THE USE OF ARTIFICIAL INTELLIGENCE AT THE STAGES OF EVACUATION, DIAGNOSIS AND TREATMENT OF WOUNDED SOLDIERS IN THE WAR IN UKRAINE

Abstract. Predictive analytics plays a very important role in the diagnosis and treatment of wounded soldiers, as well as in improving the various stages of their evacuation from the battlefield.

Artificial Intelligence (AI) can analyze historical data, current conditions, and other factors to predict potential conflict zones or areas prone to casualties, helping military personnel plan evacuation routes accordingly. Predictive modeling with route analysis using AI algorithms can analyze historical data to identify high-risk areas prone to casualties based on past conflict patterns. AI also can aid in efficient evacuation processes by analyzing data and providing real-time insights to optimize evacuation routes and prioritize patients based on severity of injuries.

Key words: artificial Intelligence, predictive modeling, evacuation soldiers.

Artificial Intelligence (AI) can play a significant role in improving various stages of evacuation, diagnosis, and treatment of wounded soldiers. AI can aid in efficient evacuation processes by analyzing data and providing real-time insights to optimize evacuation routes and prioritize patients based on severity of injuries.

Predictive analytics are playing very important role. AI can analyze historical data, current conditions, and other factors to predict potential conflict zones or areas prone to casualties, helping military personnel plan evacuation routes accordingly. AI also can aid in efficient evacuation processes by analyzing data and providing real-time insights to optimize evacuation routes and prioritize patients based on severity of injuries.

First stage of the process is all available historical, geospatial and environmental data integration. Historical data from previous conflicts, missions, or incidents can provide insights into patterns of casualties, terrain challenges, and preferred evacuation route. Geographic information system data, including topography, road networks, and urban layouts, can help AI understand the terrain and infrastructure. Information about weather conditions, natural disasters, and other environmental factors can influence the choice of evacuation routes. Predictive modeling with route analysis using AI algorithms can analyze historical data to identify high-risk areas prone to casualties based on past conflict patterns. By combining historical data with real-time information, AI can identify factors such as the presence of hostile forces, civilian populations, and potential threats along different routes. AI can use optimization algorithms to determine the most efficient routes considering factors like distance, travel time, and potential hazards.

Drone Assistance is another possibility to help in evacuation of wounded soldiers. Real-time data from sensors, surveillance cameras, and drones can provide up-to-date information about ongoing conflicts, road conditions, and changing threats, identifying safe paths and allowing evacuation teams to make informed decisions (Fig. 1).

The DJI Mavic 2 Enterprise Advances drone is compact and universal with high-resolution thermal imaging and visual cameras with 32x digital zoom, ensuring positioning accuracy. Quickly identifies objects using ultra-zoom, creating up to 240 waypoints in difficult weather and combat conditions. Lightweight and portable drone with high ascent and descent speeds, excellent maneuverability and connectivity [1].

Sorting, diagnosis and assessment of the severity of the condition of the wounded is one of the most important stages in providing assistance and saving the lives of wounded soldiers. AI can assist medical personnel in accurately diagnosing injuries and conditions, even in challenging environments.

AI can monitor social media and open sources for real-time updates on conflicts, roadblocks, and other relevant information. Integration with communication systems can provide continuous updates on the status of wounded soldiers, enabling dynamic
route adjustments. AI algorithms can read and analyze medical images like X-rays, CT scans, and MRI images to quickly identify fractures, internal injuries, and other medical conditions.

Wearable sensors and devices equipped with AI can continuously monitor vital signs and detect changes in a soldier's health, alerting medical teams to potential issues. It can be used Smart Watches and Fitness Trackers for health monitoring in military settings like Apple Watch, Fitbit, and Garmin offer heart rate rhythms, activity tracking, and even ECG capabilities. Wearable ECG Monitors like AliveCor KardiaMobile provide single-lead ECG monitoring and can detect abnormal heart rhythms and arrhythmia in military personnel and wounded soldiers [2, 3] (Fig. 2).

Pocket accurate electrocardiograph (weight only 24 g) with simultaneous recording and analysis of the cardiogram according to 6 indicators. ECG monitor collecting information from three bipolar limb sensors (I, II and III) and three unipolar sensors (aVR, aVL and aVF). A special Kardia mobile application for reading and analyzing results identifying normal heart rhythm, atrial fibrillation, bradycardia, and tachycardia. Obtaining an electrocardiogram in 30 seconds (reading time from 30 seconds to 5 minutes), FDA approved. For detection of respiratory function a devices like the Biostrap and Hexoskin can monitor respiration rate, helping to detect breathing and cardio abnormalities (Fig. 3).

Biostrap uses an optimized infrared sensor that captures high signal-to-noise ratio and high-resolution photoplethysmography (PPG) measurements from deep within the skin, up to 10 times deeper than green light, to provide reliable biometric data. Unlike the green light sensors used in most wearable devices, the Biostrap PPG signal is not affected by melanin (darker skin tone), tattoos, or other physiological changes. Using raw signal analysis, Biostrap enables in-depth analysis of biometric health indicators using powerful cloud-based algorithms. After a short baseline phase, Biostrap Kairos provides actionable AI-powered recommendations and automated alerts for significant changes at the individual or population level for data-driven decision making and outcome monitoring [4, 5].

