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Benefits of information technology in the field of primary health care of crew members onboard ships

Christiana Atanasova [1, *], Marina Yordanova [2]

[1] *PhD, Department of Operation and management of maritime transport ,Nikola Vaptsarov Naval Academy, Varna, Bulgaria*
[2] *PhD, Professor Temelkov Specialized Surgical Hospital, Varna, Bulgaria*
[*] *Corresponding author: k.atanasova@nvna.eu*

Abstract: Automation and digitization are already changing the maritime industry. It is essential for the communication, storage, and exchange of data. The application of digital technologies is only a prerequisite for forming the frameworks for transformation. The hard part is integrating them. Digitization should be the tool, and digital transformation should be the way. The terms eHealth and telemedicine are closely related to this. In this regard, the article examines some of the various applications of digital technologies in healthcare, particularly in the primary healthcare of ship crew members.
Information technology undoubtedly leads to improved planning and automation of routine activities. And in the field of shipping, they will provide even an increased possibility of saving human life. Mobile applications increase the level of competence and provide qualitatively new opportunities to refresh the practical medical skills of seafarers.
An analysis of relevant literature regarding the need for the use of information technologies in modern shipping is provided. It can be concluded that modern mobile technology allows crew members to access information in real time and at any time.
However, digital transformation is not a destination, it is a journey. Keeping up with the latest digital trends is vital.

Keywords: big data, diagnosis, artificial intelligence, data processing

1. Introduction

Digitalization is also a fundamental tool for the development of precision medicine. With this definition, we designate the possibilities for individualized diagnosis and treatment based on results such as genomics, patient data, health information from wearable devices, etc. Precision medicine's achievements are targeted anti-cancer drugs, individualized immunotherapies, or 3D-printed personalized prostheses (Zhukovska et al. 2022). In the future, it will also be ordering bioprinted tissues and organs for a particular patient. As technology advances, precision medicine becomes more widely applied and accessible to patients.

Mobile phone treatment, including education, information, counseling, reminders, and monitoring, can help patients adhere to their treatment plans. Regarding mobile technology and primary health care, researchers created a measure that examines five different constructs: health service efficacy, education, notification, consultation, and following-up. These five factors influence attitudes of public health personnel regarding the use of mobile phones.

Maintaining and improving the health of a ship's crew is significantly more difficult at sea than on shore (Karadencheva, 2022). Healthcare at sea poses several unique challenges and problems due to the isolated and remote nature of maritime environments. Ships may be far from shore, making it difficult to access medical facilities quickly in case of emergencies or serious medical conditions. Also communication with onshore medical professionals can be challenging, particularly when ships are in remote areas with poor or unreliable

connectivity. Moreover, long periods of isolation and confinement at sea can lead to mental health problems among crew members, such as depression and anxiety, as well as harsh weather conditions, extreme temperatures, and the physical demands of maritime work can contribute to health problems.

Pauksztat et al. (2022) provide evidence of the need for medical care at sea which has grown exponentially in recent years, and through COVID-19 the demand for mental health care has increased. During the same period, the age of digital technology was developing with full force. Smartphones have appeared, real-time traffic planning is taking place, and users have much more reliable and detailed information about their journeys than transport operators. Shippers can track their shipments through each stage of the transportation process using the so-called intelligent transport systems. But how does digitization impact medical care onboard ships?

In this regard, the present work aims to discuss the role of information technologies in the field of primary health care of crew members onboard a ship. The goal thus set is achievable by performing the following tasks: (1) presentation of the essence and characteristics of digital technologies; (2) role of mobile health applications; (3) their application in the marine healthcare.

2. Navigating the Digital Horizon

The deepening economic, social and demographic crisis in connection with the coronavirus pandemic in the last two years has forced a significant part of global, European and national businesses to accelerate the massive digitization of their economic activities. This process caused severe changes in the way of life, employment, education, consumption, and mobility of the population (Mednikarov et al. 2019). There is a need to improve the knowledge, skills, and qualifications of employed personnel in both the public and private sectors.

Maritime transport is no exception to this process. The COVID-19 pandemic has accelerated digitization in various industries, including maritime transport (Chua et al. 2022). But the application of information and communication technologies is primarily aimed at optimizing the processes of planning and managing cargo traffic, monitoring and control of loading and unloading facilities, as well as secure and safe transmission of data regarding the sending and receiving of customs and other documents.

The negative consequences of the lack of digitization in medical care for ship crew members are a lack of standardized medical data and integration models for accurate health information and creating a predictable and controlled health environment. It leads to questioning the reliability of official health information and medical data. In addition, inability to make informed management and medical decisions for disease control and effective treatment of crew members; obstruct the quality of the treatment process; obstruct the ability to provide first or emergency aid in time.

