

Evaluating the impact of telemedicine mobile units on health outcomes, healthcare system resilience, and disaster response in flood-affected areas: a case study of Sehat Kahani

Evaluación del impacto de las unidades móviles de telemedicina en los resultados sanitarios, la resistencia del sistema sanitario y la respuesta ante catástrofes en zonas afectadas por inundaciones: estudio de caso de Sehat Kahani

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Abstract

Introduction: Was explored the deployment of telemedicine services through mobile units in flood emergencies. with a focus on health outcomes, mortality rates, and the resilience of healthcare systems in disaster-affected areas. Sehat Kahani (SK), a healthcare initiative, introduced a two-tier telehealth model combining physical camps, mobile units, and a telehealth app to enhance accessibility and delivery in crisis situations.

Objective: To assess the effectiveness of SK's telemedicine model in improving healthcare outcomes and system resilience during flood emergencies. Also, to identify key factors contributing to the successful integration of telehealth into disaster relief efforts.

Methods: Semi-structured interviews were conducted with key stakeholders, including SK staff, healthcare providers, beneficiaries, funders, and top-level management. Interviews provided insights to implementation process, challenges encountered, and strategies employed to address these challenges. Were identify resource analysis, accessibility, security, scalability, training, evaluation, collaboration, and sustainability.

Results: Findings underscore the significance of comprehensive assessments, budget analysis, and collaboration with government agencies and corporate partners in the implementation of telehealth services. Accessibility concerns were effectively addressed through SK's multi-tiered model, combined mobile clinics with a user-friendly telehealth app. Security, privacy, and confidentiality were maintained by adhering to data protection regulations such as HIPAA. Training programs for healthcare professionals focused on empathy, rapport building, and technical proficiency, ensuring high-quality care delivery. SK's scalability measures and preparedness for increased patient volume facilitated efficient service delivery during disasters.

Conclusions: The case study concludes that SK's comprehensive approach, encompassing key factors, successfully integrates telehealth into disaster relief efforts. This model offers valuable insights for future telehealth initiatives in disaster response scenarios, particularly in developing nations affected by flood emergencies

Resumen

Introducción: Fue explorado el despliegue de servicios de telemedicina con unidades móviles en emergencias por inundaciones. Centrando el impacto en resultados de salud, tasas de mortalidad y capacidad de recuperación de los sistemas de salud en las zonas afectadas por desastres. Sehat Kahani (SK) introdujo un modelo de telesalud de dos niveles, combina campamentos físicos, unidades móviles y una aplicación de telesalud.

Objetivo: Evaluar la eficacia del modelo de telemedicina de SK para mejorar los resultados de la atención sanitaria y la resistencia del sistema durante las emergencias por inundaciones. También pretendió identificar factores clave que contribuyen al éxito de la integración de la telesalud en las labores de socorro en caso de catástrofe.

Métodos: Se realizaron entrevistas semiestructuradas con las principales partes interesadas, como el personal de SK, proveedores de atención sanitaria, beneficiarios, financiadores y directivos. Las entrevistas permitieron comprender el proceso de implementación, dificultades encontradas y estrategias empleadas para superarlas. Se hizo un análisis para identificar manejo de recursos, accesibilidad, seguridad, escalabilidad, formación, evaluación, colaboración y sostenibilidad.

Resultados: Se subraya la importancia de evaluaciones exhaustivas, el análisis presupuestario y la colaboración con organismos públicos y socios empresariales para implantar con éxito los servicios de telesalud. Los problemas de accesibilidad se abordaron eficazmente mediante el modelo de varios niveles de SK, que combinó puestos móviles y una aplicación de telesalud. La seguridad, privacidad y confidencialidad se mantuvieron mediante el cumplimiento de normas de protección de datos como la HIPAA. Los programas de formación para profesionales sanitarios se centraron en la empatía, el establecimiento de relaciones y la competencia técnica. Las medidas de escalabilidad de SK y aumento en la atención de pacientes facilitaron la prestación eficiente de servicios durante la catástrofe.

