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Integrating Telemedicine, Health Informatics, and Smart City with Saudi Arabia's Vision 2030: Advancing Sdgs 3 and 11

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Abstract: Technological advancements within the healthcare system and environmental safety have emerged as pivotal components of developmental endeavours in the Kingdom of Saudi Arabia, necessitating thorough investigations in this domain. This research scrutinizes pivotal facets concerning the accessibility of healthcare services in Saudi Arabia, the utilization of technology, and challenges associated with urbanization. Its overarching objective is to align with Sustainable Development Goals (SDG) 3 and 11, by incorporating technological frameworks like telemedicine, health informatics, and smart city systems into the Kingdom's Vision 2030 agenda. The study encompasses 693 participants, comprising health authorities, technologists, educators, environmental and social practitioners, alongside ordinary citizens. Data acquisition transpired through a survey questionnaire, with subsequent analysis employing pertinent statistical methodologies. Descriptive statistics, including mean values, percentile metrics of Likert scales, and standard deviations, were computed and presented within tabular formats. The study discerns deficiencies in health-related behaviours (SDG 3) and urbanization-induced challenges impinging upon health and well-being (SDG 11). It delineates pathways to address these concerns, advocating for bolstered telemedicine initiatives, dissemination of health-related information, and the actualization of smart city initiatives. The findings illuminate nuances pertaining to healthcare differentials, elucidating issues regarding healthcare accessibility, with digital interventions—particularly telemedicine services and smart city endeavours—emerging as instrumental mechanisms to enhance healthcare delivery while navigating urban challenges. Notably, the results underscore a positive inclination among participants toward leveraging technology to ameliorate healthcare accessibility issues. The study furnishes actionable insights conducive to the integration of technological solutions within the Vision 2030 framework, aligned with the Sustainable Development Goals set forth by the United Nations.

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Public Interest Statement

This research delves into the realms of healthcare accessibility and urbanization in Saudi Arabia, aligning its objectives with Sustainable Development Goals 3 and 11. By strategically incorporating telemedicine, health informatics, and smart city infrastructure within the framework of Vision 2030, the study endeavours to offer holistic solutions to these pertinent challenges. The findings underscore substantial disparities in healthcare access while shedding light on the transformative potential of technology-driven interventions. Notably, participants express strong endorsement for smart city initiatives, acknowledging their capacity to enhance healthcare outcomes and mitigate environmental degradation. This investigation furnishes policymakers and stakeholders with invaluable insights, underscoring the imperative of targeted policy interventions aimed at fostering healthcare equity and fostering sustainable urban development.

Study Background

The Saudi Vision 2030 initiative marks a profound transformational journey for Saudi Arabia, aspiring to diversify its economic portfolio beyond oil dependency while prioritizing environmental sustainability. At its core, Vision 2030 envisions prosperity and advancement for the nation. However, this entails a strategic shift from reliance on oil revenues to fostering growth across diverse sectors, notably technology and science. The overarching aim is to harmonize economic, social, and environmental considerations to realize the objectives of the United Nations' Sustainable Development Goals (SDGs). Notably, SDG 3 (Good Health and Well-being) and SDG 11 (Sustainable Cities and Communities) assume paramount importance within the Saudi context, reflecting the nation's commitment to enhancing public health and fostering sustainable urban development. Prioritizing advancements in healthcare accessibility and leveraging technology to bridge informational disparities for marginalized populations align closely with the principles enshrined in SDG 3, resonating with the broader objectives of social progress outlined in Vision 2030.

Indeed, collaborative efforts are crucial in addressing the challenges of sustainable development, which transcend national boundaries. SDG 11, focusing on sustainable urbanization, aligns seamlessly with the objectives articulated in the Planet category of Saudi Arabia's SDGs Roadmap. The pursuit of sustainable communities and cities echoes the imperative for innovative solutions that promote both human well-being and environmental health. The explicit mention of leveraging technology to address critical issues such as water purity, energy efficiency, and climate resilience closely mirrors the objectives outlined in SDG 11. Saudi Arabia's proactive stance in embracing technologies aimed at promoting responsible consumption, mitigating climate change, and preserving biodiversity underscores its significant role in advancing both national and global agendas for sustainable urban development. By aligning with the goals of SDG 3 and SDG 11, Saudi Arabia demonstrates a holistic commitment to urban development that prioritizes the well-being of both its populace and the environment, marking a commendable dedication to sustainable progress.

The research delves into the intersection of SDGs 3 and 11, seamlessly integrating them within the framework of Saudi Arabia's overarching Vision 2030. SDG 3, titled 'Good Health and Well-being,' epitomizes a global endeavour to ensure healthy lives and promote wellness across all age groups. In the Saudi context, challenges pertaining to the limited availability of healthcare services assume relevance, necessitating thorough analysis to align strategies with national aspirations. Concurrently, SDG 11, 'Sustainable Cities and Communities,' resonates with Saudi Arabia's Vision 2030, reflecting concerted efforts toward fostering vibrant, inclusive, and sustainable urban environments. Given the pronounced urbanization trends in Saudi cities, it becomes imperative to comprehend the associated health challenges and chart sustainable developmental trajectories accordingly.

Vision 2030 serves as a visionary roadmap for Saudi Arabia, envisaging a transformative landscape where economic diversification converges with social progress and environmental stewardship. The integration of SDGs 3 and 11 within Vision 2030 underscores the acknowledgment that health constitutes a fundamental prerequisite for urban development, aligning with the nation's strategic priorities. Ensuring the provision of quality healthcare not only serves as an end but also contributes to the broader objective of enhancing citizen welfare, thereby fostering resilient and cohesive societies. Similarly, the emphasis on sustainable urbanization, intrinsic to SDG 11, underscores the vision's commitment to cultivating liveable cities that synergize economic prosperity with environmental preservation.

As Saudi Arabia progresses in implementing Vision 2030, this study assumes critical importance, offering clarity on how global sustainability targets can complement and reinforce the country's developmental agenda. By elucidating the intricate interplay between health, urban development, and sustainability, the research underscores the imperative of integrated approaches in realizing Saudi Arabia's aspirations for a prosperous, inclusive, and environmentally sustainable future.

