Developing Artificial Intelligence Tools using Mobile Networks for Management of Military Mass Casualties, Republic of Korea

By

Hyo Keun No, MD

[Degree to be awarded: MPH]

Hubert Department of Global Health

____

Scott JN McNabb, PhD, MS

Committee Chair

Developing Artificial Intelligence Tools using Mobile Networks for Management of Military Mass Casualties, Republic of Korea

By

Hyo Keun No, MD

Inha University, Republic of Korea

2006

Thesis Committee Chair:

Scott JN McNabb, PhD, MS

A thesis submitted to the Faculty of the
Rollins School of Public Health of Emory University
in partial fulfillment of the requirements for the degree of
Master of Public Health
in Global Health

2020

Abstract

Developing Artificial Intelligence Tools using Mobile Networks for Management of Military Mass Casualties, Republic of Korea

By

Hyo Keun No, MD

Background: The Korean military's current strategy to evacuate and treat mass casualties in response to weapons of mass destruction is undeveloped.

Objective: We intend to find the approach to improve Korean military mass casualty evacuation and treatment through advanced artificial intelligence (AI) and using mobile applications for reporting.

Project Contents: Through the development of an AI-based mobile network platform and using GPS information, the currently operating strategy for military emergency patient reporting will improve to optimally triage and evacuate mass casualties.

Discussion: After the development of the new mobile network platform the military medical personnel should carry out simulation exercises.

Conclusion: The AI-based mobile network platform can be a practical mass casualty care solution for the South Korean military.

Developing Artificial Intelligence Tools using Mobile Networks for Management of Military Mass Casualties, Republic of Korea

By

Hyo Keun No, MD

Inha University, Republic of Korea

2006

Thesis Committee Chair:

Scott JN McNabb, PhD, MS

A thesis submitted to the Faculty of the
Rollins School of Public Health of Emory University
in partial fulfillment of the requirements for the degree of
Master of Public Health
in Global Health
2020

Table of Contents

Acronyms List

AFMC	Armed Forces Medical Command, Republic of Korea
AI	Artificial Intelligence
App	Smartphone Mobile Application
CBRNE	Chemical, Biological, Radiological, Nuclear, and Explosives
COVID-19	Coronavirus-19
EMS	Emergency Medical Services
GIS	Geographical Information System
GPS	Global Positioning System
LTE	Long Term Evolution (a type of 4th-generation telecommunication technology)
MCI	Mass Casualty Incident
MOU	Memorandum of Understanding
NATO	North Atlantic Treaty Organization
RFID	Radio-Frequency Identification
ROK	Republic of Korea
WMD	Weapons of Mass Destruction

Introduction

After World War II, the Korean Peninsula was divided; the government of the Republic of Korea was established in the south and the Democratic People's Republic of Korea in the north. The 1950-53 Korean War was halted by an armistice signed in 1953 [1]. Since then, North Korea developed weapons of mass destruction, including repeated nuclear tests and new ballistic missile launches, to strengthen its asymmetric military capabilities despite economic difficulties [2]. This poses a real threat not only to the Republic of Korea but also to neighboring countries and the world, and the United Nations Security Council and other countries around the world have worked closely together to come up with countermeasures and put pressure on North Korea to impose economic sanctions [3].

Today, the world is seeing new threats that are different from the past due to the development of weapons of mass destruction (WMD) (e.g., nuclear, biologic, and chemical) [4]. Accordingly, individual countries are building more advanced defense systems to counter the threat of WMD. In order to prepare for emergency situations, emergency medical systems for disaster situations and transport and treatment plans for mass casualties have also been prepared. At present, the Republic of Korea has quickly escaped the pain of war and has made remarkable advances in public and private health care systems and technologies. The level of treatment for individual injuries in the military medical system has improved considerably, but the strategic evacuation and treatment system to cope with mass casualties has not deviated significantly from the conventional battle-style manual.

Also, due to the serious low birthrate in the Republic of Korea, the number of men obliged to join the military is rapidly decreasing. As a result, the Republic of Korea Army will be reduced to 360,000 by 2022, down a total of 100,000 from the current level [5]. In response, the military is stepping up efforts to develop a Warrior platform that combines combat and surveillance drones with advanced wearable electronic equipment in which advanced wearable electronic equipment is combined [6]. In addition, under the leadership of the Department of National Defense, the army is striving to establish a battlefield ecosystem centered on artificial intelligence (AI) information, along with the recent establishment of an AI research and development division [7]. In the military medical field, the introduction of a mobile application for reporting military emergency patients available to the entire military and the introduction of a military medical evacuation helicopter system covering the entire territory [8] [9]. However, the annual budget for military health care is expected to be reduced as the number of soldiers continues to decline. As pushing for the number of combat troops to be cut, there is decrease the number of medical personnel in the troops. Accordingly, it is necessary to improve the multi-dimensionally military medical system to cope with changing situations.

Problem statement

The Korean military's current strategy for the evacuation and treatment of mass casualties to counter the real threat of the use of modernized WMD remains at the level of response of the traditional battle style of the past, limiting effective response in the event of catastrophic mass casualties.

There were many difficulties in providing prompt patient evacuation and optimal recovery treatment for patients as they had to go through the report of casualty occurrence through the general military command system and upward evacuation system of the injured military personnel from lower to higher units. If it was difficult to transport through the military's medical system due to the complex of military command systems from injured patients-generated units to higher-level units, they were sent to a private medical institution by contacting the nearest EMS.

