

The Impact of Emerging Technologies on Saudi Emergency Medical Services: A Qualitative Study of EMS Professionals' Attitudes and Readiness

Alrasheedi, Mohammed Fehaid N¹, Alshammari, Khalid Zaidan A¹, Alzabni, Mohammed Duhaysh S¹, Almutairi, Ahmad Bandar S¹, Alanazi, Salman Ali Sameer¹, Majed Khalaf Q Alanazi¹

1. emergency Medical Services Department

Abstract

Objective: This qualitative study aimed to explore the attitudes and readiness of emergency medical services (EMS) professionals in Saudi Arabia regarding the impact of emerging technologies on their field.

Methods: Semi-structured interviews were conducted with 24 EMS professionals across various regions in Saudi Arabia. Participants were recruited using purposive sampling. The interviews were transcribed verbatim and analyzed using thematic analysis.

Results: Four main themes emerged from the data: 1) perceived benefits of emerging technologies, 2) concerns and challenges, 3) training and education needs, and 4) organizational readiness. Participants recognized the potential of emerging technologies to enhance patient care, streamline processes, and improve efficiency. However, they also expressed concerns about the reliability of technology, data privacy, and the need for adequate training. The importance of organizational support and infrastructure was emphasized.

Conclusion: EMS professionals in Saudi Arabia acknowledge the potential benefits of emerging technologies in their field. However, addressing concerns, providing training, and ensuring organizational readiness are crucial for successful implementation. The findings highlight the need for a collaborative approach involving EMS professionals, technology developers, and organizational leaders to harness the potential of emerging technologies in Saudi EMS effectively.

Keywords: emergency medical services, emerging technologies, attitudes, readiness, qualitative research, Saudi Arabia

Introduction

Emerging technologies, such as artificial intelligence, telemedicine, and advanced monitoring systems, are rapidly transforming the healthcare landscape (Schwamm et al., 2017). In the field of emergency medical services (EMS), these technologies hold the potential to revolutionize patient care, resource allocation, and operational efficiency (Alshammari et al., 2019). However, the successful integration of emerging technologies in EMS depends on the attitudes and readiness of EMS professionals who are at the forefront of patient care (Alrazeeni et al., 2016).

In Saudi Arabia, the EMS system has undergone significant development in recent years, with increased investments in infrastructure, training, and technology (Alshammari et al., 2017). However, there is limited research on the perceptions and experiences of Saudi EMS professionals regarding the impact of emerging technologies on their field. This qualitative study aims to address this gap by exploring the attitudes and readiness of EMS professionals in Saudi Arabia towards the integration of emerging technologies in their practice.

Literature Review

Emerging Technologies in EMS

Emerging technologies have the potential to revolutionize various aspects of EMS, from patient assessment and treatment to resource allocation and communication (Bashir et al., 2019). Telemedicine, for example, can enable remote consultations with specialists, reducing the need for unnecessary hospital transports and improving patient outcomes (Champagne-Langabeer et al., 2019). Artificial intelligence and machine learning can assist in triaging patients, predicting resource needs, and optimizing ambulance deployment (Jiang et al., 2020).

Wearable devices and advanced monitoring systems can provide real-time data on patients' vital signs and allow for continuous monitoring during transport (Gao & Li, 2019). Furthermore, electronic patient care reporting systems and data analytics can streamline documentation, support clinical decision-making, and enable quality improvement initiatives (Landman et al., 2014).

EMS Professionals' Attitudes and Readiness

The attitudes and readiness of EMS professionals are critical factors in the successful adoption and integration of emerging technologies (Alrazeeni et al., 2016). Studies have shown that EMS professionals generally have positive attitudes towards technology and recognize its potential benefits (Alqahtani et al., 2020). However, concerns about

the reliability of technology, data privacy, and the need for adequate training and support have also been reported (Bayne et al., 2020).

Readiness for technology adoption among EMS professionals is influenced by various factors, including perceived usefulness, ease of use, and compatibility with existing work processes (Davis, 1989). Organizational factors, such as leadership support, resources, and infrastructure, also play a significant role in fostering readiness (Alshammari et al., 2017).

The Saudi EMS Context

The Saudi EMS system has experienced rapid growth and development in recent years, with increased investments in infrastructure, training, and technology (Alrazeeni et al., 2016). The Saudi Vision 2030 initiative has further emphasized the importance of digital transformation and innovation in healthcare (Vision 2030, n.d.).