The dynamic framework of Vision 2030 in Saudi Arabia encounters various limitations, necessitating strategic interventions for mitigation. A prominent challenge lies in the pervasive inaccessibility of healthcare, particularly prevalent in underserved regions such as developing areas or urban neighbourhoods. Insufficient medical infrastructure and training among healthcare personnel exacerbate disparities in healthcare provision, posing a significant obstacle to realizing the goals of SDG 3, which prioritize universal well-being and happiness through equitable healthcare access. Addressing these hurdles is imperative to cultivate a modern and inclusive healthcare ecosystem accessible to all segments of society. Moreover, rapid urbanization in Saudi Arabia exacerbates environmental and health concerns, including pollution, traffic accidents, and diminishing green spaces, thus underscoring the critical intersection between urbanization and public health. To align with Vision 2030's objectives, it is essential to foster sustainable and resilient cities capable of accommodating burgeoning urban populations. This necessitates a comprehensive understanding of the multifaceted interactions between urbanization and health, guiding the formulation of effective policies and interventions.

This article seeks to present a holistic framework for tackling the challenges outlined in SDG 3 and SDG 11 through strategic technological advancements. By leveraging technology as a transformative agent, the aim is to promote equitable healthcare access and facilitate sustainable urban development. Through meticulous analysis and integration, the paper endeavours to equip policymakers, academics, and stakeholders with actionable insights crucial for advancing Saudi Arabia's pursuit of a more sustainable and health-conscious future.

Theoretical Foundation

The adoption of the Diffusion of Innovations Theory as the theoretical framework for this study provides a structured lens through which to analyse the implementation of telemedicine, health informatics, and smart cities within Saudi Arabia's Vision 2030. Everett M. Rogers' seminal theory elucidates how new ideas and technologies permeate through social systems over time, offering insights into the factors that influence their success or failure.

The theory's five key attributes—relative advantage, compatibility, complexity, testability, and visibility—help elucidate why certain innovations gain traction while others falter. Innovations that align with existing values, possess moderate complexity, offer trialability, and yield observable results are more likely to be embraced. Moreover, the classification of adopters into distinct groups—innovators, early adopters, early majority, late majority, and laggards—enables a nuanced understanding of adoption rates and patterns across different segments of society.

By leveraging this theoretical framework, the study aims to elucidate the motivations driving the adoption of telemedicine, health informatics, and smart cities in Saudi Arabia. It seeks to identify strategies that capitalize on the major attributes identified by the Diffusion of Innovations Theory, thereby facilitating a smoother transition within the healthcare and urban development sectors. Through comprehensive integration across sectors, the study envisages improved access to healthcare services, enhanced urban safety, and sustainable urbanization aligned with both the broader SDGs and Saudi Arabia's Vision 2030 agenda.

Study Objectives

This study pursues the following objectives:

a) To assess the repercussions of restricted access to healthcare services and the ramifications of urbanization challenges in Saudi Arabia.

b) To investigate the efficacy of telemedicine, health informatics, and smart city initiatives in mitigating particular obstacles related to healthcare access and urbanization in Saudi Arabia.

c) To deliberate on the integration of telemedicine, health informatics, and smart city initiatives within the framework of Saudi Arabia's Vision 2030, correlating with the specified SDGs.

Review of Related Studies

Overview of Review

The literature review examines the interconnectedness of technology, health, and urban development within the specific context of Saudi Arabia. The initial segment sheds light on the challenges surrounding healthcare accessibility both locally and globally, while also proposing solutions. Telemedicine emerges as a pivotal tool in overcoming these barriers, offering transformative potential in healthcare delivery. Subsequently, the review delves into the intricate relationship between air pollution and urbanization, elucidating the health implications of urban development. It explores the adverse health effects stemming from urbanization and proposes innovative approaches, notably smart city initiatives, to mitigate these consequences. In the final section, the review aims to bridge the gap between health and urban development through technological interventions. It seeks to demonstrate how technology has influenced urban sustainability and access to healthcare services. This would be achieved through a comprehensive analysis of lessons learned, success stories, and case studies. Ultimately, the objective of this review is to present a holistic perspective on existing knowledge and practices, paving the way for the introduction of novel viewpoints and strategies.

Access to Healthcare Services and Implications

The third SDG 3 underscores the imperative of providing high-quality healthcare services across all stages of life. SDG 3 encompasses several crucial dimensions of healthcare access, including the assessment of essential medical facilities' availability through the metric of "Coverage of Essential Health Services." Additionally, Indicator 3.1, "Health Workforce Density," offers insights into the availability of adequately trained healthcare professionals to deliver efficient services. Analysis of these indicators reveals that SDG 3 not only prioritizes the provision of healthcare services but also emphasizes their quality and inclusivity.

While significant strides have been made in enhancing the healthcare sector in Saudi Arabia, challenges persist in ensuring universal access. Vision 2030's healthcare improvement agenda is confronted by a notable challenge: the prevalence of non-communicable diseases, as evidenced by Albejaidi & Nair (2021). Alfaqeeh et al. (2017) underscores the varying utilization patterns of primary healthcare, particularly highlighting disparities between urban and rural areas. Al-Hanawi et al. (2020) assert that financial inclusivity significantly influences individuals' ability to access emergency healthcare, suggesting that enhancing financial inclusion could mitigate related challenges.

Furthermore, Al Khashan et al. (2021), employing a mixed-method approach, delve into primary healthcare reforms, delineating advancements, obstacles, and future prospects. These studies serve as compelling indicators of the imperative for interventions aimed at bridging access gaps to align with SDG 3 objectives.

Healthcare informatics emerges as a pivotal avenue for enhancing the delivery and accessibility of healthcare services. Facilitating more efficient sharing of health records not only enhances the quality of care but also mitigates the redundancy of medical tests. This is significant as it fosters an augmented repository of knowledge and services pertaining to health. Aftab et al. (2020), through an exhaustive document analysis coupled with qualitative interviews, underscore the comprehensive approach healthcare informatics brings to healthcare delivery, particularly emphasizing the imperative of prioritizing reproductive healthcare services. The reviewed literature elucidates the challenges inherent in the healthcare pathway in Saudi Arabia and proposes effective solutions within the ambit of SDG 3. Telemedicine and health informatics serve as exemplars of how technology can bridge access gaps, thereby fostering a more robust healthcare system.

