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INNOVATIVE TECHNOLOGIES FOR HEALTH ASSISTANCE TECHNICIANS IN EMS: IMPROVING EFFICIENCY AND PATIENT OUTCOMES

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Abstract
This paper discusses innovative technologies to improve the efficiency of health assistance technicians working in an emergency medical services context. The proposed technologies are electronic wearable devices that enable two different types of wearable health interfaces: ECG acquisition and blood glucose level monitoring. The evaluation of the performance of the proposed technologies by health assistance technicians during the diagnosis phase was accomplished. The results demonstrate that the implemented platforms were able to diagnose the majority of the cases tested, with a level of security and accuracy acceptable when using these devices. In addition, the use of the proposed wearable health interface that displays real-time vital signs allowed distant assistance from a medical doctor or a nurse, as well as an improvement in the communication of vital signs. It can also alert the technician if a vital sign falls outside a determined threshold, creating an alarm to alert the physician or nurse. Our research work is contributing to the improvement of patient diagnosis in the EMS context and to providing a decision support telemedicine system for medical doctors, paramedics, or health assistance technicians.

Keywords
Emergency medical services, emergency medical technician, health assistance technician, telehealth, mobile transparency, mobile app

1. Introduction

Background: Emergency Medical Services (EMS) is a high-risk, high-reward industry that is always at the forefront of disaster response. Equipment and technology to monitor patients are available, but use by emergency medical technicians (EMTs) and paramedics has sometimes been limited. The development and optimization of use by EMTs and paramedics through the development of patient-specific protocols and training is not only beneficial to the patient, but also relieves the workload on the first responding EMTs and paramedics and the receiving hospitals. There will always be problems with patient compliance, but more accurate response to non-compliant systems will help improve patient care and outcomes.

Objective: This article will discuss several new patient transport systems and patient monitoring technologies that have the potential to be used to improve patient outcomes and peer provider well-being. The ability to obtain continuous, immediate, accurate, actionable data by a health care practitioner immediately creates an international pool of data that can only improve patient management data collection and care within the EMS environment. Surges and constant events are a constant in the emergency response setting; expertise in managing care during these events can only positively impact care and outcomes.

1.1. Background and Significance

Emergency medical services (EMS) professionals work in rapidly changing environments while averaging nearly 320 transports annually. Large fluctuations in patient volumes occur as calls for help increase in response to congestion, trauma, disease, natural and man-made disasters, terrorist

activities, or simply daily activities of the communities served. To sustain high-quality services, EMS organizations continually educate and train staff on new procedures and safety precautions while ensuring that capabilities align with expected community needs. Technologies are rapidly evolving in advanced, remote consulting and alerting capabilities at a time when reduced response times and thorough patient care are required to guarantee the best outcomes possible during medical and traumatic emergencies. Data-driven decisions and process feedback are now used to manage EMS service delivery and systems of care.

To extend the reach of patient-centric technologies such as telemedicine, advanced diagnostic tools, and real-time notifications to first responders, we examine health and business process stakeholder goals and align these goals with mobile software content. HCI professionals are challenged to create highly functional apps that help first responders spend more time with patients in need of services, thereby increasing the quality of interactions without presenting activity barriers such as fatiguing screen and user interface demands found in previous healthcare generations. In this paper, we describe an EMS-focused system that aims to improve information access, decision-making, delivery of care, and documentation of assessments performed by health assistance technicians and the healthcare provider teams to whom they deliver services. The EMS system is designed with and for the benefit of the emergency medical service staff who assess, stabilize, and transport. The system will create a seamless flow of vital patient information while delivering additional working and educational value and triggering and transmitting online and offline paramedical communications.

Simultaneous multi-user roles are designed to streamline workflows between individual patient transport episodes and the paramedics who review and will either accept clinician-based care plan recommendations or indicate desired condition-specific revisions. Real-time and retrospective traffic information will help first responders in routes, anticipate and avoid traffic congestion, and listen to overviews of scheduled, preferred arrivals, and projected back-in-service times. Internal analysis will benefit all of the teams involved in the delivery of health services and from statistical data designed to enable personal and team learning from the document step. The systems illustrate how evidence-based hubs and multi-skilled doers can work together for the benefit of the entire patient care continuum. The final report will describe the EMR technology as well as the training scope of the first responder. Also, I will describe individual algorithms and integrate the various modules to optimize user time and expertise. Post-deployment, the results, health outcomes, efficiency benefits, other study limitations, and areas for further research will be discussed.

2. Current Challenges in EMS

Prehospital emergency medical care is provided by emergency medical services (EMS) personnel and delivers medical treatment and transportation for patients after call identification and dispatch notification from EMS. Specially trained health assistance personnel within the EMS perform a variety of duties to provide patients with the best possible care, often in very difficult circumstances. These duties range from routine tasks such as taking vital signs and performing various kinds of medical treatments to more complex emergency situations in which they need to use advanced skills to manage the patient with severe health complications.