Five years ago, the introduction of a mobile application for reporting military emergency patients that can be installed on smartphones of military officials who can use mobile phones enabled faster emergency patient reporting and the evacuation system of AFMC Emergency Medical Operation Center. In addition, the recent deployment of a newly developed unit of military medical evacuation helicopters has enabled the rapid transfer of military emergency patients from anywhere in the country to higher-level medical institutions. As such, the military emergency medical system for a small number of patients has made a lot of progress, but the tactics of mass casualty treatment and evacuation are believed to limit the practical effect in the rapidly changing situation of modern warfare, as they maintain traditional battle-style tactics of dispatching the evacuation unit from the rear, which relies on the traditional chain of command.

Purpose statement

The purpose of this project is to find ways to improve the modern mass casualty evacuation and treatment system of the Korean military, which can effectively respond to the threat of WMD in accordance with the changing situation of the Korean military.

Research objectives

The objectives of this study are:

- Identify the benefits and limitations related to the evacuation and treatment of mass casualties according to the characteristics of the battlefield environment in Korea.
- Check the characteristics of the functions of the mobile application for reporting military emergency patients currently used by the Korean military and check whether additional functions can be improved and utilized.
- Identify the development of AI-based technology within the South Korean military and the possibility of military healthcare.

Due to recent open changes in the Korean military, mandatory service personnel allowed to use mobile phones in their units since 2020 [10]. As a result, all military personnel can use the mobile application for reporting military emergency patients on their mobile phones. South Korea is the world's No. 1 country with 4th-generation LTE communication penetration and has network coverage of 97.5% in 2019 [11]. Taking advantage of these advantages at present, we will consider the need to develop efficient mass casualty evacuation and treatment mobile applications based on AI in this study.

Significance statement

In peacetime, the possibility of mass casualties from the use of WMD is low. Therefore, preparing practical countermeasures in preparation for this is in the latter phase of the policy. However, if such a situation occurs without a systematic system in place, it can cause massive human and material damage that is hard to imagine. This is similar to the context in which the current COVID-19 pandemics caused a global public health crisis [12]. Few before the COVID-19 pandemics were prepared in advance for integrated countermeasures against the pandemic of infectious diseases that could put individual countries into crisis in a short period of time. This is because countries have expected that the potential for the pandemics of these worldwide infectious diseases is low.

To date, North Korea has continued to conduct hundreds of WMD tests and tests despite numerous sanctions by the U.N. and other countries around the world [13]. This could be a relatively higher possibility of damage to WMD, especially for the Republic of Korea facing North Korea. Therefore, the South Korean military is required to come up with countermeasures related to the defense of more thorough chemical, biological, radiological, nuclear, and explosive materials (CBRNE). This is the same in the military health care sector of South Korea. This will be essential to the rapid evacuation of mass casualties and the improvement of the ability to deal with them. The purpose of this research is to be achieved by improving and developing functions of mobile applications for reporting military emergency patients operated by the Emergency Medical Operations Center of the Armed Forces Medical Command, which is responsible for the medical field of the Republic of Korea military.

Review of the literature

In the traditional strategy of dealing with mass casualties in the past, we sought to find literature on disaster situations and respond to mass patient outbreaks utilizing various modern technologies. Keywords used mainly in literature searches were "mass casualty", "disaster", "mobile application", "remote", "triage", "transportation", "evacuation", "artificial intelligence", "machine learning", and "geolocation".

1. Mass casualty evacuation and triage using advanced technology

Under a catastrophic emergency situation in which mass casualties occur, there is an absolute shortage of response personnel. In disaster medicine, rapid and appropriate patient triage is important for effectively treating and transporting many patients in a short time. For implementing this triage, there was a study using augmented reality-based smart glass [14]. The study conducted a randomized simulation study by dividing the subjects into three groups. They divided it into a control group without technical help, a paramedics group with help from triage algorithm, and telemedicine supported group using smart glasses.

A total of 362 cases of patient classification were carried out, and the patient classification accuracy of the control group without technical assistance was 58%, but the average time required was much faster at 16.6 seconds. The accuracy of paramedics with the help of the triage algorithm was 92% (p=0.04), but the average time required was 37.0 seconds. The accuracy of the groups receiving the telemedicine support was 90% (p=0.01), and the average time required was 35.0 seconds. In groups using smart glasses, the average triage time was more than twice that of the control group, but the patient triage accuracy was relatively accurate.

This would further reduce the time required for patient triage if they became more familiar with the use of the smart glasses through repeated training. In the future, accurate triage using smart glass at emergency sites is expected to be effective in transporting and dealing with mass casualties. Of course, the use of such technologies will be limited to areas where appropriate Internet connections are available to take advantage of smart glasses.

Attempts to use new technology in disaster medicine have been continued to carry out optimal injury triage, evacuation, and treatment mechanisms. There was a study that used commercially available Google Glasses to carry out full-scale triage exercise, identify casualties at disaster and mass injury sites, and collect and transmit on-site information and videos [15]. Despite Google Glass' short battery life and privacy limitations for the injured, the study found optimal results in the triage, evacuation, and treatment of the injured in remote health care areas and disaster situations. In this study, at the same time as triage using Google Glass in the field, and instant reporting to the dispatch center, smart allocation of vehicles, personnel and resources was done at the same time (Fig. 1).

Ultimately, the most important thing in mass casualty management is whether the triage, evacuation, and proper treatment of the injured are done within the so-called “Golden Hour”. In order to reduce this time required, the development of rapid and precise triage manual and repeated simulation exercise has been carried out in the field of disaster medicine. In the future, we believe that the use of skilled new technology will enable the rapid handling of more disaster-prone mass casualties. Currently, in the case of the mobile application for reporting military emergency patients developed and used by the Armed Forces Medical Command, medical guidance for a small number of patients is possible due to video call function, but in mass casualty situations, it is thought that it will only be a function of information transmission of on-site situations or some triage guidance.