Telemedicine, specifically, is geared towards enhancing healthcare access across geographically disparate regions within Saudi Arabia. As elucidated by Noor (2019), telemedicine facilitates the provision of medical prescriptions and valuable advice online, transcending geographical constraints. SDG 3's mandate to enhance the quality of healthcare services through broader accessibility, particularly in rural areas, finds resonance in telemedicine initiatives. Al-Hanawi et al. (2020), through a survey involving 597 stakeholders, underscore the critical role of financial inclusion in accessing emergency

healthcare funds in Saudi Arabia. Telemedicine's ability to address patients' medical needs irrespective of geographical barriers ensures inclusivity and broader healthcare access, thereby indirectly advancing the holistic well-being vision of SDG 3. Additionally, Aftab et al. (2020) underscore the global applicability of telemedicine in connecting and treating individuals devoid of healthcare access, thereby serving as a conduit for extending healthcare facilities to those most in need. Telemedicine, therefore, emerges as a facilitator in realizing the objectives of SDG 3, ensuring equitable healthcare provision across Saudi Arabia.

Health informatics plays a crucial role in ensuring accessible and efficient digital healthcare systems for all. Abubakar et al. (2020) elaborate on the electronic sharing and secure storage of health records in Saudi Arabia, offering a streamlined framework for efficient service delivery. Kabakian-Khasholian et al. (2020) advocate for the integration of patient care through health informatics, emphasizing its comprehensive approach. SDG 3 underscores the importance of healthcare enhancement through informatics, as highlighted by Abubakar et al. (2020). Furthermore, Almulhim & Cobbinah (2023a) stress the necessity of sustainable strategies to address environmental concerns stemming from urbanization in Saudi Arabian cities.

Urbanization and Smart City Initiatives: An Overview

Saudi Arabia grapples with the challenges of escalating urbanization and associated air pollution issues, aligning closely with the objectives of Sustainable Development Goal 11. Urbanization has led to environmental degradation and heightened public health risks, reshaping urban landscapes (Almulhim & Cobbinah, 2023b). Akasha et al. (2023) underscores the imperative of balancing urbanization with sustainable development, as evidenced by a case study in the Arab peninsula. This underscores the urgency of implementing immediate measures to foster sustainable urban communities, thereby mitigating air pollution and enhancing health outcomes.

The urban health landscape presents a diverse array of challenges, necessitating the integration of smart city initiatives. Alfaqeeh et al. (2017) highlight marked disparities in primary healthcare delivery between rural and urban areas in Riyadh, Saudi Arabia, where rural regions often lack adequate medical facilities, exacerbating health issues. Bridging this divide requires extending healthcare services beyond traditional settings through enhanced communication channels and smarter infrastructure. Almulhim et al. (2023a) delve into the intersection of smart urban planning and sustainability in Saudi Arabian cities, advocating for initiatives aimed at fostering well-being and addressing urban health challenges. Their study underscores the pivotal role of green spaces and recreational areas in promoting urban health and sustainability. The advent of smart city projects has ushered in a transformative paradigm shift in healthcare delivery within urban areas. Andejany et al. (2023) assert that Saudi Arabia's endeavours in developing smart, sustainable cities have significantly altered the urban landscape, offering insights into leveraging technology to cultivate sustainable urban environments.

Osman et al. (2021) propose a comprehensive voluntary local review plan aimed at enhancing the Kingdom's sustainable development objectives, with a particular emphasis on smart city initiatives. This framework underscores the importance of sustainable smart development and inclusivity, advocating for collaboration among citizens and society to achieve improved health outcomes and quality of life.

Several studies have delved into specific measures aimed at mitigating air pollution, addressing the adverse impacts of urbanization, and promoting smart city initiatives. Akuraju et al. (2020) revealed the potential synergies between urbanization and SDG by examining their intersection through SDG 11 indicators. Their findings underscore the importance of aligning urban strategies with sustainability objectives for achieving sustainable development. Almulhim et al. (2023b) shed light on the governance of Saudi Arabian cities towards sustainable urbanization, emphasizing the urgency of incorporating initiatives to ensure alignment with SDG-11 targets. To achieve the broader objectives of SDG 11, urban development must strategically integrate technologies aimed at addressing air pollution and advancing smart city initiatives.

Andejany et al. (2023) explore the transition of urban cities in Saudi Arabia into sustainable smart cities and the attendant challenges. Their study underscores the potential benefits of pursuing smart city goals, including improved quality of life and environmental sustainability. Technology emerges as a critical enabler in addressing urban challenges and advancing sustainable development goals. The study underscores the need for smart city initiatives to address a range of issues beyond the immediate focus, ensuring long-term sustainability.

Osman et al. (2021) focus on assessing and monitoring growth to achieve specific goals at the city level, using Buraidah city in Saudi Arabia as a case study. Their work lays the foundation for sustainable development by integrating environmental considerations and introducing smart city programs. Osman et al. (2021) provide a methodology for evaluating the efficacy of smart city projects in Saudi Arabia, underscoring the importance of SDG 11 in advocating for digital strategies to enhance urban livelihoods.

Intersection of Technology, Health and Urban Safety; Exploring the Gap in the Literature

Numerous studies have highlighted a significant gap in understanding the intersection of integrated health technology and urban safety, crucial for achieving sustainable development goals. While existing research has predominantly focused on specific aspects, there remains a notable deficiency in our comprehension of how technology can enhance overall health and safety standards. Particularly, Al-Hanawi et al. (2020) deliberated on the integration of financial considerations with healthcare services to enhance operational efficacy, particularly in Saudi Arabia concerning emergency health funds. While extensively exploring the financial aspect of telemedicine, the study also examined how technology facilitates improved healthcare accessibility and a cloud-based medical response system. Collaborative efforts in research and technological advancements are imperative to mitigate the current gap in understanding the interplay among finance, health, and urban life.

Grainger-Brown et al. (2022) investigated urban development's role in meeting Sustainable Development Goals by transforming societal norms. However, the study inadequately articulates the role of technology in ensuring health equity. This present research endeavours to explore effective approaches whereby technology can enhance health standards within urban populations. Furthermore, Huraysi et al. (2023) examined how technology plays a pivotal role in enhancing urban safety, delivering quality healthcare, and implementing preventive measures to

enhance the efficiency of medical care delivery. Notably, the existing literature has yet to comprehensively explore how leveraging technology can lead to improved health outcomes and simultaneously enhance urban safety in Saudi Arabia, and how this alignment can be integrated into the Kingdom's Vision 2030 agenda.