According to its definition, first aid is the help given by people closest to the injured. First aid does not require specialized medical knowledge, equipment, medicines, and tools. First Aid’s task is to protect the injured from continuing damaging effects and to help preserve his life, which we define as organizing for the injured a maximum neutral environment and an opportunity to maximize the deployment of his protective mechanisms. Every human organism is well-designed and maximally protected. In such a situation, we need to help his chances of survival.

Emergency assistance is provided by specially trained personnel with special equipment and methods. In Bulgaria, this is done by doctors and in almost all other developed countries, by paramedics. The task of emergency aid is to stabilize and, in most cases, transport the injured to a medical facility. In a few words, the emergency service must take the patient alive to the hospital, where the issue is taken over by doctors with different specialties and completely different methods. Urgent medical care is carried out exclusively only in Medical facilities and in Bulgaria, is regulated by Ordinance No. 10 of 6 June 1995 on EMERGENCY MEDICAL SERVICES (Ministry of Health, 2022).

On the world stage, the World Health Organization (WHO) issued the "International Medical Guide for Ships" (World Health Organization, 2007) in 1967, which is still the standard for practical guidelines for maintaining or improving crew health.

2.1 Charting New Waters

Today, digitization means the conversion of analog information in any form (text, photographic material, voice, etc.) into digital format through electronic devices (scanners, cameras, etc.), so that information can be processed, stored, and transmitted through digital circuits, equipment, and networks. Another meaning of this

word is the integration of digital technologies (such as digital television) into everyday life through the digitization of everything that can be digitized. In other words, digitization is the procedure where certain operations can begin to be performed through digital media, such as computers or smartphones, with or without the help of an Internet connection. Digitization, worth clarifying, is a process that is not only carried out by companies or institutions. Instead, it is a change in the way people manage all information.

The widespread application of technology and artificial intelligence in the shipping and logistics industry would probably take years to fully implement into work processes. Still, the benefits are clear and significant even at this stage. Among them are:

- Simplification and increased optimization of existing activities;
- Increasing the efficiency of employees;
- Better conditions for transparent communication;
- Significant cost savings;
- Minimizing the risk of human error.

The improvement and ever-wider application of new technologies in every aspect of life significantly impact the development of maritime transport systems (UNCTAD, 2022, Lam et al. 2020, Wang et al. 2021). Although still on a design basis, autonomous ships can be considered a revolution in shipping.

Blockchain technology has gained its fair share of supporters and detractors but is nevertheless being embraced by the maritime industry for its proven ability to optimize costs. Shuyi et al. (2021) demonstrate how the blockchain as a secure, decentralized, and encrypted public ledger is being used in various shipping applications and is revolutionizing the way maritime trade is conducted. The shipping industry has not yet fully adopted blockchain technology. Still, it should be considered that it could be beneficial in terms of organizing, tracking, and reconciling business transactions involving many parties.

In healthcare, blockchain can be used to store patient records securely. This is important because it can help prevent medical errors and fraud.

Big data in healthcare describes the vast and ever-growing volume of healthcare data stored in a cloud (Ragupathi, 2014). Its generation is increasing with the rapid development of digital health solutions. Data systems have evolved to the Internet of (Medical) Things and enable the expansion of the healthcare IT infrastructure through data sharing (Gu et al. 2020, World Health Organization, 2007). Big data in healthcare has also expanded to include health insurance claims, pharmaceutical data, and patient behavioral data (Groves et al. 2022, Morrison et al. 2022).

However, to overcome the challenges that still exist in implementing digital technologies in maritime transport and healthcare, regulators and industries must work together to strike the right balance between encouraging innovation and protection against negative consequences and externalities.

2.2 Mobile Health Applications: The Compass of Care

Heavily regulated, healthcare is digitizing later than many other industries, making it an attractive arena for technological innovation.

The main challenges in the sector are legacy and outdated technology systems and analog processes. Healthcare providers are looking to improve the customer experience, looking for more modernization and integration of technology into a homogenous ecosystem that is easily accessible to the patient.

With different regulations in individual countries, ensuring security and correct use of data are also challenging. Globally, many efforts are being made to improve operational efficiency by focusing on automation and robotics.

All solutions that work through a mobile device are summarized under mHealth. This includes a wide range of apps for smartphones, tablets or smart watches. mHealth (Li et al., 2020) refers to medical and public health actions assisted by mobile devices such as mobile phones, patient nursing devices, personal alphanumeric assistants, and other tuner devices (Li et al., 2020, Rowland et al. 2020). The most crucial goal of mHealth is to improve healthcare quality and access to it. Using mobile phones in healthcare can lead to lower healthcare costs and a change in population behavior towards prevention, which can improve healthcare outcomes in the long term. Information through mHealth can provide health-related information, access to

data for physicians in remote areas, more patient self-education, and improved diagnostic practice (Philpott, 2022).