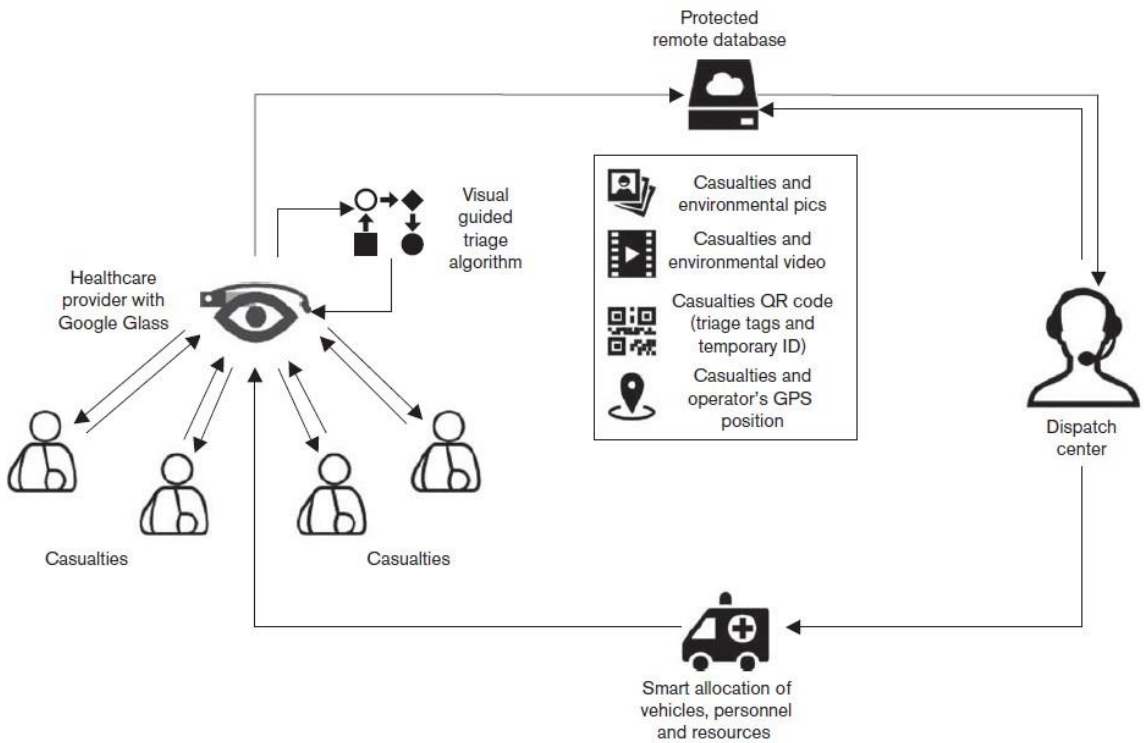


Figure.1 Flow of Information from Google Glass to the Dispatch Center [15]

Ultimately, the most important thing in mass casualty management is whether the triage, evacuation, and proper treatment of the injured are done within the so-called "Golden Hour". To reduce this time required, the development of rapid and precise triage manual and repeated simulation exercise has been carried out in the field of disaster medicine. In the future, we believe that the use of skilled new technology will enable the rapid handling of more disaster-prone mass casualties. Currently, in the case of the mobile application for reporting military emergency patients developed and used by the Armed Forces Medical Command, medical guidance for a small number of patients is possible due to video call function, but in mass casualty situations, it is thought that it will only be a function of information transmission of on-site situations or some triage guidance.

Other study suggested that there may be many restrictions on the use of telemedicine at sites where actual mass casualties occur [16]. The study sought to investigate the actual utility and user awareness of telemedicine in large-scale disaster situations and to identify appropriate uses of telemedicine. Ninety-two members of the U.S. Army's Forward Surgical Team (FST) participated in the mass casualty simulation. Only 10.9% of the participants chose Telemedicine. Participants thought the telemedicine improved decision-making skills in the treatment of patients but did not improve the timeliness of patient management. Participants reported confusion about the role in the team, time constraints, noise in the environment, and difficulties in actual use in various environments as limitations for the use of telemedicine in the mass causal management environment. The study reported three recommendations for the proper use of telemedicine in mass casualty or disaster situations. The first is the training of using telemedicine devices according to the role of the response team. The second is the provision of valuable telemedicine resources over time in time-troubled situations, and the third is the provision of appropriate telemedicine tools and devices for use in mass casualty or disaster conditions. So far, there has been no worldwide supply of telemedicine devices suitable for use in mass casualty or disaster situations. It seems necessary to improve the skill level of equipment use through the development of technologies for devices and the simulation training of continuous response team.

Efforts have also been made internationally to utilize telemedicine for disaster response [17].

NATO has sought to develop the Multinational Telemedicine System (MnTS) for disaster response. Since 2013, a group of experts from Europe and the United States have worked together to create networks and systems to use in responding to disasters between countries and have developed MnTS. It then successfully tested the MnTS through the Euro-Atlantic Disaster Response Coordination Centre's Exercises, which was implemented in Ukraine, Europe in 2015, and showed the feasibility of multinational disaster response.

This study divided the phase of the emergency management into three phases (before the disaster, during, and after recovery) and specified the key attributes of the telemedicine at each stage. In addition, the role and responsibilities of multi-participant were specified, and the installation and operation of on-site mobile hospitals, as well as the dispatch of a number of disaster rescue equipment and emergency transport vehicles, were tested in the same field exercise. Simulating exercise was as realistic as possible, allowing numerous multinational response participants to accumulate experience in telemedicine-based disaster response. After the exercise, the important part of the post-review was about telemedicine devices pre-training in the response medical personal panel. No matter how good the equipment and technology are, if actual users are not familiar and actively used in the field, their effectiveness will be greatly reduced.