Study Approach, Design and Procedure

Study Approach

To explore the integration of telemedicine, health informatics, and smart city initiatives within the framework of Saudi Arabia's Vision 2030, particularly as components of SDGs 3 and 11, a quantitative survey approach is deemed most suitable. As highlighted by Osman et al. (2021) and Cobbinah & Almulhim (2023), the quantitative study approach offers the opportunity to gauge the perspectives of key stakeholders using relevant statistical tools. This methodological approach has the potential to yield structured data elucidating how technology influences urban safety within the scope of the study. Leveraging a quantitative research methodology facilitates the collection of data from a larger cohort, providing numerical insights into various facets. Given the multifaceted nature of this paper, conducting a survey will enable the acquisition of clear and meaningful insights from participants regarding the impact of technology on healthcare service access and urban safety in Saudi Arabia. A quantitative survey method offers a structured means to investigate how technology shapes participants' health outcomes and safety within an urban context.

Study Design

The cross-sectional study design is deemed most appropriate for this investigation, as emphasized by Akuraju et al. (2020). This design enables the capture of the study population's perceptions and viewpoints regarding the relationships among the variables under consideration. By employing a cross-sectional approach, we can effectively address the current technological landscape, anticipated health outcomes, and urban safety concerns. Moreover, this design facilitates the gathering of information from a diverse array of participants, thereby expanding the scope of our investigation. To assess the effects of horizontal exposure comprehensively, the implementation of a quantitative research method through cross-sectional surveys is essential. Surveys serve as valuable tools for soliciting feedback from participants regarding technology, health, and urban safety. Ensuring the meticulous drafting of these surveys is paramount to eliciting responses that are rich in insight, as noted by Akasha et al. (2023).

Study Community

The study encompasses a diverse group of participants, including representatives from ministries of health, environment, and social services, alongside technology experts, university lecturers specializing in medical wellness, and ordinary citizens. The inclusion of such a wide-ranging study community as key stakeholders ensures that various perspectives are represented, allowing different groups to contribute their insights on the intersection of modern technology with health and safety in urban environments. The selection of stakeholders is based on the recognition that the multifaceted questions being posed necessitate input from diverse viewpoints and involved parties. Stakeholders from healthcare, environment, and social welfare departments provide expert knowledge regarding the current landscape, ongoing initiatives, and challenges within their respective domains. Technology experts offer deep insights into the potential uses and impacts of technology on health and safety in urban settings. University lecturers specializing in health and medicine enrich the survey with their research findings and academic perspectives, enhancing the depth of factual opinions.

The inclusion of everyday participants is essential as their real-life experiences, ideas, and needs are crucial in understanding the practical implications of technology's interaction with health issues in the cities where they reside. By involving a wide array of participants, the study aims to ensure robust findings that resonate with real-life scenarios, thereby enhancing understanding of how technology can reshape healthcare systems and urban environments. This diversity is paramount as the impact of technology varies for everyone. The questionnaire plays a pivotal role in soliciting diverse viewpoints, ensuring that the results reflect the myriad factors influencing the relationship between technology, health, and urban safety in the context of participants living in Saudi Arabia.

Sampling

To obtain the necessary data from the diverse study population, a randomized sampling technique was deemed the most appropriate strategy. This approach allows stakeholders from various study groups to participate in the study according to their convenience and availability. By employing random sampling, a total of 693 stakeholders voluntarily participated in the study, ensuring representation from different backgrounds and perspectives.

Study Tools and Administration

Survey tools, in the form of digitally designed questionnaires, were utilized to collect the requisite data for the study. These questionnaires were meticulously crafted, incorporating measuring items derived from various studies. Tailored to specific stakeholder groups, the questionnaire items were designed to address distinct aspects: technology experts received items focusing on the intersection of technology, health, and urban safety, while health experts received inquiries pertaining to health and healthcare access. General questions were included in the survey distributed to all participants.

The measuring variables encompassed key themes such as limited healthcare access, urbanization challenges, impacts of technology, and the integration of telemedicine, health informatics, and smart city initiatives within the Kingdom's Vision 2030. To ensure the validity and reliability of the measuring items, expert reviews and a pilot study were conducted. Experts from diverse fields, including technological innovations in the medical system, environmental technology, SDGs implementation in Saudi Arabia, and social analysis, evaluated the measuring items. Their feedback and recommendations were incorporated into the study, guiding the selection of measuring items included in the survey. Additionally, a sample of 25 participants was engaged in a survey process to assess the validity of the measuring items. Ethical considerations were paramount throughout the survey process. Participants received a participant information consent form, seeking their approval to participate in the study and informing them of their right to withdraw at any time. Participants' actual identities were not disclosed, with only general demographic details included in the survey. Stringent measures were implemented to ensure that no aspect of the survey posed any physical, social, or emotional harm to the study participants.

Analysis Procedure

The collected data undergo analysis using pertinent statistical tools, which encompass calculating percentile values of Likert scales, determining the mean, standard error, and standard deviation of the measuring items. The analysis primarily concentrates on assessing the impacts of technological innovations in augmenting access to healthcare services and mitigating the effects of urbanization on citizens' health.

Results and Discussions

Result of the Demographic Features

The study measured various demographic variables, including participant groups, age, gender, and direct contact with different segments of the study, particularly regarding the ways key variables impact them. The results are summarized in Table 1.

Table 1: Results of Demographic Characteristics.

Groups	Variables	Repetition (N)	Percentile (%)
Stakeholders Group	Workers in Ministry of Health	139	20.05
	Workers in environment and social services	217	31.32
	Technology experts	115	16.59
	Lecturers	63	9.09
	Ordinary citizens	159	22.95
Gender	Male	463	66.82
	Female	230	33.18
Age	29 years and below	19	2.74
	30-39	105	15.16
	40-49	229	33.04
	50-59	288	41.56
	60 years and above	52	7.51
Role in SDG 3 and 11	Policy marker in access to health services	102	14.71
	Policy maker in environmental and urbanization concerns	116	16.73
	Policy maker in tech-related policies in Saudi Arabia	111	16.01
	Direct beneficiary of policies on tech in access to health and environmental safety.	364	52.52

Table 1 presents the demographic characteristics of the study participants. Across age groups, the distribution reveals a diverse representation: government health workers constitute 20.05%, employees in environment and social services account for 31.32%, technology experts comprise 16.59%, teachers represent 9.09%, and regular citizens make up approximately 22.78% of the sample. Gender distribution shows that males constitute 66.82% of participants, while females represent 33.18%. In terms of age distribution, 3% of participants are under 30 years old, with the majority falling into the middle-aged category (50-59 years old) at 41.56%, and a smaller proportion being elderly (over 60 years old) at 7.51%.

