revolutions with health, health care, living, and society" (*Sonnier et al.,2020*).

**Digital
Health**

The idea of digital health can encompass technology, user experience, service, product, process, an independent ecological system, and a component of the health services ecosystem. (*Kessel et al.,2020*)

In their study they provided a comparative investigation on the level of digital health across European countries, considering governmental support and issues with policies and regulations. Their study also offered clear procedures regarding how the engagement of the various technologies in digital health depended on the current policies in multiple European countries. This study conducted a cross-country case analysis to offer guidelines for formulating and implementing policies for introducing digital health solutions at the national level. In their view, the high stakes in innovation, enhancements in health care delivery systems, and patients' shared experience result from the government's support in advancing digital health solutions effectively implemented. Thus, through the global case comparison, they sought to provide recommendations on the formation and the process of executing policies to introduce digital health solutions at the country level. Thus, the emphasis on governmental involvement and policy influence corresponds with the current study, which aims to identify the strategies with which local health authorities in Tabuk can contribute and advocate for the use of digital health technologies.

4. Melin et al. (2020). A Questionnaire for Assessing User Satisfaction with Mobile Health Apps: Development Using Rasch Measurement Theory:

In their study, they developed a Rasch questionnaire to assess users' satisfaction with mobile health apps. Their study noted that determining the degree of satisfaction among users is a significant factor in improving digital health services. Given that satisfaction is determined and addressed suitably, this aligns with the current study's goal to enhance the quality of digital health services in Tabuk City.

5. Siswati et al. (2023). User Satisfaction Levels about m-Health Application for Growth Monitoring and Children's Development in Yogyakarta, Indonesia:

A study on user satisfaction with m-health applications in Yogyakarta, Indonesia, found that the users were satisfied with the applications; however, user training needs to be enhanced. According to their research, more app users were fairly satisfied with their experiences. However, they suggested that the level of user training should be stepped up to increase the awareness of HC professionals and the general population about digital technologies. Similarly, the emphasis on user satisfaction and specified essential digital competencies for improved use of digital

care services was applied in the present study to boost the usage of such services in Tabuk City. These results have substantial implications for improving the digital literacy of healthcare practitioners and consumers for the benefit of Tabuk City's digital health services.

6. Sinha et al. (2022). Understanding digital mental health needs and usage with an AI-led mental health app (wysa) during the COVID-19 pandemic:

Retrospective analysis:

They used a survey method to study mental health applications with AI solutions during COVID-19. They examined digital mental health consumption and access and discussed an AI-based mental health application during the COVID-19 health crisis. Their post-implementation assessment found that digital mental health solutions could potentially deliver a lot in mental health when required most in a health upheaval. Like the current study, this research also focuses on the function of digital health in mental health solutions, especially in the COVID-19 crisis, to know how such services can be employed to offer mental health services in Tabuk City.

2.2.2 Comment on International Studies:

These studies offer a broad perspective of the factors in the larger environment that affect the use of digital health solutions. Nevertheless, they fail to consider factors such as cultural acceptance and regional or local technological factors that may affect the rate in certain small, developing locations.

In the two studies mentioned above, **Smith et al. (2021)** in the US determined that digital literacy and technological support were influential factors for telemedicine implementation. They stressed the necessity of having well-developed digital education initiatives and stable connectivity to guarantee the utilization of e-health solutions. In the same context, **Wong et al. (2022)**, in Europe postulated that government policies play a crucial role in enabling digital health implementation. They concluded that encouraging policies and regulations enhances the acceptance and integration of digital health tools.

2.2.3 National Studies:

1. Alzahrani et al (2023). Awareness and acceptance of teleclinic services during COVID-19 in the general population in Riyadh: Cross-sectional study:

The cross-sectional study was conducted in Riyadh, Saudi Arabia, with 1,583 participants between August 2020 and April 2021. The study focused on the use and acceptance of teleclinics. Results showed that most participants were female, had a university education, and utilized teleclinics for new complaints and medication refills. Additionally, 77.1% of participants had a good level of acceptance of teleclinics. The study concluded that the experience of using teleclinics positively impacts the level of acceptance among the population and that telemedicine could be used as an alternative for minor complaints and follow-up checkups.

The study contributes to the current understanding by examining the potential cultural and socioeconomic factors that may affect the acceptance of teleclinics. Additionally, it addresses concerns about the study's sample size and specific demographic characteristics by considering how these factors might limit the applicability of the study's conclusions to broader populations beyond Riyadh, Saudi Arabia.

2. Alshahrani et al. (2019). A systematic review of the adoption and acceptance of eHealth in Saudi Arabia: Views of multiple stakeholders:

The study followed a PRISMA-P-guided protocol to review articles on eHealth adoption in Saudi Arabia. After screening 110 papers, 15 studies met the inclusion criteria, identifying 39 factors influencing eHealth adoption. The results indicated a lack of studies from the perspective of health managers and limited geographical coverage. The study concluded that eHealth in Saudi Arabia is showing continual growth, and the findings may help professionals address current challenges and prioritize areas for improvement.

3. Mohamed et al. (2023) Patients' perception towards digital health services in Saudi Arabia: A cross-sectional study:

A study examined the impact of e-health on service performance and consumer satisfaction during the COVID-19 pandemic by using a cross-sectional, questionnaire-based study. This study highlighted limitations, including insufficient digital literacy and infrastructure. This new research expands on these studies by focusing on Tabuk City and offering specific recommendations for enhancing digital healthcare services

in the area. The study effectively outlined the benefits of digital health technologies in improving services and patient satisfaction, as well as the drawbacks, such as limited digital expertise and technology capabilities. These findings align with the current study, which explores how implementing digital health technologies can improve service delivery in Tabuk City, despite the same challenges related to digital literacy and development.

4. Hassounah et al. (2020). Digital Response During the COVID-19 Pandemic in Saudi Arabia:

Hassounah, Raheel, and Alhefzi (2020) examined the rapid integration of digital health assets during the COVID-19 outbreak in Saudi Arabia, with the central competencies of digital health literacy as the major area of difficulty. Their study pointed out that understanding posed a challenge, particularly the ability to use information technology applications like telemedicine and mobile health applications for healers, customers, or patients. It also pointed out that some of the key challenges included the issues around digital health literacy among healthcare professionals and consumers, which was concerning when using platforms like telemedicine or mobile health applications to deliver service. In contribution to help, the current study attempts to overcome these challenges to enhance digital awareness and reduce the implementation and usage of digital health technologies in Tabuk City.

5. Alshaikh et al. (2021). Impact of COVID-19 on the Educational Process in Saudi Arabia: A Technology–Organization–Environment Framework:

The scholars investigated the impact of COVID-19 on the educational process in Saudi Arabia by delving into digital transformation. They conducted a survey on SURVS that fully complies with the General Data Protection Regulation (GDPR).

A total of 2393 individuals participated in the survey. The majority (74%) expressed concerns about the COVID-19 outbreak, with 27% believing they were likely to contract the virus and 16% considering it life-threatening or severe. However, only 11% of respondents reported experiencing high levels of anxiety. Older respondents (>65 years old) were less likely to adopt hygiene practices and practice social distancing compared to younger respondents (18–24 years old)

(OR: 0.06; 95% CI: 0.01, 0.28 and OR 0.06; 95% CI: 0.01, 0.27, respectively). A high percentage of respondents (88%) stated that they were capable of self-isolation, and 82% were willing to do so. Those with lower household incomes and individuals experiencing flu symptoms were less capable and willing to self-isolate. The study noted a significant increase in anxiety levels, perceived effectiveness of social distancing, and hygiene practices post-lockdown compared to during the lockdown period. The study revealed that during the initial phase of the pandemic, there were high levels of adoption of preventive measures, as well as willingness and perceived ability to self-isolate. However, vulnerable groups such as the elderly and individuals with low socio-economic status demonstrated lower adoption and willingness to self-isolate. Tailored public health messages and interventions are required to ensure these groups adhere to preventive measures effectively.