Today's telemedicine technology goes beyond simply the ability of two-way information delivery between field response teams and emergency control centers to demonstrate the possibility of AI-based remote triage using big data in a pre-hospital environment of mass causal response [18]. Based on the big data of the national trauma databank, the field response team developed a model that can predict survival according to the individual condition of the patient through wearable equipment and thus provide immediate patient triage. This will require extensive pre-data, the full distribution of wearable equipment and long-term simulation exercise for each region's emergency response team, and a significant budget. However, in mainly disaster emergencies, it will be at the core of the mission for a small number of emergency response teams to quickly classify and transfer much more injured and patients to treatment facilities. In this regard, telemedicine, wearable wireless communication devices, and big data-based AI may be a viable solution to future disaster emergencies.

Mass casualty events are not common, making it difficult for national or metropolitan local governments to predict explosive increases in medical demand in a short period of time. The expected results of the mass casualty event were analyzed using the geographic simulation model for trauma care systems built by major cities in the United States [19]. A total of 25 major cities in the United States were modeled in a situation where mass causal events occurred within a mile of the central radius of the city, and the mortality was analyzed according to problems such as hospital transport and delay in treatment. From the results of the modeled scenario, the study emphasized the need for a system-based approach of mass casualty care and management to minimize damage and respond timely in disaster public health emergencies. It noted that this should be accompanied by mutual cooperation between public health preparedness planners and emergency response leaders.

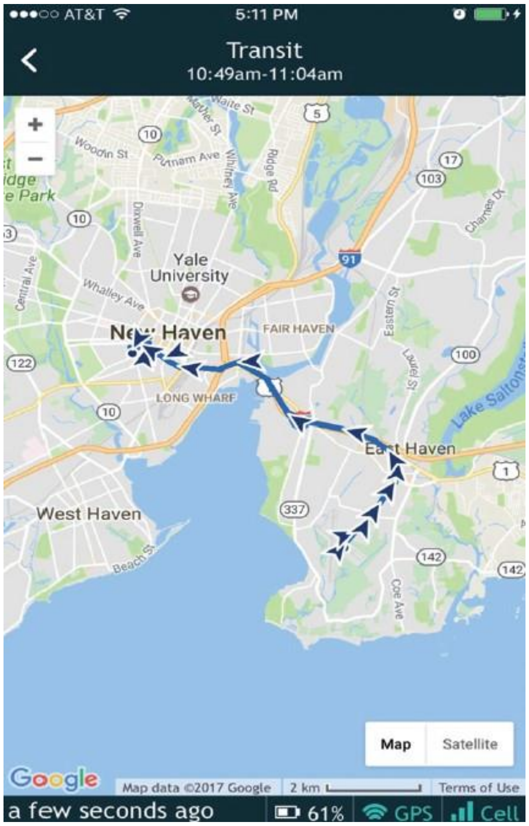
2. Technology-based Mobile Devices for Mass Casualty Care

The advent of smartphones brings many changes to the emergency medical system. The most representative of these will be Global Positioning System (GPS) based geolocalization. This feature allows emergency control centers, fire and police authorities to pinpoint the location of the callers in a short period of time, helping to make it faster and more accurate on-site dispatch possible. In one study, when the geo-localization function of a smartphone was measured with location accuracy using the mobile application of a smartphone, the conventional call group (n=54) showed that the call connection to EMS was 100% successful, but the deviation from the predicted point was 1173.5 ± 4343.1 m [21]. In the call group (n=54) using the mobile application, 85.2% (n=46) of the connection was successful, and the deviation from the predicted point identified by the automatic geolocation method was 65.6 ± 320.5 m ($p < 0.$ 0.001). The automatic geolocalization group took a much shorter time to geolocalize the caller (34.7 vs. 71.7 s, $p < 0.001$). The time it took for paramedics to arrive and do the first thoracic compression was also much shorter for the automatic geolocalization group (83 vs. 122.6 s, $p < 0.001$).

Automatic geolocalization using GPS has significant advantages in emergency situations, but it is not immediately activated during regular calls on smartphones. Also, it works only when a mobile application is available to connect to the Internet network with a smartphone. In the case of the mobile application for reporting military emergency patients developed and used by AFMC, it has a general call function and a video call function, and GPS transmission function at the current location is not immediately geolocalized, but when the GPS transmission button is pressed during a call, GPS information can be sent directly to the AFMC Emergency Medical Operation Center for accurate location verification. However, since it is a one-time transmission, tracking the current position changes of patients or initial response teams in real-time at the Emergency Medical Operation Center is limited.

Although it is not a smartphone, it produced positive results when GPS devices were used for simulated mass casual events [22]. Field triage was conducted for 46 virtual patients from the simulated mass casualty event at the airport. GPS devices were attached to 12 of the 20 virtual patients who were classified as requiring transport to the hospital, allowing medical staff waiting for patients to arrive at the hospital to view their location on a mobile application in real-time

(Fig. 2,3). As a result, the hospital's emergency department medical staff were better able to understand on-site and transport situations and to make sufficient preparations before patients' arrival in the emergency room.