Regarding roles related to SDGs 3 and 11, participants are engaged in various capacities: 20.6% are involved in making health service policies, 49.8% are concerned with environmental issues or urban problems, 16.01% are involved in technology-related regulations in Saudi Arabia, and 52.52% directly benefit from ideas related to using technology for improving health and safety conditions. This diversity underscores the strength of the study, as it encompasses a wide range of perspectives, including variations in gender and age, to inform the development of technological innovations for enhancing safety and health in Saudi cities as part of the Vision 2030 plan.

Results Derived from Access to Healthcare Services, and Technological Solutions

The study's objectives are of particular concern to health experts and technology enthusiasts involved. Firstly, the challenges surrounding access to healthcare services in Saudi Arabia are addressed. Secondly, the study investigates how advancements in technology, particularly through telemedicine and health informatics, can alleviate these access issues within Saudi communities.

To address the first concern, a total of 202 stakeholders from the Ministry of Health and lecturers participated in the survey. For the second concern, involving stakeholders from health ministries, lecturers, and technology experts, a total of 317 participants were involved in the survey. The detailed results are summarized in Table 2.

Table 2: Results of the Challenges to Access to Healthcare Services in Saudi Arabia.

Access to Healthcare Measuring Items	Agree	Disagree	Mean	Std Deviation
The healthcare facilities in my locality are easily accessible when needed	29.74%	70.26%	2.05	3.94
Trained healthcare professionals are readily available for consultation in my community	32.66%	67.34%	2.17	3.42
Essential medicines are consistently available at local healthcare centres.	35.85%	64.15%	2.13	3.49
There are noticeable disparities in health outcomes between different socioeconomic groups in my community	79.68%	20.32%	4.26	2.13
Obtaining timely access to a variety of healthcare services, beyond specific diseases, is a notable challenge in my locality	85.42%	14.58%	4.75	1.86
Some regions and municipalities have better healthcare services due to limited resources than others	91.64%	8.36%	5.32	1.59

Table 2 delineates specific challenges related to healthcare services in Saudi Arabia, particularly concerning SDG 3, which focuses on ensuring access to healthcare services for all. The key findings revealed by the table are further summarized as follows.

i. Accessibility of Healthcare Services: The majority of respondents (70.26%) express disagreement regarding the ease of accessing healthcare services within their vicinity

when required, indicating perceived challenges in accessing healthcare assistance within their locality.

ii. Availability of Trained Healthcare Professionals: A significant portion of survey participants (67.34%) indicate a belief that doctors and nurses are not readily accessible for assistance within their locality, underscoring a deficiency or difficulty in accessing trained healthcare professionals across various communities in Saudi Arabia.

iii. Consistency of Essential Medications: Most respondents (64.15%) assert a lack of confidence in the consistent availability of essential medications at local healthcare centres, highlighting observed disparities in accessing critical medications.

iv. Health Disparities: Nearly all participants (79.68%) acknowledge the existence of discernible health disparities between affluent and disadvantaged groups within their local area, indicating a focus on health discrepancies influenced by participants' socioeconomic status.

v. Challenges in Timely Access to Diverse Healthcare Services: A significant majority of respondents (85.42%) concur that accessing a variety of healthcare services promptly, beyond limited ailments, poses a significant challenge within their locality, underscoring heightened concerns regarding accessing diverse healthcare services.

vi. Regional Disparities in Healthcare Services: Most participants (91.64%) perceive certain areas and cities as having superior healthcare services due to unequal resource distribution compared to others, suggesting contemplation on regional discrepancies in healthcare services potentially associated with resource allocation.

The survey reveals various healthcare challenges, such as doctor accessibility, medication availability, and disparities between affluent and disadvantaged patients. Discrepancies in services across different areas within the community are also noted. Addressing these findings can guide improvements in healthcare services, particularly through technology integration.

Table 3: Results of the Roles of Technology (Telemedicine and Health Informatics in Solving the Challenges to Access to Healthcare).

Technological solutions to the challenges in Access to healthcare services	Strongly Agree	Strongly Disagree	Mean	Std. Dev
Implementation of mobile health (mHealth) apps for health information, medication reminders, and educational resources could empower individuals to manage their health, reducing the need for frequent in-person visits	91.42%	8.58%	5.04	1.37
The promotion and adoption of electronic health records (eHealth records) would facilitate secure information sharing among healthcare providers, ensuring continuity of care and reducing duplication of tests	93.48%	6.52%	5.17	1.28
Expansion of health drone services to deliver medical supplies, vaccines, and diagnostic equipment in remote or disaster-prone areas could address challenges in timely healthcare delivery.	88.64%	11.36%	4.89	1.63
Implementing training programs to enhance the skills of healthcare professionals in utilizing telemedicine tools would contribute to a more widespread and effective adoption of telehealth services	92.68%	7.32%	5.13	1.39
Leveraging predictive analytics in health informatics for resource allocation and demand forecasting could optimize healthcare service distribution, ensuring that essential resources are allocated efficiently based on population health needs	64.82%	32.18%	3.64	2.49
The introduction of personal health records (PHRs) accessible to individuals, allowing them to manage and share their health information, could empower patients to actively participate in their healthcare and enhance the accuracy of medical histories.	95.73%	4.27%	5.53	0.19
Encouraging collaborative research initiatives focused on telemedicine effectiveness, patient satisfaction, and the impact on health outcomes would contribute to evidence-based practices and continuous improvement	87.09%	12.91%	4.73	1.95

Table 3 highlights significant support for employing technology to address healthcare service challenges. Key findings include:

a. Mobile Health (mHealth) Apps: The survey revealed that 91.42% of stakeholders agree strongly that utilizing health apps can empower participants to manage their well-being. This consensus underscores the potential of mobile health apps to reduce in-person doctor visits and enhance healthy habits.

b. Electronic Health Records (eHealth Records): Findings demonstrate that 93.48% strongly support the notion that enhancing health records can facilitate secure information sharing among healthcare providers. This consensus reflects the belief that eHealth records contribute to more seamless healthcare delivery.

c. Health Drone Services: A majority of participants strongly endorse the idea that employing health drones can address healthcare accessibility challenges. This consensus highlights the recognition of drone technology's potential to deliver timely healthcare, particularly in remote or disaster-stricken areas.

d. Telemedicine Training Programs: Approximately 92.68% of survey stakeholders strongly affirm that implementing telemedicine training for healthcare professionals in Saudi Arabia would lead to increased utilization. This consensus underscores the importance of investing in training to enhance proficiency in online healthcare services.

e. Predictive Analytics in Health Informatics: Over 64.82% strongly agree that leveraging predictive analytics can optimize resource allocation in healthcare. While the majority support this notion, some divergence in opinion suggests varying perspectives on the effectiveness of predictive analytics in resource allocation.

f. Personal Health Records (PHRs): The data indicates that 95.73% strongly advocate for making personal health records user-friendly to empower patients and enhance medical history accuracy. This widespread support underscores the potential of PHRs to engage citizens in their healthcare journey.

g. Collaborative Research Initiatives: A significant majority (87.09%) strongly believe that fostering collaborative research in telemedicine will enhance evidence-based practices. This consensus emphasizes the importance of collaborative efforts in advancing telemedicine research based on empirical evidence.