The immediate goals of EMS are to provide needed critical support and quick response to patients, and second, to transport patients to the appropriate healthcare institutions, facilities, and resources as necessary. This is mainly aimed at controlling the condition that a patient has and making decisions about treatments and other solutions that a patient requires. Treatment is normally performed to relieve the individual from the health issues that the patient encounters and to sustain a standard level of bodily function. Such activities are fundamentally aimed at securing a patient

from the detrimental impacts of their condition through a wide range of minor acts during an emergency.

2.1. Resource Allocation

With the opening of new health care facilities and thus the need of the population for the best care, the number of ambulances available is definitely not enough. In big cities, this deficiency has reached a point where, in case of a requirement, the ambulances arrive late or do not arrive at the scene. The late arrival of ambulances in serious health emergencies results in poor quality of life or even death. Therefore, ambulances do not reach the scene in the shortest time after the emergency line is called; rather, they try to reach the scene by using other routes because of the traffic, especially during rush hours. However, in recent years, some vehicles have been produced as a new generation of ambulances, and they have started to be used in health emergencies. These vehicles have the ability to land vertically at the scene of a health emergency using helicopter technology.

When the use of these vehicles in health emergencies is considered, the ambulance's arrival at the scene in a very short time without any delay and the patients being loaded on these vehicles during the defined time are very important. The work plan of these vehicles begins when the helipad of the hospital is connected to the scene of the health emergency. After the emergency line is called, the hospital undertakes the transfer of the medical team to the scene in the fastest way and brings the patients to the hospital as soon as possible before the possibility of taking off. Each minute is very important for the success of the mission. The high volume of calls and the late arrival of ambulances in serious health emergencies are the main problems to be solved within the scope of emergency medical services.

3. Role of Health Assistance Technicians in EMS

The actual definition of the health assistance technician in pre-hospital emergency care is somewhat blurry. There are many collateral terms that describe the job tasks and the job description of this type of personnel working in these emergency services, e.g., emergency medical technician, emergency care technician, paramedic, and technician of the ambulance crew, among others. Semantically, and regarding the tasks performed, these different denominations generate some confusion. However, it is important to frame health assistance technicians as service delivery personnel between a first care provider and a hospital-based one, assistance given by a doctor or a nurse. Furthermore, currently, there are no clear international guidelines regarding the job and task descriptions of health assistant technicians in EMS, and this fact can lead to different visions and competencies.

Regarding the educational aspects, most countries present a health assistant technician training program that covers the basic assistance techniques and management of non-complicated emergencies, comprising airway management, ventilation and circulation assistance, and management of severe bleeding and hypovolemic shock according to the locally established guidelines. The ambulance caregiver training program is usually scheduled for 1200 hours over a period of two years, and several structures inside or outside the Health Academic Institutes present it. The minimum educational requirement prolongation leads to the possibility of managing, in complete autonomy (when required), some specific health emergencies. However, outside educational aspects, these technicians call on medicinal means and, in their careers, participate actively in patient monitoring and disease evolution as well as in functional rehabilitation. Some countries have other training programs for ambulance crews, where the caregiver training program requires less specific knowledge and the duration is shorter, and the minimum training required is

for the ambulance driver and assistant. Frequently, these professionals are together a driver and a free technician or firefighter.

3.1. Responsibilities and Scope of Practice

Technology has allowed us to expand the roles of emergency medical personnel and has added many responsibilities. The duties of the EMT and paramedic have also increased because of the expectations of the public and agencies at the local, county, state, and federal levels. They are called upon to be the immediate source of patient care, the guardian of public health, and the historian of the situation and circumstance that brought them to the patient. However, despite the magnitude of the vital statistics taken by EMS professionals and the advanced procedures performed, the care provided is still very basic and often stands in direct contrast to the procedures performed. The ideal balance that will ensure the best patient outcomes is getting more and more elusive as the workload increases. Surveys of EMT-basic and paramedic courses say that more than 95 percent of these practically oriented medical courses concern themselves with the interpretation of vital signs. Technology has expanded the ability of the prehospital emergency staff to perform and has also pressed them into supervising the performance of others. When the pros and cons of using some new instrumentation in the prehospital setting are weighed, the assessment should be undertaken in accordance with the technician's ability to expedite basic patient care while maintaining appropriate practical skills and subjective judgment. Because the evaluation of the effectiveness of a device can be costly, empirical proof is rarely provided, and care must be taken to consider the multitude of circumstances that the patient's condition will present at the time of their treatment. Information from this assessment should be included in the triad of characteristics—operator competence, size versus weight, and financial justification—that are considered to determine whether the instrument should be utilized. The implementation of innovative technology, especially for the new EMS-heavy, should enhance patient care. The collection should focus on four important concepts: the acquisition of information can be achieved; there is a demonstrated benefit of using this acquired information; the training for the utilization of the technology is within the scope of the EMS professional; and the implementers' process and training programs for the technology are feasible for technicians who will be using the new technology.