Conclusiones: El enfoque global de SK, que abarca varios factores clave integró con éxito la telesalud en actividades de atención en salud. Este modelo ofrece ideas valiosas para iniciativas de telesalud sobre todo en países en desarrollo afectados por inundaciones

Key study facts

Objective	To evaluate the effectiveness of Sehat Kahani's telemedicine model in enhancing healthcare outcomes and strengthening system resilience during flood emergencies, particularly in developing nations.
Study design	A qualitative case study design was employed to explore the deployment and impact of Sehat Kahani's telehealth services. The study utilized semi-structured interviews to gather in-depth insights into the implementation, challenges, and successes of the telehealth model.
Source of information	Information was obtained from Sehat Kahani
Population / sample	The population for this study included key stakeholders involved in Sehat Kahani's telehealth operations during flood emergencies. The sample consisted of a purposefully selected group of Sehat Kahani healthcare providers, administrative staff, beneficiaries, funders, and top-level management. Participants were chosen based on their direct involvement in or impact from the telehealth services during flood emergencies
Statistic analysis	The study employed thematic analysis to identify patterns and themes emerging from the qualitative data collected through interviews. The analysis focused on aspects such as resource allocation, accessibility, security, scalability, training, evaluation, collaboration, and sustainability
Principle findings	The study's findings highlight the critical role of comprehensive assessments, budget analysis, and collaboration with government and corporate partners in the effective implementation of telehealth services during disasters. The multi-tiered model of Sehat Kahani effectively addressed accessibility issues, ensuring that mobile clinics and a user-friendly telehealth app could reach affected populations. Key areas of success included maintaining security and privacy standards, particularly adherence to HIPAA regulations, and providing effective training for healthcare professionals to ensure empathy, rapport building, and technical proficiency. Additionally, Sehat Kahani's preparedness for scaling up operations during emergencies contributed to the efficient delivery of telehealth services.

Introduction

Telemedicine, provides healthcare services using information and communication technologies, emerges as a vital tool in disaster relief efforts, particularly in resource-constrained settings. In the face of natural disasters like floods, access to traditional healthcare services becomes severely disrupted, exacerbating the vulnerabilities of affected populations. Telemedicine bridges this gap by enabling remote delivery of essential healthcare services, thereby improving health outcomes, reducing mortality rates, and enhancing the resilience of healthcare systems in disaster-affected areas.

Natural disasters pose significant challenges to healthcare delivery, often resulting in infrastructure damage, population displacement, and increased healthcare needs.¹ Traditional healthcare systems struggle to cope with these demands, necessitating innovative solutions. Telemedicine leverages technology to facilitate remote assessment, diagnosis, and treatment, overcoming barriers posed by physical access limitations and infrastructure damage (1,2).

Telemedicine enhances the coordination of relief efforts and enables the provision of timely medical interventions by facilitating real-time communication and collaboration among healthcare teams. It also offers opportunities for e-learning and teleconsultation, empowering local healthcare workers with the necessary knowledge and support to respond effectively to crises.

Case studies from various countries underscore the importance of a comprehensive approach to disaster management, with telemedicine playing a pivotal role. This approach encompasses emergency preparedness, timely communication, efficient resource allocation, community engagement, disease surveillance, and mental health support. Moreover, it emphasizes the need for context-specific strategies, cross-border collaboration, and environmental considerations to address the diverse challenges of flood disasters.

Considering increasing climate variability and the growing frequency and intensity of floods, climate change adaptation becomes imperative for resilient healthcare systems. Telemedicine, supported by adequate training and capacity-building initiatives, holds promise in delivering specialized healthcare services to underserved areas, improving healthcare access, reducing costs, and empowering patients in managing their health (3,4).

While telemedicine demonstrates considerable potential in disaster response, addressing infrastructure, training, and capacity-building challenges remains crucial, especially in rural and remote areas of developing countries.^{4,5} This case study, drawn from Sehat Kahani's records and relevant health databases,, aims to investigate the effectiveness and efficiency of telemedicine mobile units in flood emergencies, focusing on health outcomes, mortality rates, cost-effectiveness, and collaboration opportunities. By examining experiences and lessons learned, this research seeks to inform future disaster response strategies and policies, ultimately contributing to improved healthcare resilience in disaster-affected regions (3,5).

Materials and methods

Research design

This study focuses on disaster-affected areas in Pakistan where Sehat Kahani deployed telemedicine services through mobile units during flood emergencies, selecting locations significantly impacted by health and infrastructure disruption. Data collection involves semi-structured interviews with key stakeholders, including

- Sehat Kahani staff members engaged in setting up and operating telemedicine mobile units.
- Healthcare providers who participated in delivering services via mobile units during flood emergencies.