In summary, participants generally have a positive attitude towards using technology to address healthcare

challenges. However, their level of satisfaction with different technological solutions varies.

Results of the Urbanization Challenges, and Impacts of Smart City Initiatives

The study underscores the significance of SDG 11, which prioritizes environmental safety, addresses air pollution, and tackles urbanization challenges across various cities. To delve into strategies for incorporating technology's impact on environmental safety and fostering healthy urban communities, it's crucial to grasp the intricacies of urbanization challenges and environmental safety issues in Saudi Arabia. This understanding provides insights into how technology can alleviate these challenges and underscores the importance of integrating these efforts into Vision 2030. Participants in this section include professionals from environmental and social services sectors, as well as technologists. Tables 4 and 5 encapsulate the key findings related to this aspect of the study.

Table 4: Nature of Challenges of Urbanisation and Environmental Safety in Saudi Arabia.

Challenges of Urbanisation and Environmental Safety in Saudi Arabia	Strongly Agree	Strongly Disagree	Mean	Std. Dev
Air pollution is a significant concern in urban areas of Saudi Arabia, adversely affecting the health of residents.	94.42%	5.58%	5.129	0.639
The rapid urbanization in Saudi Arabia has led to increased pressure on healthcare services and infrastructure.	95.08%	4.92%	5.372	0.477
Urban areas in Saudi Arabia face challenges in managing and properly disposing of solid waste.	75.08%	24.92%	4.386	1.964
The availability of clean and sustainable energy sources in urban areas needs improvement to mitigate air pollution	93.68%	6.32%	5.084	0.721
Efforts to integrate technology and smart city initiatives for sustainable urban development in Saudi Arabia are not progressing effectively	52.05%	47.95%	1.852	4.331

The findings from Table 4 shed light on crucial aspects concerning the implementation of SDG 11 in Saudi Arabia. Here's a summary of the key findings:

i. The results indicate a high level of awareness and concern among participants in major Saudi cities regarding air pollution. A vast majority (94.42%) acknowledge the detrimental impact of air pollution on health, underscoring its perceived threat to well-being. This shared recognition underscores the urgent need for measures to address and mitigate air quality issues.

ii. Participants (95.08%) also express consensus on the strain placed on healthcare services and infrastructure due to rapid urban growth in Saudi Arabia. This consensus highlights the interconnectedness of urban expansion and healthcare demands. The identified strain emphasizes the necessity for meticulous planning to ensure the sustainability of healthcare resources amid rapid urbanization.

iii. The survey reveals significant agreement (75.08%) regarding challenges faced by cities in waste management and disposal. While most participants acknowledge these challenges, a sizable proportion indicates dissent, reflecting diverse perspectives influenced by regional experiences or individual perceptions of waste management severity.

iv. A substantial majority of participants (93.68%) strongly advocate for the enhancement of clean and sustainable energy sources in cities to mitigate air pollution. This finding aligns with global imperatives emphasizing the pivotal role of clean energy in environmental preservation. It underscores the call for targeted actions to improve energy infrastructure, recognizing its direct impact on urban air quality.

v. Notably, participants exhibit varying opinions (52.05% strongly agree, 47.95% disagree) regarding the extent of technology integration within smart city initiatives to promote environmentally sustainable urban growth. This divergence underscores the complexity of these domains, reflecting diverse viewpoints on the efficacy of current technology integration efforts in fostering sustainable urban development.

The implication therefor is that it is necessary to further elicit the views of the study participants on the critical roles and importance of Smart City initiatives in ensuring sustainable safe city in Saudi Arabia.

Table 5: Impacts of Smart City Initiative.

Using Smart City Initiatives to solve the Urbanisation Challenges	Agree	Disagree	Mean	Std Dev
Implementing smart waste management systems in urban areas helps to enhance efficiency and reduce the environmental impact of solid waste disposal	86.59%	13.41%	4.86	0.84
Integrating real-time air quality monitoring systems as part of smart city initiatives helps to address and control air pollution effectively.	73.94	26.06	3.95	1.68
Promoting the use of sustainable and clean energy sources, such as solar power, through smart city technologies is a way to mitigate environmental pollution.	96.05	3.95%	5.37	0.42
Developing smart healthcare solutions is the best strategy to address increased pressure on healthcare services due to urbanization, ensuring accessibility and quality of healthcare.	91.06	8.94%	5.13	0.64
Creating smart and connected community platforms will help to facilitate citizen engagement, promoting awareness, and collaborative efforts toward sustainable urban development	92.84	7.16%	5.26	0.59

While a majority (73.94%) perceive real-time air quality monitoring systems as effective in addressing and mitigating air pollution, a notable 26.06% hold differing views, indicating scepticism or alternative perspectives on its efficacy. Moreover, there is strong support for implementing smart healthcare solutions (91.06%) and establishing connected community platforms in urban areas (92.84%). These approaches are viewed favourably as effective means to address challenges stemming from increased migration from rural to urban areas, thereby alleviating pressure on healthcare services. This underscores the potential of smart city initiatives in mitigating issues associated with urban expansion.

General Questions on Technological Solutions to Access to Health and Healthy Urban Living, and the Integration into Vision 2030

In the final segment of the questionnaire, all participants from various stakeholder groups provided their insights on the benefits of technology in enhancing healthcare access and promoting healthy urban living, as well as its integration into Saudi Arabia's Vision 2030. The results are summarized in Table 6.

