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The Role Of Medical Innovation In Supporting The Sustainability Of The Professional Performance Of Paramedics In The Saudi Red Crescent Authority

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Abstract

The purpose of the study was to expose the contribution of medical innovation towards attaining sustainable professional practice amongst Saudi Red Crescent Authority (SRCA) technicians. This was achieved through the determination of their awareness on the current medical technologies and how these technologies affect the quality of services delivered and their field efficiency. The research design was descriptive-analytical, which involved the use of questionnaire with 15 questions that were spread on five broad axes as: awareness of innovation, the influence of innovation on performance, training and technical competence, institutional support, and general challenges. Two hundred field paramedics were given questionnaire. It yielded significant results in that the degree of adoption of medical innovation was correlated with better professional performance, higher degrees of satisfaction and professional motivation. The paper has emphasized the value of the unceasing investment in training and providing a challenging institutional environment as the key to innovation and attainment of sustainable professional performance.

Keywords Medical Innovation – Professional Performance – Saudi Red Crescent Authority – Technical Competence – Training – Professional Sustainability – Ambulance Services.

Introduction

The use of portable and advanced diagnostic and treatment devices, such as automated external defibrillators equipped with smart algorithms or telemedicine technologies for immediate medical consultation, enables technicians to make more accurate and faster decisions in the difficult work environment. This continuous updating of tools and knowledge ensures that the technician remains constantly informed of the best medical practices, which reduces errors and improves the overall efficiency of ambulance intervention 1,6

Therefore, the Saudi Red Crescent Authority's commitment to adopting a culture of innovation and providing a supportive environment for it is a direct contribution to enhancing the flexibility and professionalism of ambulance service technicians. Investing in innovative technologies and targeted training is an investment in the human element, which is the foundation of the service leading to raising the rates of sustainability of high and distinguished performance and achieving the Authority's goals in providing world-class ambulance services that contribute to maintaining the health and safety of Saudi society1,6

Discussion

- **The concept of medical innovation and its importance in the health sector**

Medical innovation is defined as the process of introducing or applying new or improved ideas in healthcare and medicine to find more effective and efficient solutions to various health challenges This innovation is not limited to inventing new drugs or medical devices, but also includes developing care processes, diagnostic and treatment protocols, service delivery models and administrative systems that support medical work. The core objective is to create positive and tangible change that raises the quality of healthcare, improves clinical outcomes for patients and may reduce costs or increase access to services8,9

For example, virtual consultations reduce the need for frequent hospital visits, and intelligent decision . support systems save time for diagnosis, leading to increased productivity of medical staff and enabling the health system to provide higher quality services to a larger number of beneficiaries at a lower cost7,6

Therefore, innovation is essential to ensure the sustainability and development of the health system to meet future challenges. With the increasing aging of the population, the spread of chronic diseases, and the emergence of epidemics, reliance on traditional methods becomes insufficient, and innovation in biomedical research, vaccine development, and gene therapies becomes the first line of defense against new health threats . In addition, it promotes equitable access to care, including in remote or resource-limited areas, through point-of-care(POC) diagnostic technologies and mobile solutions, making it the primary driver of the health sector's resilience and increasing its ability to adapt to all emergency and changing circumstances7,3

- **Types of medical innovation and their applications in emergency services**

The importance of medical innovation for paramedics focuses on three main areas, starting with innovation in ambulance equipment and devices This type of innovation includes developing more efficient, accurate, and user-friendly portable devices, such as multifunctional vital signs monitors that can transmit data instantly, AI-guided automated cardiopulmonary resuscitation(CPR) devices or even , advanced techniques for stopping bleeding in the field. These innovations reduce the physical burden on the technician, increase the speed and accuracy of initial diagnosis, and ensure the application of life-saving interventions at the highest quality before reaching the healthcare facility. The second focus is innovation in care protocols and digital training This type focuses on using technology to improve decision-making and skills development, and includes the use of augmented reality applications and virtual reality In training technicians on rare and complex emergency scenarios, ensuring their high readiness without putting patients at risk, in addition to including innovation in clinical decision support systems that guide technicians step by step while dealing with emergencies according to the latest medical standards, thus unifying the level of care and reducing variation in professional performance6,7