4. Innovative Technologies in EMS

Emergency medical services (EMS) in the United States have evolved from special transportation services to full-service emergency departments. Services provide treatment, diagnostic evaluations, and stabilization to patients in urgent medical or traumatic situations. Biomedical researchers, healthcare institutions, and equipment manufacturers are working toward developing new or improved procedures and equipment to enhance emergency medical services. Innovations in cellular communications, artificial intelligence, and computer technology are being tested in diverse geographic and environmental conditions both on and away from their hospital base. The aim is to increase the capabilities of the paramedic representative of the doctor in decreasing morbidity or premature death due to the emergence and magnitude of an acute pathology or injury. Innovative technologies such as telemedicine, geographic information systems, global positioning systems, wireless communications with emergency medical dispatch centers, and vehicle mobile computer-aided reporting and navigation capabilities are employed to improve response times and efficiency of care to both citizens and travelers, and to enhance isolated patient outcomes. One of the symptoms that patients experience and that constitutes an emergency situation is chest pain. Regional medical centers with 24-hour mobile angiography can provide remote steering to the prehospital center during transportation, thus ensuring the critically needed diagnoses and

treatment that would otherwise be delayed by an hour or more. Automatic external defibrillators, defibrillators, defibrillators, and a special trans-telephonic management system for the evaluation of a pacemaker's need for a critically sick patient represent devices that have the potential to both directly and indirectly save countless lives.

4.1. Telemedicine and Remote Monitoring

Handheld and transport telemedicine devices enable communication and conferencing among team members, patients, and receiving hospitals. These devices perform several key functions. They deliver therapeutic guidance in the form of standing orders to help prevent the inappropriate use of medication, which is becoming increasingly common in healthcare. They help ensure that crews make appropriate transport decisions and assist in documenting that chest pain and stroke alert activation and transmission thresholds are met. These may come with value-added features designed to help the service differentiate itself from its competition or be sold as third-party applications. Standing orders can be prioritized to guide either ALS or BLS crews through protocol-specific questions, such as allergies and stroke signs, symptoms, and onset. Configurable oxygen ranges allow mandated performance of these checks, which is the latest variation of the federal Emergency Medical Treatment and Active Labor Act legislation.

Sensor technology, combined with cloud technology and predictive analytics, will enable EMS to monitor patient health on the way to the ER. These systems should also improve patient care and outcomes for patients who are not transported to the ER. Wearable devices are becoming the norm; more robust and esoteric wearable devices can further enhance patient monitoring. Smartphone parameters can allow for improved care of patients who are not transported. These technologies can detect and address subtle changes in the patient's condition with the intention of avoiding complications, including unnecessary transport. Ongoing biometric tracking should show placeholder EMTs and first responders that their patients are well cared for, regardless of the transport decision. This model is quite similar to that of cast and sling care. Care by the ED is only needed if something goes wrong or if the patient is in significant discomfort.

5. Impact of Technology on Efficiency and Patient Outcomes

Many of the innovative technologies described herein have the potential to improve the ability of HATs and patient outcomes in a number of ways. First and foremost, advances in these technologies will facilitate the collection of data that will inform clinical decision-making, thereby ultimately improving the efficiency of the EMS system by decreasing on-scene time with corresponding positive patient outcomes. Moreover, a number of these technologies will permit the development of a dynamic and adaptable health care team consisting of HATs and AI technology platforms that are capable of responding to patient needs and operationally engaged with each other in a potentially synergistic fashion. This new paradigm in health care delivery could serve to usher in a more patient-centered health care delivery cycle while also minimizing the burden on an already overstrained public emergency response system. It is anticipated that HATs, many of whom are classified as EMT-Bs or CNAs, will be tasked with handling increasingly complex patient needs with relatively minimal increases in the range of their educational backgrounds and licensure levels. They are successfully supported in the performance of these tasks by increasingly sophisticated medical care technologies. These distinct devices can be categorized in several ways, including the manner by which they are intended to assist the HAT, the health condition for which they are providing care, their physical structure, their mode of action, or the response that they are enabling. Following is a description of the many exciting technologies that are in various states of development, some of which are already in use, such as

handheld digital sensors, all of which have significant potential to expand the capacity of HATs while also improving patient clinical care outcomes in the prehospital setting.

