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Need to implement an automatic reporting system related to the supply and dispensing of pharmaceuticals onboard ships

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Abstract: In recent years, with the advent of digitalization, many spheres have changed their way of working, and it has been felt most strongly in healthcare and pharmacy. It has sparked a new wave of innovation and a significantly accelerated pace of digitization in this sector. This transformation requires a new, more dynamic, and flexible system. Depending on the situation, sometimes this means improving processes, for example, through automation. Therefore, the main objective of this paper is to explore the importance of the digitization process through the implementation of an automatic reporting system related to the supply and dispensing of pharmaceuticals onboard ships. The article also introduces a sample digital application for enhancing traceability and digital management of pharmaceuticals onboard ships.

Keywords: ship pharmacy, digitization, mobile health, ship medicine chest, maritime pharmacy management

1. Introduction

After 2005, the costs of medicines in Bulgaria increased dramatically. Despite the country's relatively small territory and population compared to other EU members, the market has grown significantly, and the pharmaceutical sector is characterized by fast rates of development in the Bulgarian economy. Some of the main reasons are the country's economic growth and high pharmaceutical prices (Dimova et al. 2022). The role of pharmacies during the pandemic has expanded significantly. They now include additional services such as providing health information, training, patient monitoring, supplying consumables, and vaccinations, among others. Some more key trends are expected shortly. These include the use of digital technologies to enable online prescription refills, AI solutions for predicting the demand and supply of pharmaceuticals, streamlining order fulfillment and supply chain management, and supporting the implementation of digital telehealth solutions (Deloitte 2020, Morrison et al. 2022).

By definition, the main task of health care and those working in the field is to provide services to inform, educate, improve, maintain and monitor the public's well-being, focusing on their needs and wants. But to build a complete and adequate working system, it is necessary to include all participants in it - medical specialists, patients, employers, and state and private institutions.

Healthcare professionals, locally and globally, strive to develop and facilitate procedures related to medical information processing and digitization of collected data. Access to them through individual electronic health records supports the maintenance and expenditure of medical supplies, primarily in medical facilities for hospital and pre-hospital care within a country. To make it possible, it is necessary to build several computer systems for hospital treatment, mobile applications for self-monitoring, communication with medical specialists, and programs supporting the application, consumption, and reporting of medical supplies from hospital pharmacies to medical institutions.

This information resource would be helpful in their application in different sectors outside the medical one - such as shipping (Fedotova,et.al, 2019, Gancheva, 2019). The highest form of accountability, tracking

the availability of medical supplies and checking the medical status of personnel, is of fundamental importance in the sector.

The requirements of good health, the administration of medication, and the reason for this by the crew are part of the control by the institutions related to the ship's orderliness (flag state). Realizing the growing need for medical assistance at sea in recent years (the COVID-19 pandemic and the frequent problems with the mental health of ship crew members) create a prerequisite for improving the medical training of seafarers, as well as increasing the variety of available medical supplies (MLC, STCW, Ordinance No. 6/2021).

In this regard, the present paper discusses the role of pharmacy digitization processes on board ships. The goal thus set is achievable by performing the following tasks:

(1) presenting the requirements for medicines and first-aid kits on the ship;

(2) presentation of methods for providing medical information on board;

(3) presentation of a conceptual framework of an illustrative application of digital technologies in the domain of ship medical supply management.

The research methods in the article include a literature review, data analysis, and qualitative studies.

2. Ship's Medicine and Marine First Aid Kit Requirements

The ship's medical service includes services for the provision of medicinal products and consumables, communication or the presence of a doctor in the crew, and providing first aid to the injured until the time of access to medical assistance from the shore. The availability of the ship's first-aid kit and medical store is determined depending on the category of the ship, the duration of the voyage, the number of crew members, expected ship commitments during the voyage, the type of cargo, and the areas intended for sailing (Ordinance No. 9 of 23 February 2022).

According to Ordinance 9, on medical services on ships, it is necessary to store medicinal products in the original packaging with the patient information sheet and with a remaining shelf life when purchased no less than the expected duration of the voyage. It is mandatory. Medicinal products are stored per the brief characteristics of the product and medical appliances – are according to the requirements set by the manufacturer. They have to be replaced per their expiration date.