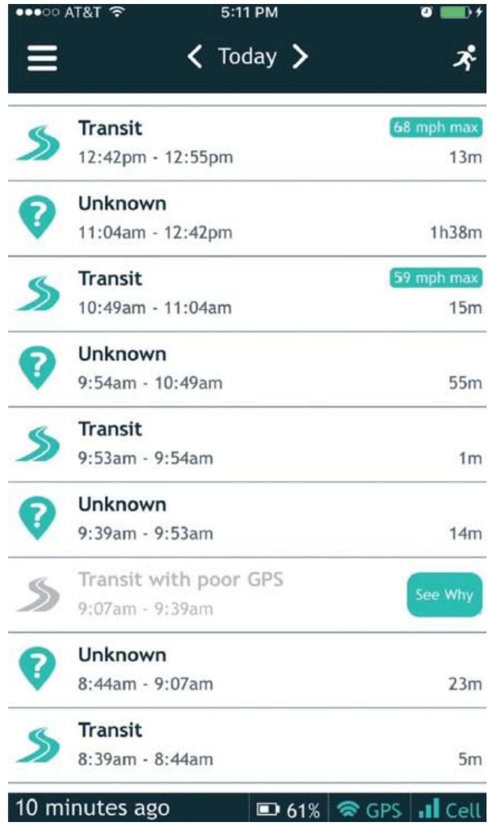


Figure. 2 Real-time Patient Tracking on App [22]

Figure. 3 Time and Location Stamp Tracking [22]

The hospital's medical staff reported that GPS trackers would be able to recognize the transport situation in real-time in a disaster medical situation, further improving mass casualty management. Indeed, preparing GPS devices in advance at all possible mass casualty locations can have many difficulties, such as budget issues. If a wearable warrior platform with GPS device function is introduced to the South Korean military in the future, similar programs can be operated. Even before that, if it is possible to develop a mobile application that utilizes GPS functions for smartphones or smartwatches, similar systems can be built, which may improve mass casualty responses. In addition, if GPS devices that can be used for medical units are distributed by local military units, in case of mass casualty, the emergency medical operation center can identify and control patient evacuation routes in real-time, and military hospitals can check the transfer situation in real-time and prepare optimal preparations.

The use of smartphone functions in disaster medicine has mainly focused on disaster preparedness and response but has also been used in mental healthcare since the disaster [23]. Efforts have been made to use mobile technologies in the care of chronic mental conditions such as post-traumatic stress disorder and depression. The most worrisome limitation is that even after a disaster or mass casualty occurs, normal access to the Internet and mobile network should be possible. This kind of mental condition management of smartphones may be more useful for the South Korean military. It has the world's best wireless Internet network, and a large number of troops are mandatory service members, ranging from 1.5 – 2 years. If it is possible to operate a peacetime mental condition management program using mobile applications or to develop applications that can reduce stress by situation during training periods, battles, or disasters, it will help maintain the morale of troops.

3. AI-based Technology

AI brings many changes to our lives with the development of machine-learning technology. These changes are already taking place in many medical fields, and the same is true of the operation of the emergency medical department [24]. It used AI-based programs in the arrival stage of emergency patients' medical institutions to reduce the waste of medical resources and promote good treatment results for patients through fast and accurate triage. During the treatment phase, the appropriate treatment level was triggered using an instant imaging medical examination reading program and an instant diagnostic tool, and the deposition of the patient treatment plan was accelerated. During the discharge phase, individual progress observation plans were established through the prediction of side effects or outcomes for each patient. In particular, "Golden Hour" is important in the area of the medical emergency. This is because optimal patient care is implemented in a short period of time, which has a significant impact on patient outcomes and prognosis. Of course, accurate big data collection must precede in order to take advantage of these machine learning-based artificial intelligence programs.

In general, the existing emergency medical system is operated in the event of a sporadic emergency patient, and the patient's proper transport and acceptance by local medical institutions are possible. However, in mass casualty events or catastrophic situations, calls to the emergency call center may be congested, and many injured people may not be matched properly with a large number of emergency transport personnel, resulting in the delayed evacuation and delayed treatment, which may increase the fatality rate. The matching system of ride demand and ride supply using artificial intelligence is already quite advanced and is readily accessible in our real lives [25]. Rideshare operators such as "Uber" and "Lyft" connect clients and rider with an artificial intelligence-based matching system using GPS information. AI-based mobile applications developed by these operators deliver two-way location information between clients and riders in real-time and analyze the rider's previous driving experiences and the past driving paths with machine learning to match the client with optimal rideshare [26].

Project contents

AFMC has been developing and operating a military emergency patient reporting mobile application since 2015 for rapid reporting and treatment of emergency cases (Fig. 4) [27].

Figure. 4 Military Emergency Patient Reporting Mobile Application, RoK [27]

This mobile application allows military officials of any unit to immediately report to the AFMC Emergency Medical Operation Center on their smartphones in the event of an emergent patient. Major functions include emergency general calls that automatically connect to the Emergency Medical Operation Center, real-time video calls using a smartphone's camera, and counseling by text message. It also includes a list of contact information for emergency rooms at military medical institutions across the country and a direct call connection function, a GPS-based automatic current location transmission function that requires user consent, and an on-site photo-

taking and transmission function. Through the development of this mobile application, it was directly connected to the AFMC Emergency Medical Operation Center instead of the existing upward military emergency patient reporting method through the command system, enabling faster on-site dispatch of medical personnel and patient evacuation and treatment.
However, there were some restrictions because only military officials allowed to use smartphones while on duty were able to install and use the mobile application. In addition, when a large number of casualties occurred, non-medical military personnel were somewhat restricted from delivering accurate status information, except for simple reporting.

A recent change in military policy has allowed all soldiers who have been on duty since 2020 to use smartphones in military units [10]. Accordingly, the Ministry of National Defense ordered all military personnel to install and use military emergency patient reporting mobile application in smartphones. South Korea has a mobile Internet network that covers about 97.5 percent of its territory, making it easy for soldiers to serve in mountainous or remote areas to connect to the Internet with their smartphones [11].

Therefore, we would like to propose the development of a mobile network platform based on the current mobile application for optimal management in the case of a mass casualty event situation in Korea, considering the current battlefield environment.