Table 6: Result of General Questions for the Third Objective

Measuring Items	Agree %	Disagree %	Mean	Std Dev
Implementing telemedicine services improves access to healthcare resources and services, promoting health equity in urban areas	95.32	4.68	5.32	0.49
The use of health informatics enhances the efficiency of healthcare systems, leading to better health outcomes for urban residents.	93.11	6.89	5.17	0.58
Smart city initiatives contribute to creating healthier urban environments by addressing key health-related challenges.	85.29	14.71	4.58	0.97
Smart city initiatives contribute to the sustainability of urban healthcare systems, aligning with the goals of Vision 2030.	90.62	9.38	4.93	0.88
The development of robust telemedicine policies and regulations is essential for ensuring successful integration into Vision 2030, promoting standardized and secure healthcare delivery.	82.57	17.43	4.27	1.09
Health informatics education and training programs for healthcare professionals should be emphasized as part of Vision 2030 initiatives to build a skilled workforce capable of leveraging technological advancements in urban health	79.32	20.68	3.97	1.18
The integration of telemedicine, health informatics, and smart city initiatives into Vision 2030 is crucial for achieving comprehensive and sustainable improvements in urban health	94.39	5.61	5.31	0.48

The study reveals a widespread agreement among survey participants regarding the beneficial role of telemedicine in improving access to healthcare services and resources in urban areas. A substantial majority, comprising 95.32%, acknowledged telemedicine's contribution to promoting equity in healthcare provision and addressing disparities within city health systems. Similarly, there was robust endorsement for health informatics, with over 93% of participants recognizing its capacity to enhance healthcare systems and deliver positive outcomes for urban populations. These findings underscore the effectiveness of technology in addressing urban health challenges. Furthermore, the survey demonstrated strong support for smart city initiatives aimed at fostering healthier urban environments and sustaining urban healthcare systems. A significant proportion, 85.29%, affirmed the role of smart city projects in addressing critical health issues, while 90.62% acknowledged their potential to bolster the longevity of urban healthcare infrastructure in alignment with Vision 2030 objectives. These results underscore the importance of integrating such technological initiatives into national strategies to achieve enduring enhancements in urban health.

Moreover, there was a consensus among participants regarding the necessity for robust policies and regulations governing telemedicine, as indicated by 82.57% of respondents. This reflects a balanced perspective on the challenges associated with the widespread adoption of technology in healthcare. Additionally, the demand for health information education and training programs, endorsed by 79.32% of participants, highlights the imperative of preparing healthcare professionals for the evolving landscape of urban health in line with Vision 2030 objectives.

Discussion of Key Findings

The analysis of the study's measuring variables, aligned with its objectives, yields significant findings. The results shed light on the challenging landscape of healthcare access in Saudi Arabia, a concern echoed in prior research by Alfaqeeh et al. (2017) and Al Khashan et al. (2021). Issues such as accessing healthcare facilities, the availability of trained healthcare personnel, and consistent medication supply, as revealed in this study, align with the observations of Alsharif et al. (2021). However, disparities in health outcomes across social strata, as noted in the study and discussed by Albejaidi et al. (2021), underscore the imperative of targeted interventions to ensure equitable healthcare access.

Furthermore, challenges related to accessing diverse healthcare services and regional discrepancies, as identified in this study, resonate with global trends in healthcare transformation. The adoption of mobile health apps (mHealth), advocated by Noor (2019), signifies a promising avenue for healthcare improvement. Similarly, the adoption of electronic health records (eHealth), as proposed by Rahman & Qattan (2021), aligns with the imperative of information systems in healthcare enhancement. The study's exploration of health drone services aligns with broader discussions on healthcare innovation, as demonstrated by Radwan et al. (2021). Additionally, the emphasis on healthcare worker training for telemedicine proficiency, endorsed by Abubakar et al. (2020), underscores the pivotal role of education in sustainable development, as highlighted in Saudi Arabian universities. Finally, initiatives such as personal health records (PHRs) and collaborative research efforts are contextualized within the broader discourse on healthcare challenges, as evidenced by Akasha et al. (2023) and Alshuwaikhat & Mohammed (2017).

In Saudi Arabia, urban development and environmental preservation pose increasingly pressing challenges, as evidenced by the research findings that reflect growing concerns regarding urban air pollution. This concern aligns with the study conducted by Akuraju et al. (2020), which examines the correlation between SDG 11 indicators and the scale of urban growth in meeting specific goals or requirements. The study underscores how rapid urban expansion impacts healthcare infrastructure, a notion further explored by Almulhim et al. (2023a) in their analysis of the sustainability of rapid city development in Saudi Arabian urban centres. The management of waste emerges as a significant challenge, resonating with discussions on environmentally conscious development by Almulhim et al. (2023b). Additionally, Schwindenhammer & Gonglach (2021) delve into the complexities of managing the interplay between food, water, and technology, further highlighting the intricacies of environmental stewardship.

However, the assertion in the study regarding the perceived stagnation in efforts to integrate technology with smart city initiatives warrants careful consideration. Smart city frameworks are increasingly viewed as potential solutions to alleviate urban challenges. The proposition of employing intelligent waste management strategies aligns with Almulhim et al. (2023a) proposals for sustainable urban growth across Saudi Arabian cities. Furthermore, the study's emphasis on real-time air quality monitoring resonates with Radwan et al. (2021) recommendations for enhancing waste management practices, underscoring the broader utility of such initiatives beyond environmental management.

Moreover, the advocacy for adopting clean and renewable energy sources echoes global discourse on fostering sustainable urban environments, as evidenced by the research conducted by Koch & Krellenberg (2018), which explores the nexus between urban growth and sustainability objectives. Likewise, the focus on implementing smart healthcare solutions corresponds with discussions by Kabakian-Khasholian et al. (2020) regarding the integration of sexual and reproductive health services. The proposal to develop smart and interconnected community spaces aligns with overarching principles of environmentally conscious development.

The survey results shed light on the potential benefits of telemedicine, health data utilization, and smart city initiatives on public well-being. The widespread agreement among participants reflects a positive perception of these technologies. Specifically, the consensus on telemedicine's role in enhancing healthcare accessibility resonates with global research findings, as corroborated by the World Health Organization (2021). Similarly, the acknowledgment of health data's contribution to improving healthcare systems aligns with broader discussions on technology's transformative impact on healthcare, as evidenced by Ostern et al. (2021).

Moreover, the overwhelming support for smart city initiatives contributing to urban health and healthcare sustainability underscores the role of technology in fostering environmentally sustainable urban development, consistent with existing literature (Caragliu, Del Bo & Nijkamp, 2009). The emphasis on establishing robust telemedicine regulations reflects the imperative of ensuring ethical and equitable telehealth service delivery, as emphasized by Alharthi et al. (2019).