A duty of the ship's captain or a person designated by him is to prepare an up-to-date list of available quantities and types of medicinal products and medical appliances. The list is signed by the master of the ship and is part of the documents subject to inspection. As for medicines containing narcotic substances or precursors, it is necessary to draw up a separate list of available types and quantities.

In 1967, the World Health Organization published an International Medical Guide for Ships for the first time. It presents international approaches to problems and situations that ship captains would encounter in the event of accidents or illness. There is also information about the ship's first aid kit, a description of the necessary medications according to the ship’s type, the total number of crew members, and the ship’s flag (Moskova et al. 2020). Over the years, the guide has been corrected several times. Currently, the requirements described in the International Medical Guide for Ships: Include a ship's medical first aid kit with medicines - third edition are applied (International medical guide for ships, 2021). It is not an official international instrument, but the handbook provides information on types and quantities of pharmaceuticals that would be a good minimum on any ship. The third edition of the International medical guide for ships gives the list of the recommended drug quantities (International medical guide for ships, 2021).

The latest edition of the guide, includes up-to-date lists of recommended drugs, deriving from the WHO Essential (Schlaich 2009, International medical guide for ships). In the lists, the necessary quantities for a crew of up to 10 people exceed 800 pieces of various tablets and injectable preparations.

And since the field of health care is constantly developing, through the creation of electronic health records, systems for organizing the hospital stay of patients, writing of online prescriptions, communication with medical specialists in real-time, the introduction of electronic reporting of income and expenditure of medicines as part of the tracking process is inevitable.

3. Digitization of the information regarding the necessary stocks of medicines in the ship's pharmacy

In the health care field by 2022, several terms are imposed - mobile health, telemedicine, telerehabilitation, and electronic health record (Revieve, 2020). All of them are united by entering data and

transmitting information between different characters and institutions electronically. Many of them can and are successfully used to inform, improve, track and control the health of ship crews. Some would help save a human life.

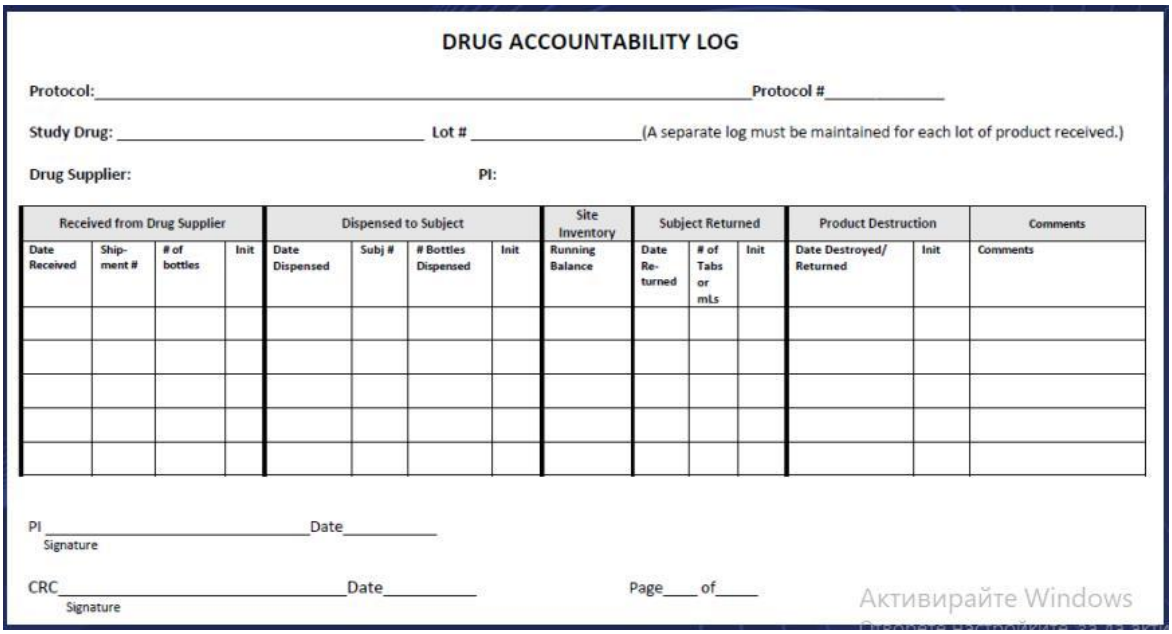
Diagnosing and treating casualties onboard ships is one of the many challenges in the shipping field. Each member of the ship's crew goes through several medical examinations and consultations before departure. Because voyages are of varying duration, some situations occur randomly, unexpectedly, and despite good general health. A person who does not have the knowledge and experience is placed in the role of a doctor or medical specialist (Mednikarov et al. 2019). Despite everything, it is necessary to take responsibility for the medical care of the injured. Judging by this, a major goal for many companies is to create and upgrade applications and digital programs to increase the health literacy of the captain and the ship's crew, provide guidance for improving and maintaining health, and control the availability and consumption of pharmaceuticals (Pharmacy Automation: Technologies and Global Markets 2021-2026).