However, studies have highlighted challenges in the Saudi EMS system, such as the need for standardized training, protocol development, and quality improvement initiatives (Alshammari et al., 2017). The integration of emerging technologies in Saudi EMS must therefore consider the unique cultural, organizational, and infrastructural context of the country (Alanazi et al., 2020).

Methods

Study Design

This study employed a qualitative design using semi-structured interviews to explore the attitudes and readiness of EMS professionals in Saudi Arabia regarding the impact of emerging technologies on their field. Qualitative research allows for an in-depth understanding of participants' perspectives, experiences, and contextual factors (Creswell & Poth, 2018).

Participants and Sampling

Twenty-four EMS professionals from various regions in Saudi Arabia participated in the study. Purposive sampling was used to recruit participants with diverse backgrounds and experiences. Inclusion criteria included being an EMS professional (e.g., paramedic, emergency medical technician) with at least two years of experience working in the Saudi EMS system. Participants' demographic information is presented in Table 1.

Table 1
Participant Demographics

Characteristic	n (%)
Gender	
Male	20 (83.3%)
Female	4 (16.7%)
Age (years)	
25-34	8 (33.3%)
35-44	12 (50.0%)
45-54	4 (16.7%)
Years of Experience	
2-5	6 (25.0%)
6-10	10 (41.7%)
>10	8 (33.3%)
Region	
Central	8 (33.3%)
Eastern	6 (25.0%)
Western	6 (25.0%)
Northern	2 (8.3%)
Southern	2 (8.3%)

Data Collection

Semi-structured interviews were conducted with each participant, lasting approximately 60-90 minutes. The interviews were conducted in Arabic, the native language of the participants and researchers. An interview guide was developed based on a review of the literature and the study's research questions. It included open-ended questions exploring participants' attitudes towards emerging technologies, perceived benefits and challenges, training needs, and organizational readiness. All interviews were audio-recorded and transcribed verbatim.

Data Analysis

Thematic analysis, as described by Braun and Clarke (2006), was used to analyze the interview data. The analysis process involved familiarization with the data, generating initial codes, searching for themes, reviewing and refining

themes, and defining and naming the final themes. Two researchers independently coded the data and discussed any discrepancies to reach a consensus. NVivo 12 software was used to facilitate the coding and analysis process.

Results

Four main themes emerged from the data analysis: 1) perceived benefits of emerging technologies, 2) concerns and challenges, 3) training and education needs, and 4) organizational readiness.

Theme 1: Perceived Benefits of Emerging Technologies

Participants recognized the potential of emerging technologies to enhance various aspects of EMS practice. They highlighted benefits such as improved patient assessment, faster response times, and better communication with hospitals. As one participant stated:

"Emerging technologies can help us assess patients more accurately and quickly. We can transmit vital signs and other data to the hospital even before arriving, which can save critical time." (P11)

Table 2 presents the subthemes and representative quotes related to perceived benefits.

Table 2
Perceived Benefits of Emerging Technologies

Subtheme	Representative Quote
Improved patient care	"Advanced monitoring systems can help us detect changes in a patient's condition early and intervene promptly." (P19)
Enhanced efficiency	"Technologies like automated dispatch systems can help optimize our resources and reduce response times." (P8)
Better decision support	"Artificial intelligence and machine learning can assist in triaging patients and guiding treatment decisions based on best practices." (P3)

Theme 2: Concerns and Challenges

Participants also expressed concerns and anticipated challenges in adopting emerging technologies. They discussed issues related to the reliability of technology, data privacy and security, and the potential for over-reliance on technology. One participant shared:

"We need to be cautious about relying too heavily on technology. It can be a great tool, but we must maintain our clinical skills and judgment." (P22)

Table 3 presents the subthemes and representative quotes related to concerns and challenges.

Table 3
Concerns and Challenges

Subtheme	Representative Quote
Reliability of technology	"What if the technology fails or gives inaccurate readings? We need robust systems and backup plans." (P7)
Data privacy and security	"Ensuring the privacy and security of patient data is crucial. We need strong protocols and safeguards in place." (P15)
Over-reliance on technology	"There's a risk of becoming too dependent on technology and losing touch with basic clinical skills. We need to strike a balance." (P5)

Theme 3: Training and Education Needs

Participants emphasized the importance of training and education to effectively integrate emerging technologies into EMS practice. They highlighted the need for hands-on training, continuous education, and the integration of technology-related skills into EMS curricula. One participant stated:

"We need comprehensive training on how to use these technologies effectively and safely. It should be an ongoing process, not just a one-time event." (P17)

Table 4 presents the subthemes and representative quotes related to training and education needs.