6. Alhodaib & Alanzi et al (2021). Understanding the Impact of Digital Health Strategies during the COVID-19 Outbreak in Saudi Arabia:

examined Saudi Arabia's experience during the COVID-19 outbreak and offered evidence that digital health strategies helped to enhance healthcare service delivery. Nevertheless, the study also found digital infrastructure and literacy to be essential hurdles. Their study is significant to the current study that tries to determine the factors affecting digital health services in Tabuk City so that strategies can be developed to overcome the barriers.

7. Mabrouk et al. (2022). Digital Learning, Life Satisfaction, and Perceived Stress Due to COVID-19 Emergency: Case Study Among Female Saudi University Students:

They examine female Saudi university students' perceptions of digital learning, life satisfaction, and perceived stress during the COVID-19 emergency. Their study showed that if digital tools are effectively integrated and backed up, they could help to reduce stress levels and improve quality of life, which gives directions to mental health concerning digital health services. The current study considers the following important in enhancing mental health support through digitized health services in Tabuk City.

8. Fadelelmoula et al. (2019). Investigating service characteristics as determinants of user performance and satisfaction in Saudi Arabia's mobile government context:

Examined service characteristics as driving forces of user performance and satisfaction in the mobile government environment in Saudi Arabia. Hence, the results of this study on how usability and accessibility influence user satisfaction are useful for improving the design of digital health platforms. Similarly, the current study aims to improve users' satisfaction since the identified factors are related to the usability and accessibility of digital health services in Tabuk City.

9. Shishakly et al. (2024). The influence of using smart technologies for sustainable development in higher education institutions:

Using the TOE framework, they conducted a study on the influence of smart technologies on sustainability within higher education institutions. The sources cover a diverse array of topics, such as user satisfaction with mobile health applications, the adoption and use of e-health services, the impact of digital health strategies during the COVID-19 pandemic, and the role of the pandemic in accelerating the digital healthcare transformation in Saudi Arabia. Additionally, the references explore perspectives and perceptions of COVID-19 and the adoption of preventive measures among the public in Saudi Arabia, providing a comprehensive understanding of the current trends, challenges, and future outlook for e-health in the country.

Their findings on the effectiveness of smart technologies in enhancing administrative efficiency and consumer satisfaction are pertinent to the potential use of digital health technologies in Tabuk City's healthcare sector.

10. Alanzi et al (2022) Users' satisfaction levels about mHealth applications in post-Covid-19 times in Saudi Arabia:

The scholars investigated Saudi Arabian user satisfaction with mHealth applications after COVID-19. Using A cross-sectional survey design Questionnaire (MAUQ) 22, The obtained results noted that the level of satisfaction was high but depended on the level of digital literacy and available technologies. This is why formative digital

literacy interventions are needed, an aspect also carried out by the current study to improve the use of eHealth solutions in Tabuk City.

11. Alghamdi et al. (2021). Digital Health Platforms in Saudi Arabia: Determinants from the COVID-19 Pandemic Experience:

The scholars thoroughly investigated the DH resources application in Saudi Arabia post-COVID-19. They concluded that digitizing health programs can only be successful with a robust digital infrastructure and increased user engagement. It was determined that health officials in Saudi Arabia have efficiently utilized various digital technologies such as mobile health applications, artificial intelligence, and machine learning to contain the spread of COVID-19. The rapid digital response in Saudi Arabia was made achievable with government support and by considering user and technology aspects. Despite this achievement, there is still a need to persist in promoting the use of digital health technologies and further investigate the influence of artificial intelligence on clinical practice. Additionally, steps should be taken to improve connectivity between primary and tertiary health centers to facilitate the exchange of electronic medical records for enhanced interpretation and management strategies. This type of study is consistent with the current research in pointing towards the requirement of a strong IT fundamental in conjunction with enhanced user sensitivity to augment the digital health services in Tabuk City.

12. Abdulaziz et al. (2023). Digital Healthcare Innovation and Development in Saudi Arabia During and Beyond COVID-19:

The examination investigated the advancement and growth of digital healthcare in Saudi Arabia before and after the COVID-19 pandemic. This was achieved by performing a detailed case study of Saudi Arabia's reaction to the COVID-19 pandemic as an example of practical innovation, which demonstrated that the crisis hastened the speed of digitalization. It highlighted the ongoing implementation of creative policies to maintain the benefits of digital health technologies. The outcome of the COVID-19 pandemic was an acceleration of healthcare transformation in Saudi Arabia, leading to the quick integration of digital tools and innovations. To sustain this progress, it is crucial to manage the readiness for change among the public and

healthcare professionals while considering cultural expectations. The potential for innovation should remain a part of the 'new normal' for future development.

According to the scholars, COVID-19 triggered a rapid digital transformation in healthcare innovations in Saudi Arabia. The research focuses on the independent variable, which is the innovation and policy support required to uphold the benefits of digital health technologies, in line with its objective of preserving the advantages gained from implementing such technologies in Tabuk City.

13. Alkhalifah et al. (2022). The role of the COVID-19 pandemic in expediting digital health-care transformation: Saudi Arabia's experience.:

I embarked on a research project to assess the gradual improvement of healthcare in Saudi Arabia during the COVID-19 pandemic. Scholars discovered that the digital transformation during the crisis was already noticeable, but it also highlighted the susceptibility of the region's digital infrastructure and population. The measures taken to contain the spread of COVID-19 relied on careful contact tracing, quarantine, and sterilization procedures. Telemedicine and mobile health played a crucial role during this period in reducing potential disease transmission and preventing the healthcare system from being. As part of its initiatives, the Ministry of Health (MOH) introduced and enhanced 12 mobile applications from 2012 to 2019, three of which were developed within three months during the COVID-19 pandemic. These apps include Tawakkalna, My Health (Sehhaty), Health (SEHA), Appointment (Mawid), Asafny, and Wasfaty. These findings are significant in uncovering the healthcare challenges in Tabuk City and are consistent with the current study's aim of identifying solutions to address these issues and improve digital health services. These national studies offer important information on the local factors that affect the use of digital health technologies in large Saudi Arabian cities.

2.2.4 Comment on National studies:

These studies shed important light on cultural acceptance, patients' perceptions of eHealth, adequate infrastructure, and digital literacy that can help strategists overcome barriers and implement digital health solutions optimally in different regions of Saudi Arabia.

It also explored determinants for enhancing the effectiveness of digital health platforms in Saudi Arabia. The suggestions on other policy interventions and training programs for improving digital health platforms can be considered relevant to the goals of the study of improving digital healthcare services in Tabuk City. Altogether, these works give a holistic view of the consequences of digital health technologies throughout the COVID-19 pandemic, opportunities, and threats. The findings from these studies will be used to propose strategies to strengthen digital health services in Tabuk City regarding digital competencies, connectivity, and consumer satisfaction.

Although such national studies help in understanding the factors influencing the use of digital health in Saudi Arabia, they mainly involve large cities such as Riyadh and Jeddah. Surprisingly, scant research has been conducted on cities with less population density, like Tabuk, where a different set of cultural and structural barriers may be present.

2.2.5 Current Study in comparison to the previous studies:

However, the current study has sought to address these limitations by being sensitive to COVID-19 and focusing only on Tabuk City. Unlike previous studies that provide a broad understanding of digital health adoption at a national level or in large urban centers, this research unlike previous studies that provide a broad understanding of digital health adoption at a national level or in large urban centers, this research will:

- 1. Assess Region-Specific Challenges and Cultural Factors:** This research will explore the cultural acceptance of digital health technology in Tabuk. It will look for factors such as cultural practices and traditional health beliefs that may affect technology uptake. This paper investigates specific regional issues and cultural aspects that determine the adoption and utilization of DHT. Concerning the cultural factors that influence the adoption of the technologies in the target locality, the study considers possible cultural practices and norms that may enhance or hinder the use of digital health interventions in Tabuk.
- 2. Evaluate Patient Perceptions and Digital Literacy:** Given Tabuk's target population, the study will capture the clients' existing knowledge, perceptions, and attitudes toward digital health solutions. This includes assessing any individual learning necessary to

enhance the use of technology in the area. The study design will focus on abstracting quantitative data about the local population's knowledge, perception, and attitudes toward the digital health solution to determine the individual learning needs for efficient technology application. This focus on digital literacy is imperative to determine to which extent the residents of Tabuk can embrace and engage with digital health technologies.