First of all, the network platform of the operational program, which enables real-time verification of the number of available beds and inpatients in each military hospital and inpatient treatment, should be developed at the AFMC Emergency Medical Operation Center. One of the important things, when a mass casualty event occurs, is the allocation to an optimal medical institution that can be transported by the condition of the injured. To this end, it is essential to share current information between hospitals and medical institutions that can be transported in real-time.

The following is the establishment of an automatic matching system with military emergency transport personnel using GPS information of the injured. In the case of the current micro-organization patient reporting mobile application, GPS information can be sent only by agreeing to provide GPS information at the current location for personal privacy protection. When installing this mobile application on a smartphone for the first time, it is necessary to obtain prior consent so that GPS information can be sent automatically in special situations such as mass casualty event or disaster occurrence. In addition, if smartphone use is restricted, portable GPS transmitters (with individual RFID chips) should be prepared for emergency use at each frontline military unit. RFID chips can function as a triage patient classification tag by checking the RFID reader after their subsequent arrival to the medical institution.

To match military emergency transport personnel who are waiting to be dispatched based on GPS information sent by the Emergency Medical Operation Center in the mass casualty situation, a mobile application version dedicated to the medical personnel will be required. This means that the GPS information of the injured is automatically reported to the military transport personnel within the same area that can be dispatched to the site within the shortest time. Mobile network platform should be operated to enable real-time tracking of GPS information of injured people and GPS movement information of the military transport personnel in the Emergency Medical Operation Center. In addition, in the mass casualty situation, it is necessary to be able to simultaneously dispatch orders from the GPS point of the first injured casualty to the military transport personnel working within the same area. For this purpose, based on GIS, according to the expected number of injuries, it is necessary to be able to implement dispatch instructions step by step at the same time as declaring a wide-area emergency situation based on the GPS transmission point where the initial situation occurred. For example, the scope of dispatch is designated by stages, such as within a radius of 25 kilometers, within 50 kilometers, and within 100 kilometers. And, the level of response can be raised depending on the amount of expected injured.

AI-based mobile network platforms are needed to perform these complex commands execution simultaneously. The data from the pre-populated military transport personnel, the triage rating of the current injured, and the matching of the medical institution to which the injured will be evacuated can be done automatically according to the pre-populated matching algorithm.

This can enable valuable initial emergency response time and efficient distribution of available medical resources. After individual matching, the mobile navigation function should be activated automatically for emergency transport personnel. Emergency transport personnel will not only be able to identify the expected arrival time from the current location to the site and the final arrival time to the medical institution but will also be able to continuously identify the optimal route for real-time traffic conditions. This situation will allow medical institutions scheduled for transport to check the patient's evacuation in real-time and prepare for optimal response, and the Emergency Medical Operation Center will also be able to track the evacuation status in real-time and direct the redistribution of available medical resources and the deployment of military medical personnel in other areas.

If matching occurs after the operation of the mobile application, multiple-person video calls, including the Emergency Medical Operation Center, should be possible simultaneously. Currently, only one-sided video transmission from the reporter to the Emergency Medical Operation Center is possible real-time status verification of patients through video information will allow optimal preparation to be made customized at the medical institution to be transferred. They can also provide medical or cardiopulmonary resuscitation remote guidance if necessary.

For these various functions to work, improvement of the current military emergency patient reporting mobile application is needed. In the case of the navigation function with the automatic destination setting, the mission would be sufficient to be operated by the navigation mobile application, which is currently generally commercialized.

Initial development projects by the Armed Forces Medical Command (AFMC) itself will require a lot of budgets, time, and effort. Therefore, close cooperation between the Information and Communication Department of the AFMC and the Artificial Intelligence Development Department of the Army will be needed, and strategic MOUs on the development of mobile applications in the public sector will be needed as soon as possible with rideshare companies and navigation production companies widely used in the domestic private sector.

Discussion

In today's reality, where the number of South Korean military enlistment resources continues to decrease due to a decrease in birth rates, many areas within the military require changes in elite and advanced technology [5]. Efforts to do so continue in the medical sector of the RoK military.

Since 2017, the Ministry of Science and the Ministry of National Defense has been conducting joint research on medical information big data for military personnel [28]. Since the establishment of the Armed Forces Medical Information System, about 1.1 billion cases of stored medical information have been standardized, paving the way for the prediction of epidemic infectious diseases by region and season and the introduction of AI diagnostic system. It will also introduce an AI-based medical platform as a pilot project in the second half of 2020 to initially use it as a diagnostic aid for military doctors, but in 2023, it will establish a system that can be diagnosed by AI alone without a doctor [29]. After developing big data theorem and algorithms, the pilot project will be carried out focusing on four major diseases in the military -- pneumonia, tuberculosis, pneumothorax, and fractures.

When the mobile network platform is realized, for a more effective response, the military medical personnel needs to carry out routine simulation exercises with military medical institutions in the wide area. This could range from natural disasters to missile or bomb drop situations, to WMD use such as chemical and biological weapons and radiation accidents. It can also consider developing a manual for concise and rapid triage at the initial casualty site and linking programs that can be easily used by non-medical personnel to a mobile network platform.

Mobile network platforms can be used in the case of military emergency patients in peacetime.

AI will be able to quickly compare and analyze ground transport using military ambulances and air evacuation using medical transport helicopters, depending on the area where the casualty occurred and the triage level. If an unexpected accident occurs, GPS geolocation may be activated to enable rapid rescue.