- Emergency management authorities who are responsible for coordinating disaster response efforts.
- Beneficiaries who received healthcare services through telemedicine mobile units.
- Funders and donors who provided support for the implementation of telemedicine services.
- Sehat Kahani's co-founder and CEO, to gather insights into strategic decisions and perspectives.

The source population consists of Sehat Kahani staff, healthcare providers, and emergency management authorities involved in providing flood relief, as well as flood-affected individuals who benefited from telemedicine services and the funders who supported the flood relief efforts. The inclusion criteria for participants require that they be individuals impacted by the flood in Pakistan and assisted by Sehat Kahani, with participants being vetted by Sehat Kahani staff before selection for interviews.

Additionally, observations of the telemedicine mobile units' operations during flood emergencies were conducted to understand operational challenges and healthcare delivery processes. Relevant documents, reports, and data pertaining to the deployment of telemedicine mobile units were reviewed, including disaster response plans, project reports, and health outcome data. This mixed-methods approach ensures a comprehensive understanding of the impact of telemedicine on health outcomes, mortality rates, and healthcare system resilience in disaster-affected areas.

Data analysis

Data analysis involved two primary methods: thematic analysis and data triangulation. Thematic analysis was conducted by transcribing and analyzing interview data and observations to identify recurring themes and patterns related to the impact of telemedicine mobile units on health outcomes, mortality rates, and healthcare system resilience in disaster-affected areas. To enhance the credibility and reliability of the study's conclusions, data triangulation was employed to compare and cross-validate findings from different data sources, including interviews, observations, and documentation. This comprehensive approach ensured a robust understanding of the study's outcomes.

Ethical considerations

Ethical considerations for this study prioritize the rights and well-being of participants. Informed consent was obtained from all participants before conducting interviews or utilizing their personal information. To protect participants' privacy, confidentiality and anonymity was ensured by using pseudonyms in the final report. Additionally, measures implemented to safeguard the security and privacy of all data collected during the study, ensuring compliance with ethical standards and protecting participant information throughout the research process.

Limitations

The study has limitations that need to be acknowledged. The study's sample size is a potential constraint. The specific nature of disaster events and the availability of key stakeholders might limit the ability to gather a sufficiently large and diverse sample. As a result, the findings may not represent the broader population affected by disasters. This limitation raises concerns about the representativeness of the findings and the ability to draw robust conclusions.

The case selection process and the availability of participants could introduce selection bias. The paper acknowledges that telehealth services might have been more accessible to certain groups, such as those with internet access and technological literacy. This bias may skew the results, potentially overestimating the positive impact of telehealth services during disasters and limiting the applicability of the findings to broader populations.

The study's findings may lack generalizability to other disaster scenarios, regions, or populations with different healthcare infrastructure and socio-economic conditions. Since the study focuses on specific events, the transferability of insights to dissimilar contexts may be limited. This restricts the broader applicability of the research in informing policies and practices for diverse disaster situations.

The research emphasizes the positive impact of telehealth services during disasters, which could introduce reporting bias. By primarily highlighting the benefits, the study may not fully capture the extent of health issues or challenges faced during the disaster. This bias may create an overly optimistic view of telehealth services' effectiveness, overlooking potential drawbacks or limitations that could be crucial for a comprehensive understanding of the subject. A more comprehensive understanding of telehealth services' negative aspects and limitations in disaster situations is crucial for a balanced and nuanced interpretation of the findings.

The limitations related to sample size, selection bias, generalizability, and reporting bias should be considered when interpreting the results of the paper. Addressing these limitations in future research would contribute to a more robust and comprehensive understanding of the role of telehealth services in disaster scenarios.

Results

The devastating flash floods of August 2022 wreaked havoc and submerged a significant portion of Pakistan. This calamity profoundly impacted the two poorest provinces of Balochistan and Sindh, and the lives of 33 million people, including half a million children. The aftermath of this flood was even more dire as it caused extensive damage to vital water systems in the affected regions and led to diseases such as malaria, dengue, E. coli, salmonella infection, scabies, and other skin diseases.