3. **Analyze Technological Infrastructure and Support:** The study will evaluate the preparedness of healthcare facilities in Tabuk for technological advancements, particularly in terms of internet connectivity. It will also analyze the ways in which governments and local health authorities can support these technologies. Additionally, the research will assess Tabuk's technological assets and infrastructure and healthcare organizations' readiness to adopt technological enhancements, including internet connectivity, with a focus on governmental support. This analysis is essential for understanding the role of facilitators and obstacles in successfully implementing digital health technologies in the region under study.
4. **Provide a Comprehensive Regional Analysis:** The study will incorporate the Technology Acceptance Model (TAM) within this context, which will facilitate the assessment of factors that influence the use of digital health technology in Tabuk. This approach will yield more refined findings that cannot be obtained from national or international studies. This model permits the exploration of the more exact local aspects that define and relate to the independent factors that influence the acceptance and usage of technology in the local environment than would be discerned from a broader study.
5. **Address Gaps Identified in Previous Studies:** As the research questions reveal, the study will try to answer the omission of small cities and the absence of regional information that has been noted in prior studies. In a way, this choice of focusing only on Tabuk the research contributes to the existing literature by extending the understanding of the factors affecting digital health adoption in different contexts, including small cities, which could be underrepresented in larger-scale investigations. Thus, the proposed approach offers a high level of specificity and allows the identification of DH's special issues and perspectives in Tabuk City.

2.2.6 Conclusion:

In conclusion, international and national studies have established an overall perspective of factors affecting the use of digital health technology, stressing digital literacy, infrastructural support, and policies framed by the government. However, these studies fail to distinguish the issues that smaller-scaled regions experience. Thus, the current study intends to complement the identified gaps by presenting a detailed investigation of Tabuk City while considering the area's cultural, technological, and infrastructural characteristics. Based on the evaluation of the national culture's receptiveness to DH technologies and the relative preparedness of healthcare organizations in Tabuk, Saudi Arabia, these research's limitations provide an understanding of the specific challenges that may limit the use of DH solutions in Tabuk.

Further, the integration of the TAM also provides a complex assessment of the determinants of technology in the Tabuk region. While presenting information about digital health teams, workloads, tasks, and responsibilities, this approach also stressed the prerequisites for overall digital health implementation while unveiling the specificity of the regional context. Thus, by filling the gap in the examination of digital health in relation to small cities, this study provides useful data that can be applied to develop strategies to improve existing services to small cities. Thus, the results obtained in Tabuk can be useful for identifying interrelated and interconnected recommendations for increasing the use of digital health applications in similar conditions and bringing significant improvements to healthcare delivery in various situations.

2.3 Theoretical Framework:

Technology integration across different fields is a dynamic process that entails several aspects, and scholars have sought to explain it through various theories. Two of the most well-known theories in this regard are the Technology Acceptance Model (TAM) and the Diffusion of Innovation (DOI) theory (*Griffin et al., 2019*).

One of the best-known models is the Technology Acceptance Model (TAM), which describes how and why users in an organization adopt a specific technology. TAM concepts reveal that perceived usefulness and ease of use are two precursors used to explain a person's behavioral intention, which will define actual usage behavior. Perceived usefulness, according to the theory, is the extent to which a person considers using a particular system to improve their working performance, while

perceived ease of use is the extent to which a person believes that using the system does not require much effort. Regarding health care, TAM can support determining how the related stakeholders, such as educators, students, health care providers, and patients, recognize and utilize technologies. For example, if twenty healthcare providers regard telemedicine platforms as easy to use and helpful in treating patients, they will incorporate them into practice. Likewise, if students perceive e-learning platforms as easy to use and beneficial for their learning needs, they will accept further and use those platforms (*Griffin et al., 2019*).

Another significant perspective in adopting technology is Everett Rogers' simplified Diffusion of Innovations (DOI) theory. DOI enlightens people on how, why, and at what rate these new concepts and technologies diffuse to cultures. It outlines the factors familiar with the adoption process: relative advantage, compatibility, complexity, trialability, and observability. Relative advantage measures how much it is better than the concept it replaces.

Relative advantage is defined as the extent to which an innovation is better than the precursor techniques in achieving the adoption goals of potential users. Complexity, however, is the extent to which an innovation is perceived to be challenging to understand and utilize. Trial ability is the extent to which an innovation can be tested in a trial fashion. Communicability, therefore, relates to the extent to which the outcomes of an innovation are central or visible to other people. Carrying out the DOI in this study helps the search for variables influencing the use of technology in health in Tabuk City. For instance, if machines and other digital assistants are perceived as more effective than traditional forms of treatment, they are consistent with the user's approach in a specific field or course of study. They are easy to operate and try out. The above-stated applications will likely be utilized (*Griffin et al., 2019*).

Besides these adoption models, there are digital health frameworks that provide comprehensive specifications of how and for what to use and assess digital health solutions. WHO's Digital Health Strategy and IMSS's Digital Health Framework can be classified as this type of concept. Each structure targets several vital principles, including user-centeredness, compatibility, security, and re-evaluation (*Alshaikh et al., 2021*).

The WHO released a document known as the WHO Digital Health Strategy, which offers a conceptual framework for enhancing health through deploying digital technologies. It reiterates the need to develop digital health solutions that fit the end user's needs and expectations. The strategy also aims at integration so that various digital health systems can easily connect and help improve the healthcare sector's operations. Data security is another one that involves safeguarding the patient's sensitive health information from unauthorized access and breaches. Another is monitoring, which enables regularly examining digital health processes and programs to identify their impact and efficiency so that changes can be made if required (*Alshaikh et al., 2021*).

The researcher is organizing the Elements of Care through the HIMSS Digital Health Framework with supporting data and information on the elements of digital health care. It is divided into several steps: planning and designing the intervention, establishing the program, formative evaluation, and summative evaluation. Stakeholder engagement is a critical component of the framework to reach its goals. Therefore, all the relevant parties' viewpoints and requirements will be addressed. However, it also underlines the necessity of having an adequate architecture based on reliable connections to the Internet, suitable HW and SW, and user training.

These frameworks of digital health are applied in this study to evaluate Tabuk City's digital health initiatives. This way, through implementing the user-centered design approach, cross-system compatibility, data confidentiality, and constant assessment, the study offers a detailed analysis of the efficiency and effectiveness of the noted measures on the end-users. Thus, using the presented approach, the study can evaluate the compatibility of digital health tools and propose recommendations based on the preferences of the providers and patients to increase satisfaction and use rates. Likewise, by stating the degree of compatibility between various digital health systems, the study will be able to outline the existing obstacles to communication and recommendations on how to eliminate them (*Alshaikh et al., 2021*).

2.3.1 Theoretical Premises of Study:

The first theoretical assumption of this research is that perceived usefulness and ease of use were major determinants of the use of digital health technologies in

accordance with the TAM. It was found that both the healthcare personnel and patients of Tabuk City would prefer using digital health the more they deem the implements helpful in delivering the services and user-friendly. From this viewpoint, Davis (1989) identified perceived usefulness and ease of use as central to fitting technology into individuals' lives. The present study assumes that perceived usefulness and ease of use are determinant factors that influence the adoption level of the technologies in Tabuk.

The second premise arises from the DOI theory that turns its attention to relative advantage, compatibility, trial, complexity, and observability, which determine the use of innovations. Accordingly, the study hypothesizes that the digital health technology diffusion will be faster in Tabuk if it provides better outcomes than the existing approaches, is enterable with current practices, is not complex, can be pilot-tested, and yields perceivable results. This assumption points to the need to present the gains accrued to stakeholders in a bid to adopt the applied digital health technologies and the simplified implementation processes to the processors of healthcare service providers and patients in Tabuk.