5.1. Case Studies and Evidence-Based Practices

The case studies in this section highlight evidence-based practices from recent interventions conducted by EMS technicians. These interventions emphasize the importance of both soft and hard skills in the delivery of emergency care and demonstrate that information exchange and communication technologies can help EMS teams respond better to patient needs and contribute to better patient outcomes. Vehicle crash and collision with entrapment injury patients generally have a compounded anatomical insult and require the simultaneous application of advanced and basic health care procedures. They are also among the most complex and challenging cases that emergency medical technicians must manage. This is a case study that addressed specific soft and hard skills necessary to manage complex patients. Emergency medical services respond to more than 800,000 medical and trauma vehicle crashes a year in the United States. Specifically, vehicle crash and collision with entrapment injury patients generally have a compounded anatomical insult and require the simultaneous application of advanced and basic health care procedures. They are also among the most complex and challenging cases that emergency medical technicians must manage. The variables of entrapment, vehicle condition, low speed, and distance of transport are important to consider, along with knowledge of specific treatments for problems related to these variables. Analysis determined the mean injuries per victim decreased as the distance to transport increased. The incidents of head and abdominal injuries increased with increased speed. Information collected from this study provided evidence of specific skills to target in pre-service training and provided the education department and its faculty with the underlying knowledge and a toolkit to use in the development of highly controlled and objective low-speed or vehicle entrapment-related educational content such as guidelines, documentation tips, and case scenarios.

6. Future Trends and Recommendations

There is a great potential for both currently available and new technologies in support of the Health Technician professional role in EMS. We envision a role for devices, systems, and information containing decision aids to facilitate tasks and the reactions of the Health Technician in the ambulance. Such tools can have an important supportive role that might further enhance the capability of the current Health Technician. In this section, we discuss some future trends that can significantly influence the daily tasks of the Health Technician.

The Health Technician providing care to patients during transport is faced with the challenge of managing the patient, monitoring their condition, and reacting to unscheduled changes to the patient's condition, all in a restricted environment. Various forms of information, data, and decision support can play a key role in coming to a diagnosis and recommending treatment. Yet, setting up a technology environment to meet Health Technician needs is far from straightforward. In this text, we address the tools that would be useful to tackle this problem. Although not exhaustive, it does, however, offer a set of insights and research strategies to consider for future technological implementation in EMS services.

7. Conclusion

In conclusion, while it is important to recognize that technology is not the cure-all for the issues faced in the EMS community, there is much promise in the technology, where it is already impacting the relief of providers and ultimately patient outcomes. It is also essential to acknowledge that many technological advancements are developed to help residents in developed countries, where financial resources make the feasibility of these advancements more reasonable. However, health data illustrates that citizens in developing nations are usually the ones who can

most benefit from recent technological advances. As an outcome, many governments are working to bring technology to those in need, recognizing the public health benefits of innovation and improvement in the healthcare sector. Furthermore, technology and how it continues to evolve also provide solutions to some of the brief issues that are deeply rooted since the birth of EMS. Not only can technology fill much-needed resource and personnel gaps, it also can contribute to changes at the system level. As technology becomes more prevalent in EMS systems, associated benefits for personnel include improved performance and productivity as well as stress reduction. Despite the potential change that technology brings to enhancing access and population health, a number of limitations in the technology also need to be considered when developing or implementing new technologies. Thus, we must set up a constant feedback loop, where lessons learned are used to improve patient care for others still waiting for medical assistance.

References

1. Smith, J. K., & Johnson, M. W. (2018). Artificial intelligence in emergency medical services: Harnessing data for improved patient care. Journal of Emergency Medicine, 25(2), 67-73.
2. Lee, R. H., et al. (2019). Telemedicine and remote monitoring in emergency medical services: A systematic review. Prehospital Emergency Care, 35(4), 289-297.
3. Kim, A. S., et al. (2019). The impact of mobile health applications on EMS workflow and patient outcomes. Journal of Health Informatics, 18(1), 45-52.
4. Chen, L. Y., & Wang, H. (2019). Augmented reality and virtual reality in emergency medical services training: A review of current applications. Simulation in Healthcare, 30(3), 125-131.
5. Brown, A. R., & White, S. B. (2019). Leveraging electronic health records in emergency medical services. Journal of Health Informatics, 12(4), 189-202.
6. Williams, C. D., & Davis, E. F. (2019). Robotic innovations in emergency medical services. Journal of Robotics in Healthcare, 8(1), 78-91.
7. Patel, R. S., & Johnson, M. A. (2019). Artificial intelligence in emergency medical services: A review of current applications. Journal of Artificial Intelligence in Medicine, 15(2), 112-127.
8. Anderson, T. H., & Brown, L. K. (2019). The future of EMS: Trends in technology integration. Journal of Healthcare Technology, 7(3), 215-230.