

Evaluating the adoption of a mobile application for quality-of-care assessments in South Sudan using Rogers' innovation diffusion theory

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ABSTRACT

Introduction: The Health Pooled Fund (HPF) in South Sudan introduced the HPF Quality-of-Care (QoC) Application (App) in 2019 to improve healthcare quality monitoring and evaluation. The App allowed direct data entry at health facilities (HFs) and provided cloud storage for remote access and analysis. The App adoption can be understood through Everett Rogers' Innovations Diffusion Theory (IDT), which explains how new ideas and technologies spread through societies. This study evaluated the QoC App adoption in South Sudan, using Rogers' IDT to understand the factors influencing adoption, and identify successes and challenges in low-resource healthcare settings.

Method: This study analysed QoC assessment data from HPF-supported HFs from 2019 to 2021, using descriptive statistics and thematic analysis to identify the trends and factors influencing adoption, based on Rogers' IDT.

Results: The study found that QoC App adoption significantly increased the proportion of HFs assessed from 39% in the first quarter when it was introduced, to 92.2% seven quarters later. The adoption of this innovation aligned with Rogers' IDT.

Conclusion: The successful implementation of the HPF QoCApp demonstrates the practical application of Rogers' IDT in a low-resource healthcare setting. The effective use of this App in South Sudan's healthcare system has demonstrated digital health potential for future public health innovations and technology adoption process.

Key words: quality-of-care, mobile technology, innovation, healthcare, South Sudan

Introduction

The Health Pooled Fund (HPF) in South Sudan introduced a mobile application, HPF Quality-of-Care (QoC) Application (App) in 2019 to address the inefficiencies of its paper-based assessment system.^[1] This innovative digital health solution allowed for direct data entry at health facilities (HFs), with subsequent cloud storage for remote access and analysis.^[2] The transition marked a significant improvement in the monitoring and evaluation of healthcare quality across HPF-supported HFs, enhancing both speed and accuracy of data collection, analysis and reporting.^[2]

Before the App was developed, QoC assessments were paper based, with data entered manually into an Excel sheet afterwards. This method was time-consuming and error-prone, causing delays and inaccuracies in reporting and analysis. The App was designed to streamline this process by allowing direct data entry at the HFs level, thereby enhancing the speed and reliability of data collection.^[2] The development and introduction of the HPF QoC App in 2019 marked a significant advance in the management of QoC data in the HPF programme in South Sudan.^[2] This innovation targeted the healthcare professionals working with the MoH, implementing partners (IPs), and HPF, who were directly involved in the QoC assessments at various HFs.^[1] The primary aim was to address the inefficiencies inherent in the then paper-based assessment system.^[2]

When the App was developed, it was expected to be widely used by all involved. However, adoption of any new technology is a complex, social, and developmental process influenced by personal views, contextual, cognitive, and emotional issues.^[1,3,4]

The adoption of this Mobile Application can be understood through the Rogers' Innovations Diffusion Theory (IDT), which provides a framework to understand how new ideas and technologies spread through societies. The theory explains how an innovation spreads over time in a social system, emphasising factors like perceived attributes, communication channels, time, and the nature of the social system.^[3]

Everett Rogers' IDT explains how new ideas, practices, and products spread within a social system, and defines innovation as a new concept for adoption and diffusion as the process of communication.^[3] Initially, according to this theory, few people accept new concepts, but their efforts eventually create a critical mass, causing the idea to spread and reach saturation. Rogers identified the following five

groups of adopters.^[5]

1. **Innovators:** The first small group to adopt.
2. **Early Adopters:** Socially forward and influential.
3. **Early Majority:** Adopt after seeing benefits.
4. **Late Majority:** Sceptical, adopt after most others.
5. **Laggards:** Resistant to change, last to adopt.

The purpose of this study was to evaluate the adoption of the QoC App introduced in 2019 by the HPF across HFs in South Sudan. The study employed Rogers' IDT to understand the factors influencing the adoption of this technology and to identify the successes and challenges encountered during its implementation in low-resource settings.