Due to the widespread use of smartphones and other mobile devices, it is easy to use an application. In this way, the user has effortless access to medical services. There are also many opportunities for innovation - the integration of medical solutions is still in its infancy. By using networked measuring devices, for example, to monitor blood pressure, heart rate or other vital signs, applications can offer added value in various areas of health.

"Smart" medical products, services and processes are increasingly entering the medicine. Giants like IBM, Google, Apple, Microsoft, General Electric and many others have been developing their programs in medicine for years. According to data from the research company Venture Scanner (Morrison et al. 2022), more than 800 companies are involved in this sector, the most and most advanced being in the USA, Great Britain and Israel.

3.3. Digital Course for Maritime Healthcare

After the "hybrid" offices, we also have a hybrid provision of medical services. This means parallel implementation, as needed, of traditional in-office examinations and remote health services (for example, online consultation via video chat). The pandemic has clearly shown the benefits of this model in conditions of "social distancing". However, the advantages of remote health services are also a fact under normal circumstances.

But it's no accident that mHealth is seen as a cutting-edge method of delivering care, monitoring patients and disseminating information. The WHO defines mHealth as “the use of mobile or wireless technologies to help people achieve their health goals.”

Seafarers aboard ships are exposed to extreme weather conditions, dehydration, equipment hazards, toxic substances, and more. Their health is constantly affected by loud noise, vibrations, inhalation of harmful emissions and overwork. In this regard, the use of mobile health applications (in first aid) helps to master better the knowledge acquired during their initial mandatory medical training (medical qualification courses) (MLC, 2006, Ordinance No. 6 of 17 June 2021, Ordinance No. 9 of 23 February 2022, Ordinance No. 11 of 30 April 2014). The applications increase the level of competence and provide qualitatively new opportunities to refresh the practical medical skills of seafarers.

Other benefits of using mHealth by seafarers are:

- Quick response from the crew - reducing wandering time from a correct life-saving decision
- Awareness of proper first aid to the patient
- Increasing the crew's sense of security
- Reducing the cost of hiring a medical specialist
- Reducing the risk of wrong decisions and fatal outcome
- Possibility of consultation with a specialist doctor of any specialty (online conversation, a doctor familiar with the details of the peak moment of a given condition and its control)
- Monitoring accompanying diseases of part of the ship's crew
- Ability to send photos to specialists for easier diagnosis
- Provision of mental help/consultation with a specialist, during a long transition

Kanev et al. (2017) emphasize the importance and even critical nature of addressing contemporary human element problems at sea. And since one of the severe problems in medical care for seafarers remains the inability to see a doctor (which can drag on for days and even weeks), modern technologies intervene to help solve this problem (Molodchik et al. 2018, STCW, 2021). One way is through the Mariners Medico Manual, approved by the flag state of Norway as an equivalent national medical manual to the WHO International Ship Medical Manual (World Health Organization, 2007, Gard, 2022). Developed by Gard and the Norwegian Center for Maritime and Diving Medicine to improve seafarers’ health protection and medical care on board ships. The Mariners Medico Guide offers up-to-date, quick-access and easy-to-use medical guidance. A comprehensive symptom-based practical approach is provided, designed and vetted by doctors specializing in marine medicine, providing step-by-step guidance, and advising when and how to seek expert medical advice if necessary (Gard, 2022).