Each medical facility has software for the automatic management of activities related to the registration of medical and non-medical data for patients, supplemented during their stay and keeping stock of medicinal products. In Bulgaria, this program is mandatory when starting a medical facility for hospital or pre-hospital medical care. Its application creates transparency in the stage of diagnosis, treatment, and follow-up of each patient (Dimitrakiev, Molodchik, 2018, Gamma Consult, 2022).

In 2014, the International Maritime Medical Association (IMMA) launched a free app for iOS and Android that lists all the medical and health-related items needed on board ships. The Marine Medical Stores Catalog lists over 5,000 items that IMMA believes are critical to the health and well-being of crew members, including a "medicine bag" of medications that must be available at all times. All drugs listed have an IMMA number that can be quoted when ordering supplies (The International Maritime Medical Association, 2022).

These two projects for facilitation and digitization of work help the health system work better. And since every single person is part of this process regardless of the sector of work; in addition, it is possible to apply analog to paper, to a digital product on the ship, for accounting of the pharmacy store, a file of each of the crew and the drugs used for him, procurement and distribution of medicines and materials, tracking their application in quantities, dosages, expiration dates, etc with or without internet access.

As a basis for building the system, it would be good to use the opiate drug reporting form which includes all the details we have mentioned (Figure 1).



DRUG ACCOUNTABILITY LOG

Protocol:_____ Protocol #_____

Study Drug: _____ Lot # _____(A separate log must be maintained for each lot of product received.)

Drug Supplier: PI:

Received from Drug Supplier				Dispensed to Subject				Site Inventory	Subject Returned			Product Destruction		Comments
Date Received	Ship-ment #	# of bottles	Init	Date Dispensed	Subj #	# Bottles Dispensed	Init	Running Balance	Date Re-turned	# of Tabs or mLs	Init	Date Destroyed/ Returned	Init	Comments

PI _____ Date_____
Signature

CRC_____ Date_____ Page____ of____
Signature

Figure 1. Drug accountability log (Rinaldi, 2017)

The main problems with using previous practices, namely paper reporting, create several issues. Examples are the lack of up-to-date information on the suitability of all products, the impossibility of determining the exact quantities of all medications (given their number), and the lack of documentation on

which crew member has been given a drug and the reasons for it. From here arise several other problems shared by many retired ship captains related to the prevention of ignorance of the new additions to the crew and the stock of medicine that they carry with them, which is not allowed (Bhargava, 2019).

It is important to note that there is currently no system to support the electronic reporting of the ship's pharmacy and warehouse and to support the resolution of the mentioned issues and cases.

4. Development of digital technologies in the field of pharmacy informatics

Panda & Satapathy (2021) describe a system model of a medical supply chain. However, a centralized organization handles the current medical supply chain system which is not trustworthy. With online resources the biggest problem is the same - diversity and lack of credibility. The data must be verified and secure when it comes to medical information. In shipping, the methods of obtaining information about medical products and drugs by unqualified non-medical persons are precisely from these sources. The Internet and the various mobile applications created are becoming the leading resource for dealing with a crisis peak situation, intending to make a life-saving decision.

On the other hand, a challenge for the ship's crews is the frequent running out of essential medicines from the ship's pharmacy network and the problematic administrative work of layout paper forms. This also leads to wasted hours searching for important consumables. Many authors, including Agarwal et al. (2020), describe how mobile device strategies are currently being used to improve reporting and digital tracking of health commodities. So, the answer lies in digital transformation. It offers many advantages such as efficiency, quality, time, and cost savings.