Method

This study examined the QoC assessment data extracted from the HPF-supported HFs for the period 2019 to 2021. Descriptive statistics and thematic analysis were used to identify trends and factors influencing adoption, based on Rogers' IDT. Data were obtained from the HPF QoC database and project reports from July 2019 to March 2021. Both quantitative and qualitative analyses were employed to understand the implementation and adoption of the HPF QoC App.

This study did not require ethical approval as it was based on publicly available reports and secondary data from the HPF project, all of which did not include any personal or sensitive information. In addition, this case study complies with ethical guidelines, and informed consent was obtained from the HPF senior management.

Results

As of July 2019, when the utilisation of the QoC App was introduced, the HPF programme was supporting 797 HFs consisting of 25 hospitals, 195 Primary Health Care Centres (PHCCs), and 577 Primary Health Care Units (PHCUs). Quality of care assessments were carried out in these HFs and the assessment data were analysed quarterly.^[2] As presented in Figure 1, the number and proportion of HFs assessed progressively increased from 39% in the first quarter when the App was introduced (July – September 2019), to 92.2% six quarters later (January – March 2021). The App experienced slowdown due to increased data, necessitating the development of a web-based interface for direct web access to the backed-up assessment data.^[2]

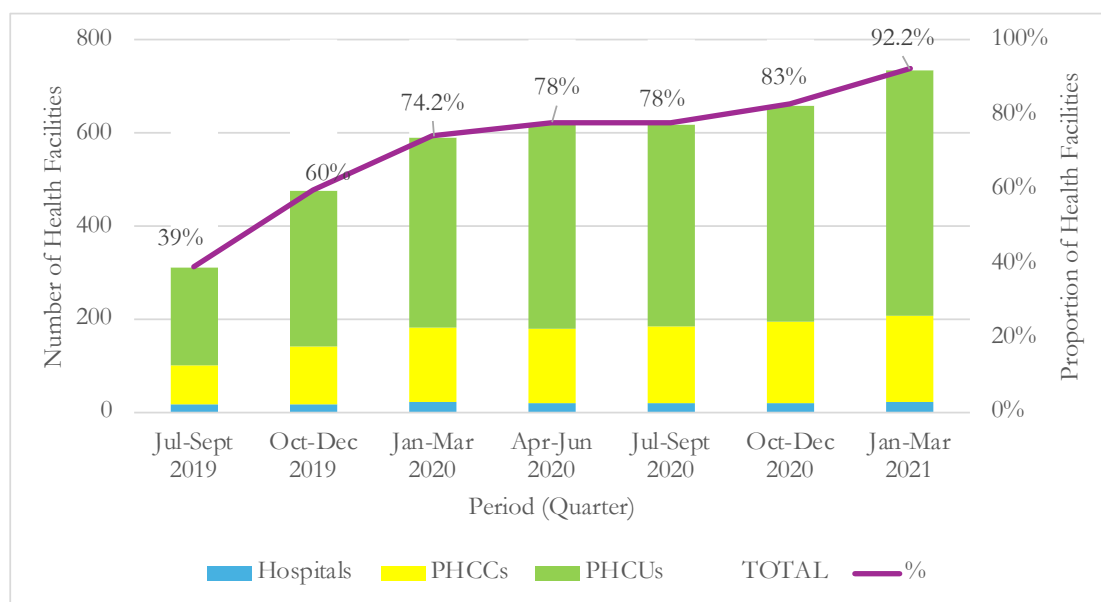


Figure 1. Number and proportion of health facilities assessed

Discussion

The HPF's QoC App improved the QoC assessments' efficiency through direct data entry, cloud storage, and versatility across various healthcare facilities (HFs) in South Sudan, ensuring data security and accessibility for remote analysis (2021b). To ensure seamless adoption, the programme conducted Training of Trainers (ToT) sessions in May and June 2019. These trainers subsequently trained users at the county level, enabling them to commence QoC assessments using the App by July 2019.^[1]

The App was piloted with users who provided valuable feedback, leading to the adjustments in the application and recognizing them as innovators according to the IDT.^[5]

During the introduction quarter, QoC assessments were conducted in 39% of the HPF-supported HFs across South Sudan. The staff who carried out these assessments, according to the IDT, are regarded as the Early Adopters.