The third premise relates to the impact of organizational environment, culture, patients' attitudes, computer literacy, and technology environment on using DTs in health care. Some of the factors considered important in the study include cultural beliefs and norms, religion, the community's health practice, knowledge, familiarity with online tools, and accessibility to reliable internet connection coupled with the presence of friendly policies. All these are considered influencing factors that affect the adoption process. Thus, the premise lies in the fact that addressing such regional and cultural factors, as well as the collaboration with increasing the level of individuals' digital literacy together with the development of adequate infrastructure and support – all of the aforementioned would be instrumental in the further advancement of digital health technologies in Tabuk City during the COVID-19 virus spread.

Chapter 3: Research Methodology

3.1 Introduction:

A quantitative research design has been employed for the data collection method in this research, as questionnaires and interviews are ideal for accumulating the quantities of data to determine the impact of digitalization on healthcare in Tabuk City's end-users. The Quantitative approach is relevant since the researchers can compare the collected data; thus, the information gathered will be more valid and reliable. Quantitative data is related to specific figures and statistics that provide a detailed estimate of user satisfaction level, the number of acceptors and users of digital tools, and perceived benefits and risks of using the technology.

3.2 Research Design:

Since the study is oriented to analyze the influence of digitalization in the development of healthcare in Tabuk City, a quantitative research approach will be adopted to conduct the study. The study will mainly concentrate on m-Health applications like Sehhy, Mwaidy, Wasfaty, and online virtual clinics. A quantitative approach is appropriate in this research endeavor because it is geared toward measuring the degree of the adoption and use of digital health tools by developing nations and searching for relationships between variables. As the study employs more quantitative data, it offers opportunities to generalize the results to the increased numbers of Tabuk's healthcare providers and citizens.

Quantitative research, with its rigorous and scalable nature, is crucial when studying phenomena that have significantly impacted many people through digital health tools. The design involves data collection using formal tools like questionnaires, enabling

measurement and statistical analysis of the answers. The increased importance of digital health tools, particularly in the context of the COVID-19 pandemic, underscores the significance of this research. By adopting a quantitative approach, this study aims to provide a comprehensive understanding of the usage, efficiency, and challenges associated with these tools.

3.3 Population of the study:

The study population will encompass all healthcare providers and citizens in Tabuk City. To ensure a comprehensive and representative sample, diverse participants will be selected across the province. Tabuk, with a population of 623665, is served by 1,719 doctors and 2,953 nurses in six hospitals and 37 primary healthcare units. This inclusive approach will capture the responses of the general population. (*“Population by Nationality (by Region, Governorate, City, and Nationality, 2023, Statistical-Yearbook-2022,” 2022)*)

A vast and diverse population offers a sound framework for the sampling process. Using a sample of 500 participants as a minimum due to time constrain, both in and out of healthcare practice, the information will be collected from health providers such as doctors, nurses, Pharmacists.... etc., and beneficiaries such as citizens and patients. This sample size is considered adequate for achieving a high level of reliability in the results and, at the same time, possessing practical feasibility regarding data gathering and analysis. The researcher chose a random sample, and for this reason, the selection of the samples will be made based on the stratified random sampling method to ensure that these subgroups of the population will be covered in the study. This shall be done according to the population of users into different strata regarding professions such as doctors or nurses and the status of the users as patients. Election samples will then be carried out within the stratum to guarantee that all key organizations are adequately covered. This method increases the credibility and dependability of the findings since it minimizes the sampling prejudice and guarantees the representation of the population in the sample. Regarding the adoption and usage of digital health tools, the stratified sampling technique will assist in establishing the disparities across different classes of the population.

Table 2-3: Population of the study

Population size	No. of doctors	No. of Nurses	NO. of hospitals	NO. of primary health care	NO. of Minimum random samples	Percentage of the random samples to the population size
623665	1,719	2,953	6	37	500	8.10%

3.4 Data Collection Methods:

The primary data gathering technique will be structured questionnaires to gather detailed information concerning the usage, level of satisfaction, and perceived benefits and barriers related to digital health tools. The close-ended questions make it easier to get quantitative data, and thus, the questionnaire will consist of them only. These questions will focus on demographic information, the frequency of use of the applications, perceived usefulness and ease of use, and perceived barriers. Structured questionnaires are easy to compare and analyze because they minimize the variation of the answers from the respondents.

Minor a pre-testing survey, the instruments will be administered among a small sample of the targeted population before the eventual large-scale administration. Accountability for this is taken to the pre-testing, which determines the validity and reliability of the questionnaire. During the creation of the questions, there is an opportunity to detect all the vague or problematic aspects that may arise during the investigation, which will help to make corrections before the primary data collection stage. The last one will be administered both online and offline, and the questions developed will be such that there will be easy answers for all the participants. The strong points of this approach are efficiency, cheapness, standardized gathering of

data, and the possibility of obtaining a large amount of information from a considerable number of respondents, which will create the basis for further analysis.

3.5 Method of Analysis:

The arithmetic data gathered in the surveys will be analyzed quantitatively using statistical tools, including SPSS or R, to ensure accuracy and credibility. Survey data will be analyzed using descriptive statistics to establish the level of satisfaction, the extent of using digital health tools, and perceived benefits and challenges. The preceding means that these statistics will comprise mean, median, mode, standard deviation, and frequency distributions. Another approach is a descriptive analysis, which will present the cross-sectional survey results by categories, percentages, and proportions, clearly showing the extent to which the sample population uses the identified digital health tools.

Inferential statistics will also be used to identify the correlation and pattern of various variables. Differences in satisfaction and usage of the product by different demographic variables, including age, gender, and profession, will be determined using t-tests and chi-square tests, respectively. The factual usage of the tools and the perceived ease of use and usefulness of the digital health tools shall be analyzed using regression analysis. With the help of statistical software, data analysis will be done professionally to arrive at valid results. Therefore, synthesizing the following five research questions will enable this study to generate comprehensive findings that will increase understanding of the factors that foster the uptake and use of digital health tools in Tabuk City (*Alkhalidi et al., 2021*).

3.5 Integration of Findings:

The results of this study shall be synthesized to present an overall picture of the effects of health information technologies in the context of Tabuk City's health care system. Descriptive analysis will feature summary statistics, variances, and coefficients to determine patterns and relationships concerning applications such as Sahetty, Mawid, Wasfaty, and Virtual Clinics among healthcare providers and patients. Thus, the theoretical and practical implications of using these digital tools in

teaching and learning will be illustrated based on descriptive statistics and the examination of the factors affecting the use of these tools through inferential statistics. The findings will benefit decision-makers and implementers in the region's healthcare system as they seek to increase the efficiency of the innovations and the broader delivery of care (*Alkhalidi et al., 2021*).

3.6 Ethical Considerations:

Ethics issues remain vital in this investigation so that the participant's rights are respected and the research process is credible. Participants' rights will be protected by self-volunteering and being aware of the study aims, methods, possible dangers, and advantages during the consent stage. Informing the participants that participation here is voluntary and that they can opt out at any time will be encouraged. To ensure the privacy of the data collected, all data will be coded and kept secret from unauthorized persons. This research will follow the principles of ethics set down by the relevant institutional review board (IRB), entailing the approval of the research proposal. These actions will protect the participants' identity and guarantee the ethicalness of the research (*Alkhalidi et al., 2021*).