A new mobile application would help unify the existing ones and facilitate the application, consumption, ordering, and reporting of medical supplies onboard ships. We propose a dedicated digital app designed to facilitate maritime medical logistics. We will call it "Maritime MedSupply." Maritime MedSupply is a ship-specific mobile application tailored to meet the unique needs of maritime medical supply management. It simplifies the process of applying for medical supplies, monitoring consumption, placing orders, and generating reports.

This app is an essential tool for the crew members because its main functionalities include:

- Digital Medical Supply Catalog - Comprehensive catalog of approved medical supplies and equipment; Search and filter functionalities to quickly locate specific items; Detailed product descriptions, including usage instructions and precautions.
- Inventory Management - Real-time tracking of medical supply inventory onboard; Barcode scanning for easy addition and removal of items; Alerts for low stock levels and impending expiry dates.
- Consumption Monitoring - Crew members can log the consumption of medical supplies; Reports on consumption patterns and trends.
- Application for Medical Supplies - Crew members can submit digital requests for required supplies; Customizable request forms with fields for quantity.
- Order Placement - Accurate and up-to-date product information; Order history tracking for reference and reordering.
- Notifications and Alerts - Receive notifications for order approvals, supply shortages, and critical alerts; Alerts for items nearing their expiry dates to prevent wastage.
- Multi-Platform Access - Accessible via mobile devices, tablets, and desktop for flexibility; Synchronized data across all devices for real-time updates; Offline mode.
- User Permissions and Security - Access control to ensure data security; Encryption and authentication protocols for secure data transmission.

The benefits of this application should be considered in two directions. The first provides the benefits of unified information related to the technical characteristics of the ship's pharmacy, namely the availability of drugs by type, quantity, expiration date, information on new additions, and their consumption to each crew member. That will help with organization and order in the ship's pharmacy. On the other hand, the benefits will be related to constant and unlimited access to instructions for the use of the medications themselves -

symptoms and diseases for which to apply, dosage and intake, information on allergies, as well as the possibility of combination with other medicines from drug groups.

In Bulgaria, every hospital needs to have such a system for monitoring the dynamics of the income and expenditure of medicines (Gamma store, 2022). It contains comprehensive information on all medications available to a medical facility. Each introduction of new additions is based on the date of receipt and changes to this product. The characteristics on which the program is based are the name of the medicine (current, renewed), expiration date (from the package with the shortest to the one with the longest), the purchase price (old, new), availability, and person to which the medication is prescribed. Some medical facilities also record the package numbers. This type of application, in the absence of such a significant dynamic as in medical facilities, would support the overall organization of the ship's pharmacy.

Among the practical benefits is the information about the ingredients of each product, provided by the platform. It aims to familiarize the user with the characteristics of the drugs. The process is quick and easy, making it an essential assistant in the busy daily life of ship crew members. Moreover, data integration throughout the lifecycle ensures accurate and consistent information transfer. Vertical integration connects the various levels, from production and automation systems to management, transforming process and product data into critical information that supports the decision-making process. The maximum effect is achieved when automation hardware and industrial software work together. It means that both elements are seamlessly integrated and perfectly aligned with the technological requirements of the pharmaceutical and marine industries. Telepharmacy services will play an essential role in increasing patient access to pharmaceutical care.

4. Conclusion

The crisis has exacerbated long-standing problems related to the lack of digitization in healthcare and pharmacy, including maintaining the availability of medicines. Digital solutions can bring us much-needed flexibility and enable monitoring and immediate response. It will improve operational excellence by optimizing supplies, resources, and workforce.

Therefore, the article has attempted to present an analysis of relevant literature and provide information on the need to implement an automatic reporting system related to supplying and dispensing pharmaceuticals onboard a ship.

It also establishes a potential research framework for a future empirical study of the introduction of an application to facilitate the management of the onboard ship pharmacy and the maintenance of the availability of pharmaceuticals and medical supplies required by flag state regulations. Maritime MedSupply is a vital tool in ensuring that ships are effectively managing their medical supply inventory. And above all it supports compliance with maritime healthcare standards.

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