The development of mobile network platforms has the characteristics of the South Korean military, which requires the linkage of navigation programs. Almost all South Korean military ambulances are driven by mandatory service soldier drivers in the 20’s. Their service period has been continuously shortened from the last 24, 21 months to 18 months. Most of them have short driving experiences such as cars and trucks before joining the military, and after joining the military, they become military ambulance drivers after taking driving lessons. In unskilled conditions, there are many unaccustomed mountain areas due to the characteristics of the military's unit location or training area, and there are many nighttime operations, exercises. As a result, there is still a steady stream of accidents involving military medical ambulances during the transportation of emergency patients [30][31]. Automated navigation programs to patient occurrence points and medical institutions to transport patients after AI-based matching will also help military ambulance drivers drive safely.

With the addition of the program, the medical emergency patient reporting mobile application installed on the entire soldier's smartphone will be able to add not only emergency patient reporting functions but also basic monitoring of various epidemic diseases (i.e., body temperature, flu symptom reporting) or mental condition management functions for soldiers under stress.

Until now, the RoK military is still using the paper triage sheet to prepare for mass casualty management situations. This may have pros and cons, but if the location of the occurrence is an area with wireless Internet connectivity, we can consider switching to electronic methods such as RFID tags and barcode. The method of storing and sharing patient information quickly in electronic medical records through verification devices can ensure stability in data storage and transmission. The version of the mobile application used by military medical personnel will enable the rapid identification of patient information and triage state.

Currently, wearable health devices and various health-related smartphone applications, including smartwatches that allow relatively accurate ECG and blood pressure measurements and records, have been developed and are on the market [32][33]. In the future, the day will come when the wearable health device checks the health status of soldiers in real-time, and AI will automatically execute emergency medical requests.

If the voice recognition function of a smartphone is linked to a military emergency patient reporting mobile application, the program can be run with wearable equipment such as a headset, smart glass, or smartwatch without turning on the smartphone directly. The Warrior platform, which is currently being developed by the Korean military, can also be planned to develop for connecting a mobile network platform using wearable GPS devices, smartwatches, and smart glass.

However, the most worrisome problem with these mobile platforms may be security vulnerabilities. It is unlikely in peacetime, but there is a possibility that our military's location information may be exposed in situations where they are in combat or war. Accordingly, high-level security functions must be activated simultaneously for safe mobile network operation. In addition, prior consent is needed to approve use in emergency and emergency situations as there may be concerns about privacy breaches due to the user's exposure to the automatic GPS location.

Conclusion

Modern society is changing rapidly, and new technologies can present a new direction. The AI-based mobile network platform can be the practical mass casualty care solution for the South Korean military. It is necessary to maintain the health and power of military personnel through the continuous improvement of the current military emergency patient reporting mobile application and the development of new functions in operation at AFMC. This requires close cooperation with various national agencies and leading private companies related to AI.

Recommendations

If big data of the more complex private sector is combined based on the mobile network platform developed in the military in the future, it can also develop into a private EMS network platform. In the private sector, it may be available not only in peacetime but also in natural and human disaster situations.

This mobile network platform may also assist efficient transport and treatment after the patient's diagnosis and severity triage is performed in a pandemical situation, such as the mass outbreak of COVID-19 patients, and after the EMS program could automatically match with inpatient medical institution and transport personnel for a confirmed patient. For example, in order to prevent cases of death during quarantine at home due to an explosive increase in the number of patients, the EMS control center integrates and manages data, and automatically matches patients, emergency transport personnel, vehicles, and hospitals prepared for hospitalization in nearby or remote areas. This may be able to automatically match them with pre-programmed algorithms by AI. It could also be used in these catastrophic public health emergencies by reducing many unnecessary administrative efforts and allowing patients to be treated in a timely manner. This will require the establishment of an integrated database of hospital beds by wide-area regional units within the country and the development of a disaster response program that enables the recognition of available beds on the same platform. Building platforms and developing AI-based applications can cost a lot of money and time. However, life is so precious that it is hard to value. This will be more valuable in the future, especially in terms of declining military personnel and military medical personnel.

References

1. CIA. (2018). The World Factbook: Korea, South. Retrieved from https://www.cia.gov/library/publications/the-world-factbook/geos/ks.html

2. Nuclear Threat Initiative. (2020). The CNS North Korea Missile Test Database. Retrieved from https://www.nti.org/analysis/articles/cns-north-korea-missile-test-database

3. Council on Foreign Relations. (2020). What to Know About Sanctions on North Korea. Retrieved from https://www.cfr.org/backgrounder/what-know-about-sanctions-north-korea

4. UN. (2020). Nuclear Weapons – UNODA. Retrieved from https://www.un.org/disarmament/wmd/nuclear/

5. United Press International. (2019). S. Korean army to curtail forces by 100K amid shrinking population. Retrieved from https://www.upi.com/Top_News/World-News/2019/10/11/S-Korean-army-to-curtail-forces-by-100K-amid-shrinking-population/8771570773084/

6. Hankyoreh. (2018). South Korean overseas military contingent armed with latest combat gear. Retrieved from http://english.hani.co.kr/arti/english_edition/e_national/850545.html

7. ROKA. (2020). i-Army2030. Retrieved from https://www.iarmy2030.mil.kr/index.do

8. Dailymedi. (2015). AFMC, Development of military emergency patient reporting mobile application. Retrieved from http://www.dailymedi.com/detail.php?number=791940

9. Edaily News. (2020). The introduction of a new military evacuation helicopter No. 1. Retrieved from https://www.edaily.co.kr/news/read?newsId=01233286625641656&mediaCodeNo=257&OutLnkChk=Y

10. Ministry of National Defense. (2018). Allow all soldiers to use mobile phones. Retrieved from http://kookbang.dema.mil.kr/newsWeb/20180308/3/BBSMSTR_000000010021/view.do