To meet the needs of the affected population, Sehat Kahani established a two-tier model with mobile units in low-income flood-affected areas and a telehealth app. The mobile units allowed

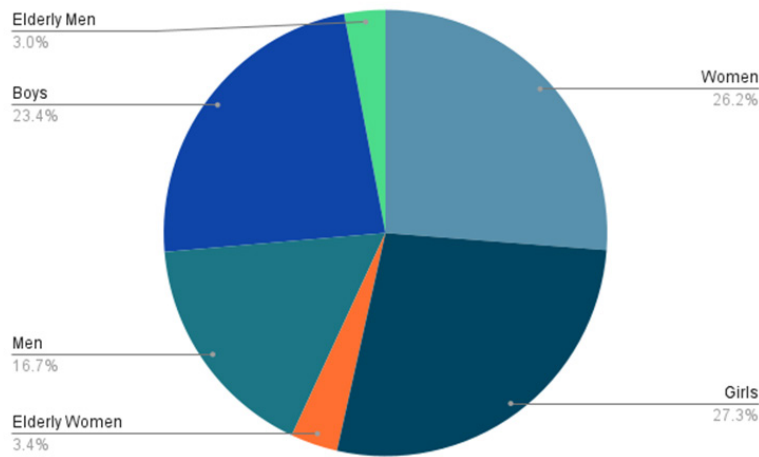


Figure 1. The demographic breakdown of the individuals served by the mobile units

Sehat Kahani to set up medical camps in the areas and offer one-on-one medical assistance to individuals. This was the first step, as limited internet connectivity was an issue. However, a telehealth app was developed, allowing current and new patients to connect with doctors and specialists in minutes. This model significantly benefited the province of Sindh-the mobile units traveled to 12 districts, 26 tehsils, and 86 villages-helping more than 25,000 patients. These patients included 6,600+ women;13,000+ children; and 1,790+ elderly (Figure 1).

Assessing healthcare needs and telehealth services

In disaster relief, understanding the healthcare needs of the affected population forms the cornerstone of effective telehealth implementation. The interviews with Sehat Kahani staff-including Dr. Sara Saeed Khurram, the CEO, and Co-founder; Atif Ali, the Chief Growth Officer; and doctors emphasized the necessity of conducting a comprehensive assessment of the affected regions to identify communities that are challenging to access. Sehat Kahani conducted a comprehensive analysis of available resources, including budget and funds, to strategize the implementation of telehealth services. Collaborating with government agencies is crucial to gain insights into the affected areas. Conversely, collaborating with corporate partners and donors provides us with additional resources; Lifebuoy, a subsidiary of Unilever, equipped us with the necessary medications and care packages to run a mobile clinic. Additionally, Zong, a mobile data network operator in Pakistan provided necessary funding for implementation of a telehealth application which could handle a high volume of users.

Envisioning the role of telehealth in disaster relief

Telehealth has the potential to play a crucial role in disaster relief efforts by bridging the gap between healthcare services and disaster-affected populations. Specifically, telehealth can bring about a range of benefits to these communities. Dr. Khurram shared that offering immediate access to medical consultations enables timely diagnosis and treatment of disaster-related injuries and illnesses. Telehealth also eliminates geographical barriers, ensuring that even remote or isolated areas can receive medical

attention. Dr. Khurram recounts the case of an 11-year-old girl affected by the flood. She and her family walked through flood waters for days. Due to this, her feet had cuts that led to gangrene infection. Once reaching the mobile clinic, doctors treated the young girl by removing the dead tissue and providing antibiotics.

Telehealth facilitates communication between healthcare professionals, allowing specialists to guide on-ground medical teams, as illustrated in the case of a young boy affected by the flood waters who developed a skin rash all over his body. At the mobile clinics, the doctors connected with a dermatologist through telehealth. The dermatologist identified the rash and prescribed the boy with topical ointment.

This innovative technology minimizes the need for patients to travel to overcrowded medical facilities, reducing the risk of disease transmission and eliminating barriers to healthcare for many rural and economically disadvantaged patients, who must take time off work and travel a significant distance to receive care. Dr. Khurram shares that “Telehealth services can be adapted to address specific disaster-related health challenges, such as outbreaks of infectious diseases, ensuring a targeted response.” Ultimately, telehealth contributes to the overall effectiveness of disaster relief operations, promoting efficient and well-coordinated healthcare delivery to affected populations.