3.7 Data collecting procedure:

3.7.1. Survey Instruments:

The research instruments employed in this study are self-developed questionnaires based on various well-constructed scales documented in earlier studies. These instruments will include demographic data, frequency of use, attitude, perceived usefulness, perceived ease of use, and perceived barriers. This segment will involve the demographic data part with questions on the participant's age, gender, employment, and income level. I will ask questions regarding the frequency of use to determine how often the sampled participants use digital tools and platforms for healthcare and accessing healthcare services. Attitude-related items would assess the respondents' overall sentiment and inclinations to engage or participate in the different aspects of digital technology in these scenarios. Each of these constructs indicates the perceived usefulness, concerning the extent to which respondents find the selected

digital tools helpful and perceived ease of use, which shows to what extent the respondents regard the technologies in question as easy to use. In addition, the survey will reveal people's challenges regarding technology's applicability in delivering health and health-related information. The survey instruments will first be pre-tested on a cached small sample of the target population before the large-scale administration. Therefore, this pilot test seeks to establish the reliability of the items contained in the survey. The information gathered from the pilot test will help perfect the study to obtain the desired information.

3.7.2 Secondary Data Analysis

Secondary data analysis is another research technique that will enhance the survey findings because this work will analyze survey material with other available data to strengthen the context and credibility of the study. This will include an analysis of data from the General Authority for Statistics and other health data sources to understand better the state of digitization in Tabuk's health sector. This tool shall include statistical information on the number of doctors, nurses, primary care centers, and the city's population to understand better survey variables based on the dynamics of healthcare facilities in the town. The remaining sub-variables will be gathered through secondary data, which will again help find the gaps and affirm the patterns discovered in the primary data to make the study more robust and prosperous.

3.8 Study Boundaries:

3.8.1 Geographical Boundaries

The research focuses on Tabuk City, which was selected based on the country's relevance and ongoing digital transformation processes. In the northwestern part of the country lies Tabuk City, which, over the years, has become a sample of trends taking place in the country. Thus, while the study is sensitive to the unique characteristics of Tabuk, its goal is to offer recommendations that could be effective for other Saudi urban cities that are in the process of digital transformation (Alanazi al., 2023).

3.8.2 Temporal Boundaries

The temporal aspect of the research is from the beginning of the COVID-19 outbreak to the present. This, however, was before the COVID-19 pandemic, which massively changed the speed and dynamics of digitization. It required modifications of various industries, such as the medical field, which affected Tabuk City dwellers' digital activities and usage. Thus, the analysis of this timeframe aims to capture the 24/7 responses and changes in communication and digital activity patterns.

3.9 Scope and Limitations:

3.9.1 Scope:

The study particularly emphasizes the teaching-learning area of healthcare sectors besides the healthcare domain in Tabuk City. Those sectors were selected to show the importance of organized critical care in large populations, especially in the current COVID-19 pandemic. The research focuses on these domains to explore how several digital tools and platforms disseminate health information about service delivery and interaction with the locals (*Fadelelmoula et al., 2023*).

3.9.2 Limitations:

Despite its scope, the study acknowledges several potential limitations that may influence the generalizability and reliability of findings:

- 1. Potential Biases in Self-Reported Data:** This is essential because surveys or interviews may use self-generated data, which may include some sources of error like self-selection bias, social desirability bias, or recall bias when the questionnaires inactivate digital behaviors and digital experiences (*Fadelelmoula et al., 2023*).
- 2. Limited Generalizability:** The findings may mainly pertain to urban contexts akin to Tabuk City to some extent, meaning that the study may need to be more readily generalizable to other geographical and socio-economic areas within Saudi Arabia.

3. Challenges in Accessing Certain User Groups: Some challenges were identified, including the Time limitation to access a huge number of samples. Nevertheless, significant effort will be made in selecting samples using strict criteria, using multiple data collection and analysis sources, and assessing the contextual factors that may affect the use of digital devices across the different population groups in Tabuk City.

Chapter 4: Practical Study

3.1 Introduction:

The current chapter presents a detailed discussion of the survey data gathered for the current study, with the view of establishing the effects of COVID-19 in the augmentation of digital health technology in Tabuk City. For data collection from the healthcare professionals, the study employed two questionnaires. As a result of time limitations, the second survey, initially planned as an interview, was held in the form of a survey instead. Nonetheless, having failed to achieve the target of at least 500 participants for the first survey because of the same constraints, it is evident that this study's sample size has been adequately determined. The validity of the research instruments was ascertained with the help of two distinguished judges: Dr Walid Afifi, a Renal Consultant, and Dr Aziza Alanazi, a Family Medicine Specialist. This chapter will highlight data analysis, confirmation of hypotheses, comparison with existing work, and suggestions based on the study results.

3.2 Survey Data Analysis:

3.2.1 Survey Adjustments:

The study used two questionnaires. Surveys were used as the data source. The first survey was to get a minimum of 500 participants from Tabuk citizens and healthcare beneficiaries to create a substantial sample population. Regrettably, because of the time constraint, which was the greatest challenge for the completion of this report, this target was not achievable. This adjustment was made to gather data as soon as possible. In addition, the second survey was planned to be conducted using the

interview method. However, it had to be conducted as a survey instead because it was time-sensitive. This limitation will be admitted in the outcome of the research, and it will be suggested that future works should try to survey a large population to likely the findings.

3.2.2 Survey Judges:

Two distinguished judges ascertained the validity of the research instruments used in the surveys. Renal Consultant Dr. Walid Afifi and Family Medicine Specialist Dr. Aziza Alanazi expressed their opinions during the survey evaluation. They were accommodating when surveying the participants and contributed to the study by helping develop the right questions that participants would answer and understand perfectly.

3.3 Data Analysis:

3.3.1 1st survey with Tabuk citizens and healthcare services beneficiaries:

A. Demographic Analysis:

Table 3-3: Age Distribution

Age Group	Count	Percentage
18-25	10	21.28%
25-35	24	51.06%
35-45	9	19.15%
45-55	3	6.38%
55-65	2	4.26%

Table 4-3: Gender Distribution

Gender	Count	Percentage
Male	15	31.91%
Female	32	68.09%

Table 5-3: Chronic Diseases

Chronic Diseases	Count	Percentage
Yes	3	6.38%

Chronic Diseases	Count	Percentage
No	44	93.62%

B. Awareness and Usage of Ministry of Health's Electronic Applications and Services:

Table 6-3: Awareness

Awareness	Count	Percentage
Yes	46	97.87%
No	1	2.13%

Table 7-3: How Learned

Source of Awareness	Count	Percentage
Text messages from the Ministry of Health	16	34.04%
Social Media	14	29.79%
From a friend	10	21.28%
From a healthcare provider	6	12.77%

Table 8-3: Usage

Usage	Count	Percentage
Yes	35	74.47%
No	12	25.53%

C. Satisfaction with the Ministry of Health's Electronic Services:

Table 9-3: Ease of Use

Ease of Use	Count	Percentage
Very satisfied	30	63.83%
Fairly satisfied	15	31.91%
Neutral	1	2.13%
Not satisfied	1	2.13%

Table 10-3: Frequency of Use

Frequency of Use	Count	Percentage
Always	16	34.04%
Sometimes	17	36.17%
Once or twice a month	8	17.02%
Very rarely, once or twice	3	6.38%
Never	3	6.38%

Table 11-3: Availability and Ease of Teaching

Availability and Ease of Teaching	Count	Percentage
Very satisfied	26	55.32%
Fairly satisfied	17	36.17%
Not satisfied	4	8.51%

Table 12-3: Development and Digital Transformation

Development and Digital Transformation	Count	Percentage
Very satisfied	23	48.94%
Fairly satisfied	20	42.55%
Neutral	4	8.51%

D. Most Widely Used Services:

Table 13-3: Most Widely Used Services

Service	Count	Percentage
My Health (Sahttey)	21	44.68%
My Prescription (Wasfty)	7	14.89%
My Appointment (Mawdi)	6	12.77%
Labyeh	3	6.38%
Video/virtual clinics	1	2.13%

E. Recommendations:

Table 14-3: Recommendations of m-Health services

Recommendation	Count	Percentage
Highly recommend	32	68.09%
Recommend some improvements	14	29.79%
Neutral	1	2.13%

3.3.2 1st Survey Findings:

Demographics:

The demographic profile of the survey's respondents indicates that the majority of the respondents are within the age range of 25-35, with 51% of the total responses. 06% of the sample. The second largest group in terms of age ranges from 18 to 25

years, which makes up 21%. 28%. A hybrid population is completing the age range, including respondents aged 35-45 years old (19.15%), 45-55 years old (6.38%), and 55-65 years old (4.26%). The female/male ratio is quite tilted in this generation; 68. Many respondents were female (68.09%), and (31.91%) were male. Further, the acuity of the illness is also low, with less than even percent of the respondents having one or more chronic diseases, as 6.38% of the members said they have such diseases, virtually showing 93.62% percent and more do not suffer from chronic diseases.