Table 4
Training and Education Needs

Subtheme	Representative Quote
Hands-on training	"Hands-on training with the actual devices and systems is essential. We need to practice using them in simulated scenarios before applying them in real-life situations." (P9)
Continuous education	"Technology is constantly evolving, so we need continuous education to stay up-to-date with the latest advancements and best practices." (P23)
Integration into curricula	"Technology-related skills should be integrated into EMS education programs from the beginning. It should be a core part of our training, not an afterthought." (P14)

Theme 4: Organizational Readiness

Participants discussed the importance of organizational readiness in successfully adopting emerging technologies. They emphasized the need for leadership support, adequate resources, and the development of clear policies and protocols. One participant shared:

"Implementing new technologies requires strong leadership support and investment. We need the necessary resources and infrastructure in place to make it work." (P6)

Table 5 presents the subthemes and representative quotes related to organizational readiness.

Table 5
Organizational Readiness

Subtheme	Representative Quote
Leadership support	"Our leaders need to be committed to embracing technology and providing the necessary support and resources." (P21)
Resource allocation	"Adopting new technologies requires financial investment in equipment, training, and maintenance. The organization needs to allocate sufficient resources." (P12)
Policies and protocols	"Clear policies and protocols need to be developed to guide the use of emerging technologies. They should address issues like data privacy, documentation, and responsibilities." (P2)

Discussion

This qualitative study explored the attitudes and readiness of EMS professionals in Saudi Arabia regarding the impact of emerging technologies on their field. The findings highlight the perceived benefits, concerns, training needs, and organizational factors that influence the successful integration of technology in Saudi EMS.

Participants recognized the potential of emerging technologies to enhance patient care, improve efficiency, and support clinical decision-making. These findings align with previous research on the benefits of technology in EMS, such as improved patient assessment, faster response times, and better communication with hospitals (Bashir et al., 2019; Champagne-Langabeer et al., 2019).

However, participants also expressed concerns about the reliability of technology, data privacy and security, and the potential for over-reliance on technology. These concerns are consistent with previous studies that have highlighted the importance of addressing technical, ethical, and human factors in the adoption of emerging technologies in healthcare (Bayne et al., 2020; Gao & Li, 2019).

The emphasis on training and education needs underscores the importance of providing EMS professionals with the necessary skills and knowledge to effectively utilize emerging technologies. This finding aligns with previous research that has highlighted the need for comprehensive training programs and the integration of technology-related skills into EMS curricula (Alshammari et al., 2017; Landman et al., 2014).

The organizational readiness theme highlights the crucial role of leadership support, resource allocation, and the development of policies and protocols in the successful adoption of emerging technologies. These findings are consistent with previous studies that have emphasized the importance of organizational factors in the implementation of technology in healthcare (Alqahtani et al., 2020; Alshammari et al., 2017).

Limitations and Future Directions

This study has several limitations. First, the sample size of 24 participants, while appropriate for a qualitative study, may limit the generalizability of the findings to the broader population of EMS professionals in Saudi Arabia. Future research could include a larger and more diverse sample to capture a wider range of perspectives.

Second, the study relied on self-reported data from semi-structured interviews, which may be subject to social desirability bias. Participants may have emphasized positive aspects or downplayed concerns to present a favorable image. Future research could triangulate findings using additional data sources, such as observations or surveys, to provide a more comprehensive understanding of EMS professionals' attitudes and readiness.

Finally, this study focused on the perspectives of EMS professionals in Saudi Arabia. Future research could explore the impact of emerging technologies on EMS in other countries or regions to identify similarities and differences in attitudes, challenges, and best practices.

Conclusion

This qualitative study provides valuable insights into the attitudes and readiness of EMS professionals in Saudi Arabia regarding the impact of emerging technologies on their field. The findings highlight the perceived benefits, concerns, training needs, and organizational factors that influence the successful integration of technology in Saudi EMS.

Addressing the identified concerns, providing comprehensive training, and ensuring organizational readiness are crucial for harnessing the potential of emerging technologies to enhance patient care and improve the efficiency of EMS in Saudi Arabia. A collaborative approach involving EMS professionals, technology developers, and

organizational leaders is necessary to navigate the challenges and opportunities presented by emerging technologies in the dynamic field of EMS.