The interviews offered a better understanding of the implementation process, the challenges encountered, and the strategies employed to overcome them. The analysis also identified critical issues related to resource allocation, accessibility, security, scalability, personnel training, evaluation, inter-organizational collaboration, and the sustainability of telemedicine services. These findings were instrumental in understanding the factors that influenced the success of telehealth interventions in disaster relief efforts. By addressing these challenges and employing a combination of on-ground medical expertise and telehealth technology, the interventions were able to provide timely, effective, and sustainable care in disaster-affected regions.

Addressing accessibility concerns in telehealth services

Sehat Kahani's experience reveals a multi-tiered model that addresses accessibility concerns for vulnerable populations lacking technology or internet connectivity. Sehat Kahani first implemented the physical camps and then a two-tier telehealth model: The physical camps provided medical camps in the areas and offered one-on-one medical assistance, while the mobile unit consisted of a van that traveled across the affected areas, providing awareness and understanding of telehealth, and enhancing patient access, outcomes and experiences, and a telehealth app, a "One Window" application allowed current and new patients to connect with doctors and specialists in minutes. The combined efforts ensure that those without internet access can still receive medical attention.

Patients could download the "One Window" application to establish a direct link with healthcare providers. This innovative approach streamlined access to medical assistance and ensured that services were tailored precisely to the identified needs. Furthermore, the interviewees stressed the importance of collaborative efforts involving healthcare providers, telehealth specialists, and on-site relief teams. Such collaboration fosters a cohesive environment, ensuring the seamless integration of telehealth solutions and alignment with the healthcare requirements of disaster-affected communities.

In disaster scenarios where internet connectivity might be disrupted, physical forms can be employed to maintain medical care continuity. Partnering with tele companies like Zong facilitated internet connectivity in remote areas during disaster relief efforts. Addressing accessibility requires blending physical presence and online options and leveraging local community networks.

The internet connectivity offered by the telehealth model is significant, as shared by one interviewee, "I had a very bad cough and fever for two months and was getting concerned about it. I'm busy with work, so I didn't get time to visit a doctor. I tried out the Sehat Kahani app after a friend recommended it. The doctor I got connected with, and she pointed out that I might have tuberculosis. She told me to complete some tests and asked me to visit the clinic with the results. I used the booking feature on the app to schedule an appointment and show her the results. Lo and behold, it was Tuberculosis."

Addressing internet connectivity challenges

The interviewees highlighted a significant challenge posed by limited internet access in disaster-stricken areas. While technological solutions, such as the proposed application, play a vital role, the interviewees stressed that physical presence remains indispensable. The ability of 4G or 5G technology to extend connectivity is acknowledged, but boots-on-the-ground interventions were deemed essential to bridge connectivity gaps comprehensively. The strategy proposed included forging partnerships with internet providers and leveraging existing infrastructure to establish robust and reliable connectivity networks. This holistic approach guarantees that the benefits of telehealth are accessible to even those residing in areas with inconsistent internet connectivity, thereby leaving no one behind.

Establishing key partnerships for telehealth implementation

Strategic partnerships and collaborations underpin Sehat Kahani's success in disaster relief efforts. These collaborations extended beyond healthcare professionals to corporate partners, donors, and government agencies. Key partners like Unilever and Zong played crucial roles by providing funding, resources, and internet connectivity. Collaborating with government entities allowed for comprehensive assessments and prioritization of efforts. This approach diversified available resources and contributed to the overall success of implementing telehealth services in disaster-stricken areas.

Security, privacy, and confidentiality

The Sehat Kahani staff emphasized that safeguarding patient information in telehealth is non-negotiable. Security, privacy, and confidentiality were paramount concerns in handling healthcare data, particularly during disaster relief efforts. The interviewees underscored the necessity of adhering to stringent data protection regulations like HIPAA to ensure patient information is transmitted and stored securely. However, implementing patient care in mobile health clinics sometimes does not allow for privacy. To mitigate this situation, Sehat Kahani utilized spatial separation and partitioned areas by placing two doctors under a tent ten feet apart, with a curtain between them, allowing doctor-patient privacy. This approach ensured data security and respect for privacy for individuals seeking medical assistance through the medical clinics. By prioritizing these aspects, the integrity and trustworthiness of telehealth services in disaster relief efforts are upheld, paving the way for their effective implementation.

Sehat Kahani's approach to maintaining security and privacy during telehealth services is notable. While challenges arise in ensuring complete confidentiality in online consultations, the organization addressed this by maintaining physical separation and privacy in medical camps.