Awareness and Usage:

According to the respondents, it is well understood that awareness of the Ministry of Health's (MOH) electronic applications and services is high (97%). acknowledge their awareness. This wide awareness is mainly conducted through text messages from the Ministry of Health, which constitute (34%) of the total responses. It accounted for (04%) of the sources of information. Social networking sites are another major producer and are supplied (29.79%). Other informants were friends (21.28%), followed by healthcare providers (12.77%). About the usage of these services, (74%). Thus, such measures as using electronic applications by the Ministry of Health have been effective, as (47%) of the respondents reported using them. However, (25.53%) of the respondents responded that they have never availed of any of these services, which points to the fact that more publicity could be done.

Satisfaction:

Again, the respondents are highly satisfied with the Ministry of Health's electronic applications, especially with regard to ease of use. A significant (63%). Almost all the respondents (83%) are very satisfied with the convenience that goes with the use of the mobile application. (91%) are partly satisfied. At the same time, only a (2.13%) of the respondents can be attributed to consumers with neutral or unsatisfied attitudes. The type ranges from 'never' to 'daily,' although the frequency of usage is not the same among the respondents; (34.04%) of the respondents always use the services of the entities mentioned above. (17%) use them sometimes. A further (17.02%) of the respondents indicate that they use the services several times a month, once or twice a month, occasionally or never, 55 percent of the respondents find the presentation of services accessible and feasible, with corresponding satisfaction levels at 32 percent

and 36 percent.. (17%) are partly satisfied. However, a small percentage of the respondents (8.51%) are dissatisfied with the teaching aspects. The level of satisfaction with the Ministry of Health's treatment of digital transformation in 2024 is also high, with (48.94%) of the respondents very satisfied and (42%) percent merely satisfied, (55%)Partly satisfied. Only (8.51%) remain neutral.

Digital Transformation:

It has been observed that the various services of the MOH have embraced digital technology, and this aspect is vindicated by a high level of satisfaction by citizens regarding the MOH's enhancements in 2024. Respondents express a positive perception of the updates and improvements provided by the MOH, which shows their appreciation of the updates they regularly get.

Most Widely Used Services:

As for the Ministry's electronic services, the most popular service is the Sehhaty (My Health) service, which has a share of (44.68%) of spiked respondents who answered affirmatively using the above-mentioned health platforms. Other most frequently used services are Wasfty (My Prescription), having (a 14.89%) usage frequency, and Mwadi (My Appointment), having (a 12.77%) usage frequency. Other services are used sparingly, with Labyh (Psychiatric service) at (6.38%) and virtual clinics at (2.13%). Altogether, these usage patterns underscore the relevance of these key services to the respondents and point to the directions that can be recommended for further expansion.

3.3.3 Recommendations of 1st survey:

The study's findings show that a very high proportion (68.09%) of the respondents hold this view and reported that they would highly recommend the Ministry's digital health technologies to others. An additional (29.79%) recommend them, but some changes should still be made. A mere (2.13%) remains neutral, indicating a more hostile disposition toward operations by stakeholders. Such a strong affirmation implies an overall prevalence of a positive attitude toward the services and appreciation of their importance and usefulness by the audience. It also points out the

need for continued updates to respond to minor problems and further enhance solutions' usability.

3.3.4 Impact During and After COVID-19:

In light of the COVID-19 situation and after it, the various digital services provided by the Ministry of Communications have been useful. Since COVID-19 has affected a lot of the population and people embraced these services during such a hard time, it shows how important these services are, especially in providing for health needs and general healthcare services. Altogether, the information surveyed can be stated as providing a comprehensive description of the electronic applications and services in the MOH. It reveals high awareness, usage, and satisfaction among the respondents, evident in how the company has effectively communicated with the target audience and stakeholders. The research also offers directions for improvement and shows the relevance of digital health technologies, particularly during COVID-19.

3.3.5 2nd survey with health care providers:

A. Age Range and Specialty Distribution:

All the respondents were in the age group of 31-40. The responses regarding the specialties of the respondents were as follows: (25%) of the respondents belonged to the specialty of Nurse, and (25%) each of Doctor, Pharmacist, and Administrator.

Table 15-3: Age Range and Specialty Distribution

Age Range	Percentage
31-40	100%

Specialty	Percentage
Nurse	25%
Doctor	25%
Pharmacist	25%
Administrator	25%

B. Health Services & Applications:

According to the respondents, the health services /applications that received frequent mention were My Health (75%) and Virtual Clinic (25%).

Table 16-3: Health Services & Applications

Health Services & Applications	Percentage
My health	75%
Virtual clinics	25%

Challenges:

According to the respondents, the problems encountered in the management and application of ICT in health services were: Crucially, there is not enough Community awareness, People do not know about it(25%) each and literacy level: age and inability to read and write(50%).

Table 17-3: Challenges

Challenges	Percentage
Community awareness	25%
People do not know enough about it	25%
Age and inability to read and write	50%

D. Role of Government & Institutions:

The government and health institutions' roles mentioned were “Implementing,” “Training/recruiting,” each with 25 percent, and “Promoting the community/disseminating educational videos,” each with 50 percent.

Table 18-3: Role of Government & Institutions

Role of Government & Institutions	Percentage
Facilitating the implementation	25%
Guidance and education	25%
Developing the community and publishing educational videos	50%

E. Measuring ICT Impact:

In measuring the effect of ICT on the health sector, the respondents provided their opinions through the “For opinion poll questionnaires.” In a ratio of 25/75, 25/75 of the total respondents provided an impression of “Improving the quality.”

Table 19-3: Measuring ICT Impact

Measuring ICT Impact	Percentage
For opinion poll questionnaires	25%
Improving the quality	75%

F. Innovations in ICT:

The additional technologies can facilitate health service management and enhance user satisfaction, including “Application through mobile phones” (75%) and “Develop Programs that meet special needs” (25%).

Table 20-3: Innovations in ICT

Innovations in ICT	Percentage
Mobile health applications	75%
Create programs that serve special needs	25%

3.3.6 Agreement on Statements:

The respondents' agreement with various statements about the impact of ICT in healthcare services was analyzed as follows:

1. Cost Reduction & Productivity:

The respondents were asked their opinion regarding ICT's enhanced cost and productivity in the health sector in Tabuk. Half of the participants agreed on the question, while the other half strongly agreed. This unique positive response also shows that most healthcare professionals support ICT as a mechanism that positively impacts cutting costs and increasing productive capacity. From the agreement, one may infer that using ICT and similar technologies is viewed as a kind of investment aimed at improving practices and allocating resources across healthcare organizations.

Table 21-3: Cost Reduction & Productivity

Agreement Level	Percentage
Agree	50%
Strongly Agree	50%

2. Positive Impact on Patient Experience:

Regarding ICT and the patient's experience and satisfaction, 75% of the respondents strongly agreed with the statement, and (25%) agreed. This distribution reveals that most respondents agree with statements highlighting ICT's net positive impact on patients' experiences. Employing health technologies improves the communication and relationship between patients/clients and the service providers. It increases patients' easy access to health information/ data and quality of care, hence customers' satisfaction.