In summary, the survey findings illuminate complex healthcare accessibility challenges and potential solutions, encompassing technological advancements and environmental considerations in Saudi Arabia. Integrating insights from various studies enhances our understanding of these challenges and solutions, emphasizing the importance of collaborative efforts to leverage technology's benefits while addressing associated challenges. This collective approach is pivotal in fostering public health improvements aligned with long-term development goals, including those outlined in Saudi Arabia's Vision 2030.

Conclusions

This study delves into healthcare, technology, and urbanization issues in Saudi Arabia, aligning with SDGs 3 and 11. Utilizing surveys and statistical methods, it examines healthcare complexities, including technological interventions like telemedicine and health data management, amidst urbanization challenges and environmental concerns. Findings highlight healthcare disparities and emphasize the importance of targeted interventions for equitable access. Proposals for technology integration, from mobile health apps to smart city initiatives, offer promising avenues for healthcare improvement. Additionally, the study addresses urbanization's impact on air quality and waste management, providing a comprehensive understanding for informed decision-making toward healthier, sustainable communities in Saudi Arabia. This study is valuable, but it faces certain limitations. Its reliance on a one-time survey makes it challenging to establish direct correlations between identified issues and proposed solutions. Longitudinal studies could offer deeper insights into how these issues evolve over time. Additionally, self-reported survey data may introduce response bias, as participants might provide socially desirable answers rather than their genuine opinions. Future research could employ mixed methods to enhance understanding. Moreover, the study's focus on a specific demographic may limit its generalizability. Including diverse groups, such as rural residents and individuals with varying socioeconomic backgrounds, would provide a more comprehensive understanding of healthcare challenges and technology acceptance. This study provides an in-depth examination of healthcare accessibility and the integration of technology amidst urban expansion in Saudi Arabia. Novel technological approaches, informed by previous research findings, offer promising avenues for enhancing healthcare delivery. Challenges associated with rapid urbanization underscore the intricate relationship between urban development and public health. Despite inherent limitations, this study serves as a valuable foundation for future research endeavours and policymaking efforts. Collaboration among government agencies, healthcare providers, technological innovators, and urban planners is essential to address these challenges and ensure equitable and sustainable healthcare services. Community engagement is crucial to validate the effectiveness and relevance of proposed solutions. Continuous research and adaptation to evolving technological and urban trends are imperative to devise effective healthcare strategies aligned with the Vision 2030 agenda.

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Conflicts of Interest

The authors declare no conflict of interest.

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Authorship and Level of Contribution

Both authors have participated substantially in the manuscript's conceptualization, drafting, revision, and final approval.

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Appendix: Survey Questionnaire Items

Section One: Demographic Variables

a) Stakeholder Group:
- Workers in Ministry of Health
- Workers in environment and social services
- Technology experts
- Lecturers
- Ordinary citizens

b) Gender:
- Male
- Female

c) Age:
- 29 years and below
- 30-39
- 40-49
- 50-59
- 60 years and above

d) Role in SDG 3 and 11:
- Policy maker in access to health services
- Policy maker in environmental and urbanization concerns
- Policy maker in tech-related policies in Saudi Arabia
- Direct beneficiary of policies on tech in access to health and environmental safety

Section Two: Access to Healthcare Measuring Items:

1. The healthcare facilities in my locality are easily accessible when needed.
2. Trained healthcare professionals are readily available for consultation in my community.
3. Essential medicines are consistently available at local healthcare centers.
4. There are noticeable disparities in health outcomes between different socioeconomic groups in my community.
5. Obtaining timely access to a variety of healthcare services, beyond specific diseases, is a notable challenge in my locality.
6. Some regions and municipalities have better healthcare services due to limited resources than others.

Section Three: Technological Solutions to the Challenges in Access to Healthcare Services:

1. Implementation of mobile health (mHealth) apps for health information, medication reminders, and educational resources.
2. Promotion and adoption of electronic health records (eHealth records) to facilitate secure information sharing among healthcare providers.
3. Expansion of health drone services to deliver medical supplies, vaccines, and diagnostic equipment in remote or disaster-prone areas.
4. Implementing training programs to enhance the skills of healthcare professionals in utilizing telemedicine tools.
5. Leveraging predictive analytics in health informatics for resource allocation and demand forecasting.
6. The introduction of personal health records (PHRs) accessible to individuals, allowing them to manage and share their health information.
7. Encouraging collaborative research initiatives focused on telemedicine effectiveness, patient satisfaction, and the impact on health outcomes.

Section Four: Challenges of Urbanization and Environmental Safety in Saudi Arabia:

1. Air pollution is a significant concern in urban areas of Saudi Arabia, adversely affecting the health of residents.
2. The rapid urbanization in Saudi Arabia has led to increased pressure on healthcare services and infrastructure.
3. Urban areas in Saudi Arabia face challenges in managing and properly disposing of solid waste.
4. The availability of clean and sustainable energy sources in urban areas needs improvement to mitigate air pollution.
5. Efforts to integrate technology and smart city initiatives for sustainable urban development in Saudi Arabia are not progressing effectively.

Section Five: Using Smart City Initiatives to Solve Urbanisation Challenges:

1. Implementing smart waste management systems in urban areas to enhance efficiency and reduce environmental impact.
2. Integrating real-time air quality monitoring systems as part of smart city initiatives to address and control air pollution.
3. Promoting the use of sustainable and clean energy sources, such as solar power, through smart city technologies to mitigate environmental pollution.
4. Developing smart healthcare solutions to address increased pressure on healthcare services due to urbanization, ensuring accessibility and quality.
5. Creating smart and connected community platforms to facilitate citizen engagement, promoting awareness, and collaborative efforts toward sustainable urban development.

Section Six: Measuring Items on the Benefits of Telemedicine, Health Informatics, and Smart City Initiatives:

1. Implementing telemedicine services improves access to healthcare resources and services, promoting health equity in urban areas.
2. The use of health informatics enhances the efficiency of healthcare systems, leading to better health outcomes for

urban residents.

3. Smart city initiatives contribute to creating healthier urban environments by addressing key health-related challenges.
4. Smart city initiatives contribute to the sustainability of urban healthcare systems, aligning with the goals of Vision 2030.
5. The development of robust telemedicine policies and regulations is essential for ensuring successful integration into Vision 2030, promoting standardized and secure healthcare delivery.
6. Health informatics education and training programs for healthcare professionals should be emphasized as part of Vision 2030 initiatives to build a skilled workforce capable of leveraging technological advancements in urban health.
7. The integration of telemedicine, health informatics, and smart city initiatives into Vision 2030 is crucial for achieving comprehensive and sustainable improvements in urban health.