Quarterly updates on the performance were provided by the HPF. These quarterly performance updates confirmed users' adoption decisions and demonstrated improvements in efficiency and accuracy.^[1,6] Effective communication, support, and continuous improvement were key for the successful adoption of this new digital health technology.^[1,6] These led to a huge accumulation of data in the database which subsequently slowed down the App and necessitated the development of the QoC web interface.^[2] The web interface improved the App's functionality by enabling

direct access to the QoC server and remote access to QoC assessment data and reports.^[2]

The proportion of HFs assessed using the App reached 78% by the fourth quarter after the introduction, which was maintained in the subsequent quarter, an indication that the level of saturation had been reached. This is attributed to the early majority phase of the IDT.^[5,6]

In 2020, the programme introduced key performance indicators (KPI) in which the IPs would incur a penalty if a certain threshold was not met.^[6] The KPI was a motivator that drove the performance to 92% by the seventh quarter after the App's introduction. Penalties compelled the cost-conscious Late Majority to use the platform in order to avoid the fines.^[5]

The Laggards are the staff who joined after the App was implemented or were assigned late by their organisations to use the QoC App as the paper-based tool was obsolete, yet they had to meet their KPIs.

Other theories that may explain the adoption of the HPF QoC App include the Technology Acceptance Model (TAM) and the Uses and Gratification Theory (UGT). According to Davis (1989), TAM has three key concepts: behavioural intention, perceived usefulness, and perceived ease of use. Behavioural intention is the motivation to use a technology. Perceived usefulness impacts a person's willingness to accept the technology, while perceived ease of use refers to the simplicity of using the technology.

Social influence, external factors like peer opinions, and individual differences like age and gender can also significantly influence an individual's perception of a technology.^[7] On the other hand, UGT emphasises that people seek out what they hope will get them some benefit.^[8] It can be used to explain human behaviour, preferences, and decision-making based on the gratification which they are seeking.^[8]

This study demonstrates the successful introduction of the HPF QoC App in South Sudan, which improved QoC assessments, and the application of Rogers' IDT. The limitations from previous studies included a small sample size, which restricts generalisability of the findings, the use of a cross-sectional design that does not allow for examination of changes over time. Additionally, the studies relied on self-reported data, which could lead to biases, and their foci were limited to the TAM and IDT frameworks.^[9] This study also has limitations due to its dependence on self-reported data and its narrow focus, as evaluations were conducted solely by users in the HPF-supported HFs.

Future research should investigate its long-term impact on healthcare quality, compare it with similar applications, explore user experience and satisfaction, conduct a cost-benefit analysis, and examine its integration with other health systems.

Discussion

The HPF QoC App's ability to collect, store, and analyse quality-of-care assessment data has proven invaluable, highlighting its potential for wider application beyond HPF-supported HFs, potentially at a national level by the Ministry of Health in South Sudan. Its introduction successfully aligns with Rogers' Innovation Diffusion Theory (IDT). Initially, a small number of staff members adopted the App, but its use gradually increased, eventually reaching widespread saturation. Early engagement with end-users and performance-based incentives were critical in promoting adoption and integrating the App into routine activities. Furthermore, other adoption theories such as TAM and UGT, provided additional insights into user behaviour and technology integration.

This study emphasises the importance of implementing innovations in healthcare settings using the innovation diffusion model, addressing user needs and systemic requirements, to ensure successful implementation and initial acceptance.

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Conflict of interest: JOY and JAD participated in quality care assessments and initiatives before the study. However, the authors believe there is no significant conflict, as this paper was written after the programme ended. The authors declare no competing interests.

Authors' contributions

JOY conceptualized the study, developed the concept note, conducted a comprehensive literature review, analysed the data, and wrote the first draft of the manuscript. VAO and JO meticulously reviewed the work and ensured that the innovation diffusion theory was correctly applied throughout the study. JAD played a crucial role in capturing the unique South Sudan context within the article. GWL provided overall quality assurance, ensuring that the manuscript was of high quality and publishable. Each author reviewed the manuscript, offering critical revisions and valuable content. All authors read and approved the final version of the manuscript.

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