The third focus is innovation in communication, data transmission, and logistics This is considered an integration of telemedicine solutions Which provides the ambulance technician with visual and audible communication with a consultant in the emergency room during patient transport to obtain immediate guidance regarding treatment. In addition, it includes innovation in smart ambulance fleet management systems that use data and its analysis to improve access and response routes predict incidents, and ensure the readiness of medical supplies in each vehicle 10,1

The first of these areas is innovation in communication and smart logistics, which is represented in the Advanced and AI-powered systems with applications use of vehicle tracking and routing systems determine the shortest and fastest route to the incident site and minimize response time This field also includes innovation in portable equipment, such as miniature ultrasound imaging devices and small blood gas analyzers, enabling the technician to make advanced treatment decisions in the field6,8

The third area, and perhaps the most important for achieving sustainable performance, is innovation in data management and targeted training. This involves using mobile electronic medical records(ePCR) to accurately and quickly document patient data and transmit it immediately to the hospital toensure

continuity of care. Moreover, simulation and virtual reality technologies are being implemented To train technicians operating in situations involving major incidents and rare scenarios with high pressure, the innovation makes the skills of technicians continuously refined and developed without jeopardizing the safety of patients, contributing to the increase in the level of the quality and efficiency of the overall professional activity and ensuring that all staff members are qualified to the most extreme extent6,9.

- **The concept of professional performance sustainability and its indicators among healthcare technicians**

The sustainability of professional performance is illustrated It is the potential of people, particularly paramedics, to perform their main tasks at the high and stable quality of competence, and effectiveness during a long time in the changing work environment, and under continuous stress. This theory is not merely about attaining good results once and is about adaptation, resistance to stress and burnout, and devotion to the life long acquisition of skills and knowledge. In essence, performance sustainability can be said to be that which determines that the paramedic will be ready to deliver excellent service in the emergency care with the ability to cope with the different cases or environmental conditions. Thus professional performance sustainability means based on three main factors: Technical competence This is needed to have always-up-to-date clinical knowledge and skill in conducting the procedure, mental and physical competence, stress management and mental health, the process of returning to the difficult work experience, dedication to the organization and the profession, which is bound to discipline working within the protocols, and compliance with the professional values9,6.

The sustainability of professional performance in ambulance services at the Saudi Red To achieve this sustainability, the organization must provide a supportive environment that includes continuous training and the provision of innovative tools to reduce the cognitive and physical burden and mental health support systems By integrating these elements, it is possible to ensure that staff remain qualified, motivated, and able to adapt to medical and technological developments, which raises the overall readiness of the Authority and achieves its vision of providing reliable and continuous emergency care6,7

The sustainability of the professional performance of an ambulance technician is measured by a set of quantitative and qualitative indicators that reflect the quality and efficiency of work in the long term. These indicators are the quality of clinical and field performance, through which full adherence to approved treatment protocols is assessed, such as adherence to basic and advanced life support protocols and the success rate in critical procedures, such as the success rate of intubation or administration of electric shock. This indicator also includes the rate of medical errors or avoidable accidents, as a decrease in these rates indicates the stability and efficiency of technical performance over time, reflecting the provision of a high level of professionalism and continuous vigilance. The second indicator relates to flexibility, operational efficiency, and continuous self-development, and is measured through response time and the rate of task completion within a specific time frame. Maintaining a consistent and effective response speed indicates sustainability in operational readiness. This indicator also includes rates of participation in training and continuing professional development programs and obtaining advanced or specialized certifications, which indicates the technician's personal commitment to updating their knowledge and skills to keep pace with rapid medical innovations, and is considered the basis of knowledge and technical sustainability9,1

The third indicator is job safety and occupational satisfaction. This indicator is measured by rates of unjustified sick leave or job turnover. A decrease in these rates is an indication of providing a healthy and sustainable work environment. This is complemented by a set of indicators of mental health, the ability to manage stress and job burnout, and the technician's overall job satisfaction levels. When the technician is stable and does not suffer from occupational burnout, he becomes more able to maintain his focus and quality in providing care which ensures the continued provision of high-quality services to the community7,5