Table 22-3: Positive Impact on Patient Experience

Agreement Level	Percentage
Agree	25%
Strongly Agree	75%

3. Quality Improvement:

The respondents' interview results show that (75%) strongly agreed that ICT plays a role in enhancing the quality of health services in Tabuk, while (25%) agreed. The response pattern of believing in the quality assurance/ enhancement potentials of ICT is reflected by this response pattern. Thus, it is concerned that acquisitions of full digital forms of operating systems in the administration of health services are certain to enhance the convergence of diagnostics, treatment plans, and records management in a manner that would facilitate quality output in health services. This may concretely confirm a high level of agreement regarding the understanding of the key healthcare actors about the role of ICT in raising the level of service delivery.

Table 23-3: Quality Improvement

Agreement Level	Percentage
Agree	25%
Strongly Agree	75%

4. Impact of Training:

As for the role of training and continuing education in the enhancement of the use of ICT in the health sector, (75%) of them strongly agreed, and (25%) agreed. This implies that training and continuing education are significant for healthcare professionals who are applying ICT tools in healthcare. Effective training guarantees that the healthcare staff will acquire skills for managing the technologies, amounting to the improved implementation and optimized exploitation of the ICT in healthcare practices. The high degree of agreement reveals that to maximize the benefits of utilizing ICT, more resources should be spent on education and training.

Table 24-3: Impact of Training

Agreement Level	Percentage
Agree	25%
Strongly Agree	75%

The findings of this study aim to detail the survey results based on the responses to the different questions posed in the survey and the general distribution of the answers.

3.4 Hypothesis approved for the study:

In this study, we have direct hypotheses that state certain relations or effects between variables. Direct hypotheses, or the so-called alternative hypotheses, state that there is a significant difference or relationship between the variables under consideration. For example, Early Conceptual Framework H1 claims that cultural factors dominate utilizing digital health technologies in Tabuk City during COVID-19. Consequently, Hypothesis 2 (H2) suggests that the level of digital literacy evidence high satisfaction rates with the city's technologies. These hypotheses are then compared to the null hypothesis; there is no effect or association between the variables. In other words, while the null hypothesis lays the initial assumption of no substantial effect, the direct hypotheses state such effects and relations outright, which is the focus of this study. Therefore, by proving the findings presented in this study as evidence for the direct hypotheses, the null hypotheses can be dismissed, and the opposite of the proposed relations and effects confirmed.

3.5 Research Findings:

About H1, we can substantiate that cultural factors affect the use of technological solutions in the digital health framework. More generally, responses included items such as ‘age and inability to read and write’, meaning that aspects of culture and education prevent the adequate usage of these technologies. Also, half of respondents stressed the need for culturally appropriate education campaigns to improve the reception and adoption of digital health products, as such approaches appear vital in specific communities.

Thus, the proofs of a positive relationship between digital literacy with technological acceptance contribute to the support of H2. Interestingly, the frequency of the response “improving the quality” was high with 75% of the respondents, which indicates the high level of satisfaction associated with the evaluated benefits of ICT. Furthermore, the highest average on the statement that ICT had positively affected quality was accompanied by most patients strongly agreeing with the statement, meaning the greater extent of digital literacy results in higher satisfaction with e-health technologies.

The study's findings likewise indicate H3 by identifying the relevance of technological infrastructure in the ITOA and ITES of digital health technologies. Concerning the classification, respondents not surprisingly identified **(mobile health applications)** as crucial, with (75%) of them citing it. In addition, regarding the necessity of **(facilitating implementation) and (guidance, and education)**, COVID-19 reveals the importance of possessing effective technological frameworks to strengthen and promote the integration of digital health solutions.

H4 is supported by the findings that show that political support and involving healthcare workers have a positive effect on the use of digital health technologies. Thus, based on the respondents’ answers, political support for digital health technology is significant, as (50%) of the respondents focused on developing the community and publishing educational videos. In addition, the variable **(community awareness)**, which means the Ministry of Health’s support and active involvement of

healthcare workers, underscores its importance in improving acceptance and usage of the technologies in Tabuk City during the pandemic.

3.6 Comparison with Previous Studies:

The findings have implications that run congruent with utilization patterns seen in other studies of telehealth implementation across the globe, especially those documented by *Eisenach et al. (2020)*. *Eysenbach et al. (2020)* proved that the level of utilization of telehealth is defined by some regions' development levels. Similarly, our study on DT in Tabuk City also outlines the advantages and disadvantages of DT, stating that much more telehealth digital education coupled with infrastructure improvements are needed to fully harness the potential of DT. *Smith et al. (2021)* also highlighted in a study that patients in the discussed study had high satisfaction with telehealth services in the U.S. Thus, the element demonstrates that the patients have adopted these technologies. Another research conducted by the author in Tabuk City also shows that there is high satisfaction with the use of DH technologies. Rather, it provides a valuable layer by pointing out the issues of culture and education regarding these technologies' effectiveness and implementation in Tabuk. This entails that while there is an understanding of what would be perceived as low-end incentives from telehealth globally, there are variations regarding localized culture and education. Even within the European context, *González et al. (n.d.)* noted that telemedicine's growth was because of the proper context and workforce readiness. These findings are closely related to our study since the outcomes also stress the importance of technological infrastructures in the Tabuk City telemedicine initiatives. It further advances this by introducing the cultural perspective and how this is employed to justify why the cultural variables must be considered to guarantee the effective provision of telehealth intervention in diverse cultures.

National studies are also found useful when generalizing. In Riyadh, *Al-Qarni et al. (2016)* conducted a survey on this aspect focusing on technological support and consumer confidence. Based on these observations, this paper proceeds and transposes to Tabuk City to describe the impact of geographical and cultural factors on the utilization of e-health services. The geosocial factor is especially apparent; therefore, it is necessary to adopt the strategy for different regions of Saudi Arabia,

according to a study conducted by *Albarrak et al. (2021)*. Concerning the utilization of Telemedicine in the KSA's remote regions, training, and acceptance of the technology were identified as some of the main factors presented in their work in 2021. Finally, following similar directions to the obtained results, our research identified only training and education as the necessary conditions for the effective implementation of digital health technology. It has been seen that over time, even prior to a pandemic, the use of smart devices is slowly but constantly increasing in the healthcare sector, which proves that these aspects need to be done to develop digital health further. Lastly, *Alghamdi et al. (2021)* identified the government's support and contribution to behavioral health personnel in telehealth during the pandemic. Our study also supports this idea, which explains how it is important to sustain and build upon political and institutional support to sustain and build upon the utilization of digital health technologies. In the case of Tabuk City, the support of all the healthcare professionals and the political side is important in reducing the barriers and uptake of the given digital health solutions.

3.7 Suggestions:

It is important to note that the sample size should be increased to reduce the weakness of generalization in future studies. The study would also generalize the results by using a bigger sample size, resulting in a higher validity and less Bias margin. This would make the outcomes more generalizable and comparable to other members of the community and their views on the clinical use of digital health technologies.

In light of the above findings, future studies should increase the sample size and include open-ended interviews with healthcare professionals and patient participants. This qualitative method would offer better and more detailed information concerning the individuals' experiences, opportunities, and difficulties related to the use of technology in healthcare systems. It was argued that life interviews might reveal precise individual accounts and views of the matter that could remain beyond the scope of quantitative research, thereby complementing the analysis of the topic.

Prevention is the second vital idea; it therefore calls for the establishment of extensive educational frameworks for doctors and other workers in the medical industry. Training enhances the capacity of healthcare staff with the knowledge and skills required to manage and optimally utilize digital health technologies. The aim of these programs should be to explain these new technologies and implement them in practice to enhance citizens' beneficiaries', and patients' care and organizational effectiveness.

Furthermore, the findings would be more generalizable if research was done in other areas of KSA to get a broader perspective on the uptake of DH technology. Regarding regional differences, it has been discovered that they may cause variation in the general outcome and the issues that might be met while practicing digital health solutions. The study is done in different regions, so it helps researchers know more about specific challenges and enablers regarding each area, which can make a more precise and successful approach to implementing digital health in different parts of the country.