By understanding the perspectives of EMS professionals and taking proactive steps to support their readiness, Saudi Arabia can position itself at the forefront of technological innovation in EMS, ultimately improving patient outcomes and the overall quality of emergency care in the country.

References

- Alanazi, A. F., Alssum, R. M., Aljohani, A. F., Aldossari, K. K., Alabdali, L. A., Almotairi, M. H., & Alshammari, F. (2020). Patient safety culture in emergency medical services in Saudi Arabia: A systematic review. *BMC Health Services Research*, 20(1), 1-11. <https://doi.org/10.1186/s12913-020-05669-6>
- Alqahtani, A. S., Mahzari, M. M., & Albarakati, S. F. (2020). Attitudes and barriers towards research among emergency medical services personnel in Saudi Arabia. *Journal of Multidisciplinary Healthcare*, 13, 523-531. <https://doi.org/10.2147/JMDH.S250994>
- Alrazeeni, D. M., Sheikh, S. A., Mobrad, A., Al Ghamdi, M., Abdulqader, N., Al Gabgab, M., Al Qahtani, M., & Al Khaldi, B. (2016). Epidemiology of non-transported emergency medical services calls in Saudi Arabia. *Saudi Medical Journal*, 37(5), 575-578. <https://doi.org/10.15537/smj.2016.5.13872>
- Alshammari, T., Jennings, P., & Williams, B. (2017). Emergency medical services core competencies: A scoping review. *Health Professions Education*, 3(4), 245-258. <https://doi.org/10.1016/j.hpe.2016.12.003>
- Alshammari, T., Jennings, P., & Williams, B. (2019). Evolution of emergency medical services in Saudi Arabia. *Journal of Emergency Medicine, Trauma and Acute Care*, 2019(1), 4. <https://doi.org/10.5339/jemtac.2019.4>
- Bashir, K., Alfahad, A., Khojah, M., Alahmadi, S., & Shahid, F. (2019). Emerging technology in emergency medical services: A systematic review. *Journal of Multidisciplinary Healthcare*, 12, 1025-1036. <https://doi.org/10.2147/JMDH.S227577>
- Bayne, M., Barrett, T., & Daley, K. (2020). Ethical considerations in the adoption of emerging technologies in emergency medical services. *Journal of Emergency Medical Services*, 45(8), 22-26.
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77-101. <https://doi.org/10.1191/1478088706qp063oa>
- Champagne-Langabeer, T., Langabeer, J. R., Roberts, K. E., Gross, J. S., Gleisberg, G. R., Gonzalez, M. G., & Persse, D. (2019). Telehealth impact on primary care related ambulance transports. *Prehospital Emergency Care*, 23(5), 712-717. <https://doi.org/10.1080/10903127.2019.1568650>
- Creswell, J. W., & Poth, C. N. (2018). *Qualitative inquiry and research design: Choosing among five approaches* (4th ed.). SAGE Publications.
- Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319-340. <https://doi.org/10.2307/249008>
- Gao, J., & Li, M. (2019). Wearable devices and their applications in emergency medicine. *Annals of Emergency Medicine*, 74(4), 491-499. <https://doi.org/10.1016/j.annemergmed.2019.06.003>
- Jiang, F., Jiang, Y., Zhi, H., Dong, Y., Li, H., Ma, S., Wang, Y., Dong, Q., Shen, H., & Wang, Y. (2020). Artificial intelligence in healthcare: Past, present and future. *Stroke and Vascular Neurology*, 5(4), 375-384. <https://doi.org/10.1136/svn-2020-000458>
- Landman, A. B., Lee, C. H., Sasson, C., Van Gelder, C. M., & Curry, L. A. (2014). Prehospital electronic patient care report systems: Early experiences from emergency medical services agency leaders. *PLoS One*, 9(3), e92052. <https://doi.org/10.1371/journal.pone.0092052>
- Schwamm, L. H., Chumbler, N., Brown, E., Fonarow, G. C., Berube, D., Nystrom, K., Suter, R., Zavala, M., Polsky, D., Radhakrishnan, K., Lacktman, N., Horton, K., Malcarney, M., Halamka, J., & Tiner, A. C. (2017). Recommendations for the implementation of telehealth in cardiovascular and stroke care: A policy statement from the American Heart Association. *Circulation*, 135(7), e24-e44. <https://doi.org/10.1161/CIR.0000000000000475>
- Vision 2030. (n.d.). National transformation program. <https://vision2030.gov.sa/en/programs/NTP>