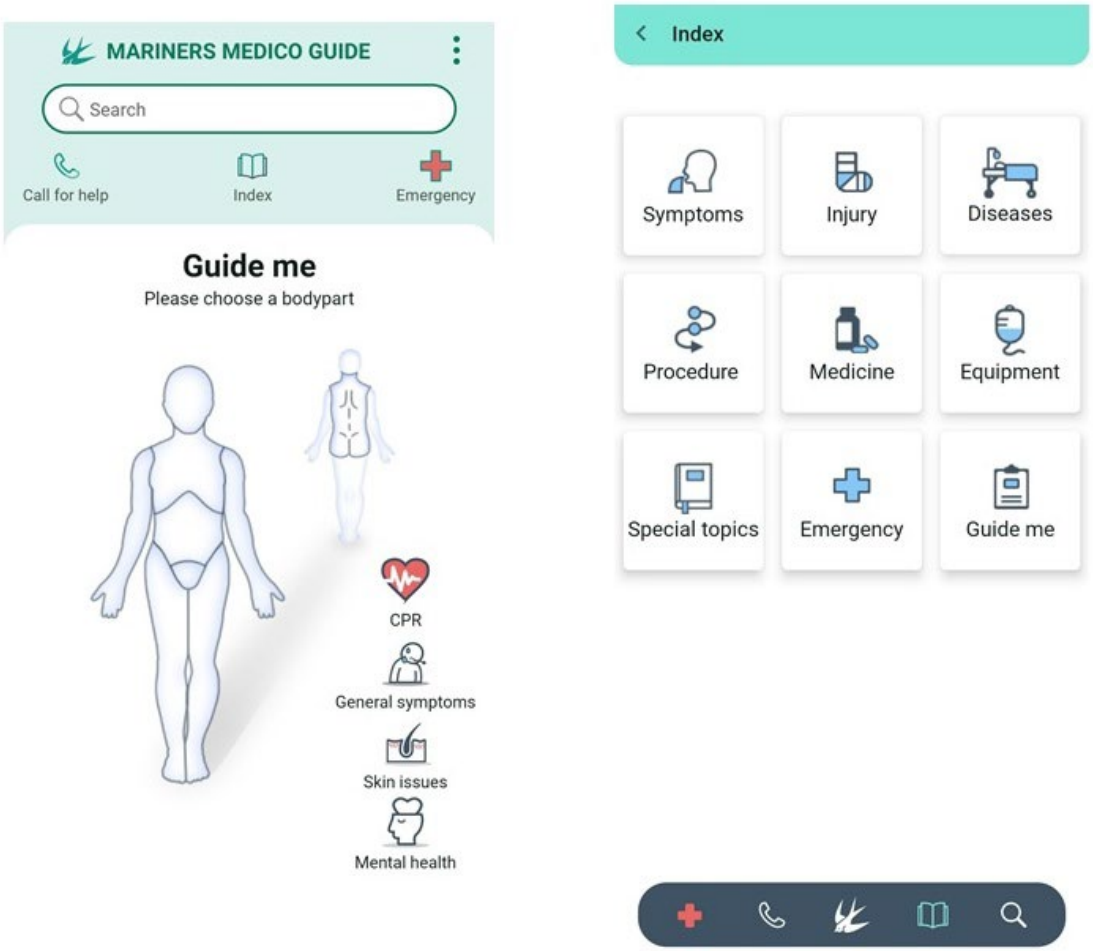

Figure 2. Mariners Medico Guide, (Gard, 2022)

The app has the option to maintain online and offline data in the app.

Another example of an intelligent mHealth solution is the Ada application (Ada Health GmbH, 2022). It asks questions, and the patient describes his symptoms. After that, the system searches the database for information about the problem and gives recommendations, and sometimes advises to consult a doctor.

There are other similar developments. Some offer the diagnosis of complex diseases, for example, diabetic retinopathy, or predict possible heart problems in apparently healthy people. The Institute of Oncology in Japan and Fronteo Healthcare has developed the KIBIT system. She analyzes the symptoms of the disease, and the characteristics of the patient's body, "digs" the specialized literature and sends the diagnosis.

In telemedicine, applications offer the possibility of overcoming the spatial distance between the patient and the professional staff. The most significant benefit is provided by optimized communication and practical evaluation of information essential to the patient's health. Both the patient and the specialized staff are registered as users. In diagnostics, these are primarily doctors, in therapy and rehabilitation – patients who benefit from the application.

In the context of the above, it can be concluded that modern mobile technology allows crew members to access information in real-time and at any time.

4. Conclusion

In conclusion, the article underscores the urgency of digital transformation in maritime healthcare. It is essential for providing efficient, timely, and high-quality medical care to seafarers. Digital technologies, driven by the pandemic's impact and trends like blockchain and big data, are pivotal in achieving this transformation.

As in almost every other field, artificial intelligence is playing a growing role in healthcare – not only on shore but also on board ships. Popular wearable devices such as smart watches and fitness trackers will play an increasingly important role. We're about to hear more about this trend in healthcare. According to Research and Markets (IMARC Group, 2022), the global connected medical device market will reach $94.2 billion in 2026, compared to $26.5 billion in 2021, i.e., will mark over threefold growth over this period.

However, any digitization requires the necessary technical infrastructure. It is essential for the communication, storage and exchange of data. In the new environment where medical services are increasingly digitized and can be provided remotely (by option or necessity), healthcare organizations that do not invest in digital technologies are doomed to progressive inadequacy.

The horizon of maritime healthcare has expanded, and the journey towards safer, healthier seas has begun in earnest. The maritime industry must continue to invest in, innovate, and adapt to these technologies to ensure that every seafarer can experience the benefits of a digitalized and connected healthcare ecosystem.

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