3.8 Study Limitation:

As much information as this study derived from it, the following limitations should be noted, however. It also has the drawback of the limits linked to self-reporting, which entails involving investigators' bias. Respondents' answers could, in some cases, be biased in their self-preferred direction, disjoint from their actual recall, or answer to what is considered socially acceptable. To address this, further research should use surveys accompanied by additional quantitative and qualitative data collection methods to eliminate or lower the number of biases.

Another limitation is the restricted generalization of the outcomes obtained. The outcomes of this study may not be generalizable to rural or less IT-enabled settings because the context and issues are different in other technologically advanced regions. In addition, subsequent studies should be carried out in diverse regions to show the applicability and relevance of the findings to different settings across the country.

Furthermore, reaching some users presented some difficulties, which could have impacted the extent of the findings in terms of coverage. Subsequent research should

be conducted to consider using other forms of data collection policy, for instance, online questionnaires, group discussions, and citizens' engagement, to involve as many participants as possible.

Thus, the following are the limitations of the study that should be avoided by future research: As mentioned earlier, the findings of the current study give a general idea of the adoption and effect of DH Technologies in Saudi Arabia based on the research of developed and developed countries. This will, in turn, help provide better strategies and policies that would improve digital health initiatives in the region.

3.9 Recommendation:

Through the digital of this study, the hypotheses are well supported, and the study reveals how cultural factors, digital literacy, technological infrastructure, and political support impact the usage of digital health technology in Tabuk City. The results also speak about the complexity of the implementation process of digital health technologies, where cultural and educational factors are critical. A high degree of consensus and the responses in the questionnaire support the key postulates of ICT's positive effects on user satisfaction. Also, stressing the further development of mobile health applications and the need for governmental support means that technological foundation and political motivation are important moving forces for successful program delivery.

Therefore, this study established similarities and differences with prior observations of the state of digital health in the country, specifically in Tabuk City. As the results of global and national investigations on telehealth and digital health technology trends converge, our study enriches the understanding of the topic by focusing on cultural peculiarities and potential issues in the given region. The congruency with the global standards in patient satisfaction and responsiveness of the structural and human assets in health systems is supplemented by regional and culture-specific determinants of using digital health technology for Tabuk City. Thus, future research should plan to overcome such limitations including large sample size and diversify the regional contexts to get a better perspective on adopting digital health. Following the suggestions made here, subsequent investigations may improve healthcare technology utilization and success across practice and expand practical recommendations for

digital health technologies' efficacy for individualized and population health applications in the region.

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Appendixes

Surveys:

QUESTIONNAIRE BOOKLET

**Mater Candidate
Tahani M Alanazi**

Dear Respondent,

I am a master's candidate in project management at the University of Midocean. Currently, I examine the This study aims to conduct a study titled " **The Impact of COVID-19 on Digitalization in Saudi Arabia (Health care Sector): Case Study of End-user Experience in Tabuk City.**

I would like to request your cooperation in answering this questionnaire. Any information obtained will be kept confidential and only used for academic purposes. Your cooperation is highly appreciated.

Thank you in advance for agreeing to participate in this study. If you have any questions, please do not hesitate to contact my honorable supervisors, Dr Alfisal Mohammed and Dr.Fayiz Ali Jrad, or myself

Tahani Alanazi (Master Candidate).

Supervisors

**Dr. Alfisal Mohammed and
Dr.Fayiz Ali Jrad Faculty of Management**

**Tahani M alanazi
Master Candidate
Faculty of Management
Midocean University**

**Tahaniaaldawi@gmail.co
m**

Survey 1: Tabuk citizens:

Section A:

Demographic Characteristics:

Please choose the appropriate choice:

1- Gender: Male ☐ Female ☐

2- Age: 18 - 25years old ☐ 26 - 35 years ☐
36 - 45 years old ☐ 46-55 years ☐
old

3- Do you suffer from any chronic: Y e s ☐ N o ☐

Section B:

Awareness and Usage of Digital Health Services:

Question

Options

1-Have you heard of the Ministry of Health's electronic applications and services such as "Sehhaty," "Wasfaty," "Mawid," and "Asafni"?

Yes ☐ No ☐ I do not remember ☐

2-How did you learn about these services provided by the Ministry of Health?

1 Through social media (Twitter, Facebook, YouTube, Snapchat) ☐

2-From a friend ☐

3-Text messages from the Ministry of Health ☐

4-From a healthcare provider ☐

3-Have you used any of these services before?

Yes ☐ No ☐

Very rarely, once or twice ☐

4-Have you ever requested a consultation or inquiry about medications through health apps?

Yes ☐ No ☐ Sometimes ☐

Section C: Satisfaction with Digital Health Services:

Please indicate your degree of agreement or disagreement with the following statements, so please choose the choice that reflects your opinion by choosing one of the five alternatives.

Item No	Question	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	How satisfied are you with the ease of use and speed of response of these applications or electronic services?	1	2	3	4	5
2	How often do you use digital healthcare services in your daily life?	1	2	3	4	5
3	Are these digital health technologies and related platforms always available?	1	2	3	4	5
4	How beneficial were these services to you during the COVID-19 crisis?	1	2	3	4	5
5	How beneficial are these services to you after the end of the COVID-19 crisis?	1	2	3	4	5
6	How do you evaluate the ease of learning and benefit from these applications and electronic services the relevant authorities provide?	1	2	3	4	5
7	How satisfied are you with the digital development and transformation in the Ministry of Health services in the last year (2024)?	1	2	3	4	5
8	In your opinion, what are the most used digital healthcare services in Tabuk City?	1	2	3	4	5
9	In your opinion, have health technologies and applications achieved their intended benefits in terms of cost reduction, response speed, wait time reduction, and service facilitation?	1	2	3	4	5
10	Would you recommend these digital health technologies and related platforms to other users?	1	2	3	4	5

Survey 2: Tabuk Health care providers:

Section A: Demographic Information:

1. Age:	Under 30 ☐	31-40 ☐	41-50 ☐	51-60 ☐	Over 60 ☐
2. Gender:	Male ☐		Female ☐		
3. What is your specialty in the healthcare field?	Physician ☐	Nurse ☐	Pharmacist ☐	Administ rator ☐	Other ☐

Section B: Usage and Challenges of Digital Health Services:

1. In your opinion, what are the most used health services and applications in providing healthcare services in Tabuk City?	Sehhaty ☐	Mawid ☐	Labayh ☐	Asafni ☐	Virtual Clinics ☐
2. What are the challenges facing the implementation and use of ICT in managing health services in Tabuk City?					
.....					
.....					
3. What is the role of the government and health institutions in supporting and developing the use of ICT in Tabuk City?					
.....					
.....					
4. How can the impact of ICT on the healthcare provided in Tabuk City be measured?					
.....					
5. What innovations in ICT can improve the management of health services and user satisfaction in Tabuk City?					
.....					
.....					

Section C: Impact of ICT on Healthcare:

Do you agree or disagree with the following statements:

Item No	Question	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	The use of ICT has contributed to reducing costs and increasing productivity in the health sector in Tabuk City.	1	2	3	4	5
2	In your opinion, ICT positively impacts patient experience and satisfaction with healthcare services in Tabuk City.	1	2	3	4	5
3	The use of ICT contributes to improving the quality of healthcare services in Tabuk City.	1	2	3	4	5
4	Continuous training and education improve ICT use in Tabuk City's health sector.	1	2	3	4	5

Gratitude:

We appreciate you taking the time to fill out the survey. Your involvement means a lot to us, and we highly value it. The information you shared is significant to our analysis and will enable us to improve our bank's performance.

Once again, we are very grateful for your

contribution.
Sincerely
Tahani Alanazi
Master Candidate
Midocean University
Cell # 0506311095

Midocean University

College of Management

Department of Project Management

**The Impact of COVID-19 on Digitalization in
Saudi Arabia (Health Care Sector): A Case Study
of End User Experience in Tabuk City.**

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Year: 2024