- **The relationship between medical innovation and improving the professional competence of workers**

The relationship between medical innovation and improving the professional competence of ambulance service workers is both causal and complementary. Innovation acts as a catalyst and enhancer of performance. The introduction of innovative technologies and tools, such as smart monitoring devices that integrate multiple functions or portable, real-time diagnostic devices, directly contributes to overcoming the field challenges faced by technicians. This type of innovative training ensures that technicians' skills remain updated regularly and continuously, and it bridges the gap between theoretical knowledge and practical application, making the acquired competence more flexible and adaptable to the rapid developments in emergency medicine protocols10,6

Study Population

The study population consists of all technicians and paramedics working for the Saudi Red Crescent Authority in various regions of the Kingdom, who use modern medical technologies in field work to provide ambulance services.

Study Sample

The study sample consisted of 200 paramedics randomly selected from various centers within the organization to ensure a realistic representation of their training level and their handling of medical innovation in diverse work environments.

Methodology

The study adopted a descriptive-analytical approach, as it is the most suitable for measuring the relationship between medical innovation and the level of professional performance, and for analyzing the attitudes and opinions of the sample members using quantitative statistical methods.

Study Instrument

An electronic questionnaire was used as the primary data collection tool.

Analysis Results

Table 1. Age Distribution of Participants

Age Group	Frequency	Percentage (%)
Under 25 years	30	15.0
25–35 years	95	47.5
36–45 years	55	27.5
Over 45 years	20	10.0
Total	200	100.0

The proportion of employees over 36 years of age also indicates the presence of medium and long experience that contributes to transferring knowledge to new staff, creating a balance between experience and innovation within the work environment.

Table 2. Years of Experience

Years of Experience	Frequency	Percentage (%)

Less than 1 year	10	5.0
1–3 years	60	30.0
4–6 years	80	40.0
More than 6 years	50	25.0
Total	200	100.0

The results indicate that most participants (4-6 years) have experience at a rate of 40%, which is sufficient time to acquire advanced field skills and use medical innovations effectively. The presence of 25% highly experienced personnel also supports the quality of services and provides professional supervision that ensures sustainability and continuous development.

Table 3. Responses to Questionnaire Statements

No.	Statement	Mean	SD	Agreement Level
1	I possess sufficient knowledge of modern medical technologies used in emergency medical services.	4.25	0.59	High
2	The Authority encourages the use of medical innovations in field services.	4.18	0.65	High
3	We are informed about new technologies before their implementation in the field.	3.95	0.72	High
4	Medical innovations have contributed to improving the quality of services I provide.	4.32	0.58	Very High
5	The use of modern technologies has reduced response times to emergencies.	4.20	0.64	High
6	Medical innovation has helped reduce professional errors during service delivery.	4.15	0.67	High
7	The training provided on new equipment is sufficient and effective.	3.88	0.75	Moderate
8	I feel confident using medical innovations in my work.	4.05	0.70	High
9	The organization provides ongoing training programs to develop technicians' skills.	3.92	0.73	Moderate
10	A work environment is available that encourages the application of medical innovation.	4.10	0.65	High
11	There are clear policies that support innovation and its sustainable use.	3.80	0.77	Moderate
12	Adequate maintenance and technical support are available for modern equipment.	3.90	0.74	Moderate
13	I sometimes face difficulties using modern technologies.	3.45	0.88	Moderate
14	Medical innovation has increased my motivation and work continuity.	4.25	0.61	High
15	Investing in innovation is essential for performance sustainability.	4.40	0.55	Very High
Overall Mean		4.07	0.69	High

The table indicates that the average reaction of the participants was fairly high which means that they have a clear idea of how medical innovation contributes to the formation of professional performance and enhancement of the quality of services. Promotions which were linked to the quality of service and professional motivation got the highest averages, which shows that innovation guarantees increased

efficiency and sustainability. When it came to the items that had average averages, they prioritized the training and technical support issues, indicating the necessity to reinforce the current training program and renew the policies on maintenance and technical supervision.