Continuous Glucose Monitors (CGMs) like Dexcom and Freestyle Libre continuously monitor glucose levels and are valuable for soldiers with diabetes (Fig. 4).

The Dexcom G7 is an innovative continuous glucose monitoring (CGM) system from Dexcom that provides accuracy, comfort and control in diabetes management. This advanced CGM technology allows military to receive real-time information about their body glucose levels on their mobile devices, empowering them to make informed decisions about nutrition, physical activity and insulin dosage. Features of the Dexcom G7: Transmitter and sensor in one device. Continuously transmit glucose readings every 5 minutes to mobile devices or Dexcom receiver.
Lowering the level of glycated hemoglobin (HbA1C) and normalizing hyper- and hypoglycemia. Customizable high and low glucose alerts. Remote monitoring and reporting for collaboration with medical teams in military environments. Compatible with Apple Watch for easy viewing of glucose readings [6, 7].

Wearable Blood Pressure Monitors like the Omron HeartGuide, offer continuous blood pressure monitoring and monitors for hypertension management in military personnel (Fig. 5).

Fig. 5 Wearable Blood Pressure Monitors like the Omron HeartGuide

Engineered to keep informed, HeartGuide is the first clinically-accurate, wearable blood pressure monitor designed in the innovative form of a wristwatch, and is registered with the FDA as a medical device. In tandem with its companion app, OMRON, HeartGuide delivers powerful new technology that makes tracking and managing your blood pressure easier than ever before [8].

Multi-sensor patches like the VitalPatch can monitor a range of vital signs, including heart rate, temperature, and activity can be used in military healthcare systems [9] (Fig. 6).

Fig. 6 Vital Patch Biosensor

Advanced helmets and gear may include sensors to monitor head injuries, environmental conditions, and vital signs (Fig. 7).

Integration of smart helmets and gear for can be in great help for a constant monitoring of soldiers health. It is one of the lightest (1.35 kg) of all Kevlar aramid fiber (Dupont,USA) helmets, which allows to mount additional equipment, a video camera, a flashlight, a protective visor, hearing protection, communication and soldier health monitoring devices. Also it is consider searching for academic papers in medical journals, military healthcare journals, and technology-related publications for in-depth studies on wearable health monitoring devices in military contexts. When exploring these topics, it’s important to focus on recent research and developments, as the field of wearable health technology is rapidly evolving. Additionally, government and military healthcare organizations may publish reports and studies on the use of these devices within the military, which can provide valuable insights and references for further exploration.

AI also can enhance treatment options of medical professionals in delivering the most effective care following AI suggestions of personalized treatment plans based on a wounded soldier’s medical history, condition, and available resources.

AI-powered surgical robots can assist surgeons with precision procedures, reducing the margin of error and improving outcomes. In conservative therapy AI can accelerate prescribing, delivery and development the necessary corresponding drugs by analyzing large datasets to identify potential new treatments for specific injuries or conditions.

Continuing to support wounded soldiers during their recovery and rehabilitation phases AI can help by creation of personalized rehabilitation plans and programs based on each soldier’s progress and re-
sponse to therapy, adjusting exercises and interventions accordingly.

Very important role of AI in the process of selection and use of the necessary fixing, prosthetic and assistive devices in patients with injured and limb amputations. AI-driven prosthetics and assistive devices can adapt to a soldier’s movements and preferences, enhancing their quality of life.

Conclusion

AI can analyze vast amounts of medical data from various sources, helping military medical teams make informed decisions based on trends and patterns and optimizing resource allocation, such as medical personnel, supplies, and equipment, ensuring efficient use of available sources. While AI has the potential to greatly improve the evacuation, diagnosis, and treatment of wounded soldiers, it’s important to consider ethical implications, such as privacy, data security, and potential biases in AI algorithms. In all stages of evacuation collaboration between AI systems and human experts is crucial. AI is a tool that can enhance human capabilities and decision-making, but it should be used responsibly and ethically to ensure the best possible outcomes for wounded soldiers.

REFERENCES

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Резюме. Прогностична аналітика відіграє дуже важливу роль у діагностиці та лікуванні поранених бійців, а також у вдосконаленні різних етапів їх евакуації з поля бою. Штучний інтелект може аналізувати історичні дані, поточні умови та інші фактори, щоб передбачити потенційні зони конфлікту або райони, схильні до втрат, допомагаючи військовослужбовцям відповідно планувати маршрути евакуації. Прогнозне моделювання з аналізом маршруту за допомогою алгоритмів штучного інтелекту може аналізувати історичні дані, щоб визначити зони високого ризику, схильні до жертв, на основі моделей мінливих конфліктів. Штучний інтелект також може допомогти в ефективних процесах евакуації, аналізуючи дані та надаючи інформацію в режимі реального часу для оптимізації маршрутів евакуації та визначення пріоритетності пацієнтів на основі важкості травм.

Ключові слова: штучний інтелект, прогнозне моделювання, евакуація солдат