11. Opensignal. (2020). The State of Mobile Network Experience- Benchmarking 5G (PDF). Retrieved from https://www.opensignal.com/reports/2019/05/global-state-of-the-mobile-network

12. WHO. (2020). Coronavirus. Retrieved from https://www.who.int/emergencies/diseases/novel-coronavirus-2019

13. Arms Control Association. (2020). Chronology of U.S.-North Korean Nuclear and Missile Diplomacy. Retrieved from https://www.armscontrol.org/factsheets/dprkchron

14. Follmann, A., Ohligs, M., Hochhausen, N., Beckers, S. K., Rossaint, R., & Czaplik, M. (2019). Technical Support by Smart Glasses During a Mass Casualty Incident: A Randomized Controlled Simulation Trial on Technically Assisted Triage and Telemedical App Use in Disaster Medicine. *Journal of Medical Internet Research*, *21*(1). doi: 10.2196/11939

15. Carenzo, L., Barra, F. L., Ingrassia, P. L., Colombo, D., Costa, A., & Corte, F. D. (2015). Disaster medicine through Google Glass. *European Journal of Emergency Medicine*, *22*(3), 222–225. doi: 10.1097/mej.0000000000000229

16. Gregory, M. E., Sonesh, S. C., Hughes, A. M., Marttos, A., Schulman, C. I., & Salas, E. (2020). Using Telemedicine in Mass Casualty Disasters. *Disaster Medicine and Public Health Preparedness*, 1–8. doi: 10.1017/dmp.2019.156

17. Doarn, C. R., Latifi, R., Poropatich, R. K., Sokolovich, N., Kosiak, D., Hostiuc, F., … Arafat, R. (2018). Development and Validation of Telemedicine for Disaster Response: The North

Atlantic Treaty Organization Multinational System. *Telemedicine and e-Health*, *24*(9), 657–668. doi: 10.1089/tmj.2017.0237

18. Kim, D., You, S., So, S., Lee, J., Yook, S., Jang, D. P., … Park, H.-K. (2018). A data-driven artificial intelligence model for remote triage in the prehospital environment. *Plos One*, *13*(10). doi: 10.1371/journal.pone.0206006

19. Carr, B. G., Walsh, L., Williams, J. C., Pryor, J. P., & Branas, C. C. (2016). A Geographic Simulation Model for the Treatment of Trauma Patients in Disasters. *Prehospital and Disaster Medicine*, *31*(4), 413–421. doi: 10.1017/s1049023x16000510

20. Case, T., Morrison, C., & Vuylsteke, A. (2012). The Clinical Application of Mobile Technology to Disaster Medicine. *Prehospital and Disaster Medicine*, *27*(5), 473–480. doi: 10.1017/s1049023x12001173

21. Ecker, H., Lindacher, F., Dressen, J., Wingen, S., Hamacher, S., Böttiger, B. W., & Wetsch, W. A. (2020). Accuracy of automatic geolocalization of smartphone location during emergency calls — A pilot study. *Resuscitation*, *146*, 5–12. doi: 10.1016/j.resuscitation.2019.10.030

22. Gross, I. T., Coughlin, R. F., Cone, D. C., Bogucki, S., Auerbach, M., & Cicero, M. X. (2018). GPS Devices in a Simulated Mass Casualty Event. *Prehospital Emergency Care*, *23*(2), 290–295. doi: 10.1080/10903127.2018.1489018

23. Sobowale, K., & Torous, J. (2016). Disaster psychiatry in Asia: The potential of smartphones, mobile, and connected technologies. *Asian Journal of Psychiatry*, *22*, 1–5. doi: 10.1016/j.ajp.2016.03.004

24. Berlyand, Y., Raja, A. S., Dorner, S. C., Prabhakar, A. M., Sonis, J. D., Gottumukkala, R. V., … Yun, B. J. (2018). How artificial intelligence could transform emergency department operations. *The American Journal of Emergency Medicine*, *36*(8), 1515–1517. doi: 10.1016/j.ajem.2018.01.017

25. Ghahramani, Z. (2020). Uber AI in 2019: Advancing Mobility with Artificial Intelligence. Retrieved from https://eng.uber.com/uber-ai-blog 2019/?_ga=2.163385850.759500833.1587532048-176254037.1587532048

26. Turakhia, C. (2018). Engineering More Reliable Transportation with Machine Learning and AI at Uber. Retrieved from https://eng.uber.com/machine-learning/

27. AFMC. (2015). Military emergency patient reporting mobile application. Retrieved from https://play.google.com/store/apps/details?id=com.nl.emergency&hl=ko

28. ITDaily. (2016). Joint research on military medical information big data. Retrieved from http://www.itdaily.kr/news/articleView.html?idxno=81506

29. ETNEWS. (2019). Military introduced AI-based medical treatment platform. Retrieved from https://www.etnews.com/20190624000278?mc=em_001_00001

30. YTN. (2019). Military ambulance rollover accident. Retrieved from https://www.ytn.co.kr/_ln/0115_201909150119380399

31. YNA. (2017). Six people injured in a military ambulance rollover accident. Retrieved from https://www.yna.co.kr/view/AKR20170803033800060?input=1195m

32. Hahnen, C., Freeman, C. G., Haldar, N., Hamati, J. N., Bard, D. M., Murali, V., … Helmond, N. V. (2020). Accuracy of Vital Signs Measurements by a Smartwatch and a Portable Health Device: Validation Study. *JMIR MHealth and UHealth*, *8*(2). doi: 10.2196/16811

33. Carek, A. M., Conant, J., Joshi, A., Kang, H., & Inan, O. T. (2017). SeismoWatch. *Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies*, *1*(3), 1–16. doi: 10.1145/3130905