Managing surge in patient volume during disasters

Sehat Kahani's strategic planning and scalability measures allowed them to effectively manage an increase in patient volume during disasters. Their telehealth platform was designed with the capacity to handle a surge in patient requests. This highlights the importance of anticipating and preparing for increased demand, ensuring the technology can handle the load and maintain seamless service delivery.

Effective training for healthcare professionals

Sehat Kahani's approach to training healthcare professionals for telehealth services focuses on tailored training that addresses disaster scenarios. They provided online training programs for healthcare providers emphasizing empathy, rapport, and technical proficiency, contributing to effective patient care while preserving privacy. Dr. Khurum explained that Sehat Kahani had a constant stream of doctors trained every 15 days. By continuously training and updating healthcare professionals, they ensured the readiness of their teams to utilize telehealth technologies effectively in disaster situations.

Metrics for evaluating telehealth services in disaster relief

Sehat Kahani's approach to evaluating the success and impact of telehealth services during disaster relief operations was metrics driven. They utilized response time, patient consultations, medications provided and reach affected populations as indicators of effectiveness and efficiency. This data-driven evaluation allows for a comprehensive understanding of the impact of telehealth interventions in disaster scenarios.

Facilitating collaboration and information sharing

Sehat Kahani's strategy of establishing communication groups with partners through platforms like WhatsApp and sharing standardized information and media allowed for effective collaboration and information sharing. This streamlined approach ensures that all stakeholders are informed and aligned, facilitating better coordination and a cohesive response.

Discussion

Telehealth in developing countries, including Sehat Kahani's telehealth model, plays a critical role in addressing healthcare disparities and improving access to quality medical services. In these contexts, factors like socioeconomic disparities, political instability, and inadequate funding exacerbate traditional barriers such as geographical remoteness, limited healthcare infrastructure, and shortages of trained medical personnel.^{1,4,5} Telehealth is a promising solution to overcome these challenges and extend healthcare services to underserved populations.

Sehat Kahani's telehealth model, rooted in accessibility, affordability, and inclusivity, aligns closely with the objectives of telehealth initiatives in developing countries. By leveraging technology, Sehat Kahani connects patients in remote and marginalized communities with qualified healthcare providers, offering virtual consultations, diagnostic services, and medical advice. This approach addresses the immediate healthcare needs of these populations and contributes to long-term improvements in health outcomes and healthcare system resilience.

One key aspect of Sehat Kahani's telehealth model is its focus on community engagement and empowerment. By partnering with local community leaders, NGOs, and government agencies, Sehat Kahani builds trust and fosters collaboration, ensuring that telehealth services are culturally sensitive, contextually relevant, and responsive to the specific needs of each community. This community-centered approach enhances the acceptability and effectiveness of telehealth interventions, leading to greater uptake and sustainability.

Moreover, Sehat Kahani's telehealth model emphasizes capacity building and skill development among local healthcare providers. Through training programs, mentorship initiatives, and knowledge exchange platforms, Sehat Kahani equips healthcare workers with the necessary tools and expertise to deliver telehealth services effectively. This strengthens the local healthcare workforce and enhances the telehealth model's scalability and replicability across different settings and regions.

In addition to improving access to primary care services, Sehat Kahani's telehealth model also addresses the broader determinants of health, including social, economic, and environmental factors. By integrating telehealth with complementary services such as health education, preventive care, and community outreach, Sehat Kahani adopts a comprehensive approach to healthcare delivery, addressing the root causes of health disparities and promoting holistic well-being.

Sehat Kahani's telehealth model's success underscores telehealth's transformative potential in advancing health equity and resilience in developing countries. They demonstrate how telehealth can overcome barriers, expand access, and improve health outcomes for marginalized populations by harnessing technology, innovation, and community partnerships. As telehealth continues to evolve and expand globally, Sehat Kahani's experiences offer valuable insights and lessons for policymakers, practitioners, and stakeholders seeking to leverage telehealth to address healthcare challenges in developing countries.

Conclusion

The case study of Sehat Kahani exemplifies the successful integration of telehealth into disaster relief efforts. The organization's holistic approach to resource analysis, accessibility, security, scalability, training, evaluation, collaboration, and sustainability is a valuable model for future telehealth initiatives in disaster response scenarios. By effectively addressing the distinctive challenges posed by disaster situations, Sehat Kahani showcases how the synergy of technology and healthcare expertise can profoundly impact vulnerable populations during crises.

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