Table 4. Mean and Standard Deviation by Main Themes

Theme	Mean	SD	Level
Awareness and Adoption of Medical Innovation	4.13	0.65	High
Impact of Innovation on Professional Performance	4.22	0.61	High
Training and Technical Competence	3.95	0.73	Moderate
Institutional Support and Sustainability	3.93	0.70	Moderate
Challenges and Overall Satisfaction	4.03	0.68	High
Overall Average	4.05	0.67	High

As explained in the table, all the aspects of the research were highly approved indicating the significance of medical innovation in sustaining professionals. The axis in which the greatest average was captured is in the Impact of Innovation on Professional Performance axis whereby the modern technologies enhance the quality of services and response speed. Although, the training and institutional support pillars scored at the average levels, these results show that there is a necessity to implement more frequent development programs and provide an environment where innovation can flourish.

Table 5. Correlation Between Medical Innovation and Professional Performance

Variables	Pearson Correlation (r)	Sig. (p-value)	Relationship
Medical Innovation → Professional Performance	0.84	0.000	Strong Positive

The results of the correlation indicate the existence of the strong and statistically significant positive relationship ($r = 0.84$, $p < 0.01$) between the level of medical innovation and the level of professional performance of paramedics. It implies that the greater the use of innovative technologies, the more successful the quality of services and the decrease in professional errors, therefore, the higher is the sustainability and field preparedness.

Table 6. Relationship Between Years of Experience and Perception of Innovation

Years of Experience	Mean Score	SD	Level
Less than 1 year	3.85	0.72	Moderate
1–3 years	4.00	0.68	High
4–6 years	4.12	0.64	High
More than 6 years	4.25	0.60	High

As indicated in the table, the awareness of the significance of medical innovation rises with the years of working experience. The more experienced paramedics are less aware and less competent in the application of modern techniques, which is evidence of the connection between experience and capacity to make the best out of innovation in the sphere. New paramedics, in their turn, require the extra training assistance to increase their confidence in the use of modern medical technologies.

Table 7. Perception of Innovation by Age Group

Age Group	Mean	SD	Level

Under 25	3.90	0.70	Moderate
25–35	4.15	0.64	High
36–45	4.10	0.66	High
Over 45	4.05	0.69	High

The findings show that, the age group, (25-35), was most knowledgeable and willing to utilize medical innovations and then the (36-45) age group. This is probably due to the fact that the two categories constitute the highest percentage of the active working population which is able to keep up with the technological advances and the smaller group requires more hands on experience to build their experiences in the field..

Continuous professional training and development is a fundamental element in building a culture of medical innovation. Innovative training aims to equip technicians with the critical and analytical thinking skills necessary to identify shortcomings and challenges in daily practice When a technician is trained to understand scientific principles and how to use new and modern technologies in treatment methods, they become capable of asking questions, suggesting improvements, and identifying deficiencies that a new innovation can address. This is the foundation upon which a sustainable innovation system is built. Furthermore, advanced professional development ensures that personnel have the ability to adopt and assimilate innovative technologies as soon as they emerge. If paramedics are not adequately qualified to handle advanced diagnostic equipment or a new communication system, these innovations will become useless. Therefore, training programs that utilize high-fidelity simulation and virtual reality technologies ensure that technicians are fully aware of the mechanisms of work, modern tools, and their protocols. These modern skills are not limited to using innovation but also contribute to enabling technicians to provide feedback .Valuable for designers and developers

In addition, professional training and development promote medical innovation by providing a collaborative learning environment Sustainability is key; when paramedics participate in workshops and problem-solving groups, they are motivated to share knowledge and practical experience. This interaction generates innovative ideas directly derived from field challenges whether these innovations are in workflow Or suggesting modifications to the tools and equipment used. Therefore, investing in the qualification of personnel is not only to raise the individual efficiency of the ambulance service technician, but it is a direct investment in the ability of the institution, which is represented by the Saudi Red Crescent Authority, to generate and absorb medical innovations that ensure the continuous improvement of the quality of its services

- **Organizational and administrative factors influencing the adoption of medical innovation**

There are two types of factors—organizational and administrative—that influence the adoption of medical innovation in the Saudi Red Crescent Authority. The first of these is administrative factors, where the success of adopting medical innovation depends on pioneering leadership and a clear vision Innovation must be endorsed at the highest management levels so that it is not seen as an additional burden or merely an initiative, but rather as a core and strategic value for the organization. Leadership must allocate the necessary resources and delegate authority to innovation teams It is what creates a safe environment for employees, and this support transforms innovation from a theoretical concept into an encouraging daily practice, breaking the barrier of fear of change among field staff. This is in addition to a flexible organizational structure and effective decision-making processes, as innovation requires the availability of speed in adapting, while rigid structures and excessive bureaucracy hinder its progress Therefore, for the institution to adopt medical innovation, it needs clear and rapid mechanisms to evaluate new ideas and provide rapid pathways for supply and technical approval of modern equipment and software. There must be open and direct communication channels between ambulance service technicians and senior management and technical authorities to ensure that the innovation process meets the actual needs of field .work, thus ensuring that innovations are relevant and useful

are considered influential factors in the adoption of medical innovation among technicians at the Saudi Red Crescent Authority For employees to continue taking risks and generating ideas, there must be clear systems in place to incentivize and foster individual and collective innovationThis includes allocating time for technicians to work on creative projects, providing material or moral rewards for successful innovations, and integrating innovation as part of the annual performance evaluation criteria for employees. When an ambulance service technician realizes that their voice is heard and that their ideas can make a difference, it ensures a regular and continuous flow of new ideas and also makes the adoption process internal and sustainable

In addition, there is resistance to change among human workers. Although paramedics are passionate about rescue, they work under critical time pressure. Any innovation that increases the procedural burden, such as an application that requires complex data entry or disrupts the usual workflow, leads to immediate resistance. In addition, some technicians may lack digital literacy or fear that technology will replace their human expertise. Therefore, the process of introducing innovation must be accompanied by a clear communication campaign that focuses on the fact that innovation is a tool to support decision-making and not a replacement for human expertise, with the participation of technicians in the experimental design phase of the innovation

- **Strategies to promote medical innovation to achieve sustainable professional performance**

There are three strategies that can be explained as follows

The system-building strategy is based on transforming the ambulance service technician from a recipient of orders to a source of innovation The Saudi Red Crescent Authority should establish platforms for managing ideas It should be easy to use, allowing the technician, after completing a difficult task, to document the challenge encountered, such as the difficulty of securing an airway in a confined space, and propose solutions to ensure the system's effectivenessInnovation speed committees should also be established This approach, which includes technicians, administrators, and technical experts to quickly evaluate these ideas, not only enhances the quality of innovation by making it realistic and responsive to needs, but also boosts the motivation and professionalism of technicians because they see their voices heard and influential in developing their profession This is a fundamental element in sustaining professional performance. The second strategy is adopting enabling technology and deepening external partnerships to reduce logistical and financial obstacles. The Saudi Red Crescent Authority should focus on importing and integrating technologies that directly address performance sustainability challenges, .such as predictive maintenance systems For ambulance equipment and the use of artificial intelligence to analyze performance records and identify knowledge gaps that need training, strategic partnerships with universities, research centers and technology companies should be developed to design and implement innovations that are specifically suited to the Saudi community environment, such as the thermal tolerance of devices, which ensures quality of performance and avoids reliance on solutions that are .unsuitable for the ambulance work environment

The third strategy, and the one most closely linked to sustainability, is to link training with continuous .assessment and occupational health Training must be transformed into a continuous, data-driven process where field clinical performance reports are used to design customized training programs that meet actual needs. In addition, innovation must extend to include occupational health solutions such as AI-supported mental health applications or innovative stress management programs. This integration of technical innovation and psychological and occupational support ensures that the technician remains in excellent mental and physical condition, which is the real guarantee for achieving sustainability in high and .outstanding professional performance in the long term

Therefore, supporting medical innovation is an investment in human capital. By adopting comprehensive strategies that focus on tools, training, and administrative support, the Saudi Red Crescent Authority can

ensure the provision of high-quality ambulance services and maintain a high level of excellence over .time

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