

DIRECTIONS FOR IMPROVEMENT OF THE SYSTEM OF LABOR PROTECTION MANAGEMENT AT A PHARMACEUTICAL ENTERPRISE USING DIGITAL TECHNOLOGIES

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Introduction

According to world practice, technological progress leads to the expansion of the range of pharmaceutical products and, accordingly, implies the development of pharmaceutical production. In the modern world, the issue of creating safe working conditions through the implementation of safe technological processes for the life and health of personnel is extremely important and relevant in pharmaceutical enterprises of all forms of ownership.

Labor protection is one of the most important aspects of the state's social policy. It is a system of legal, technical, economic, sanitary, and hygienic measures aimed at ensuring healthy and safe working conditions [1].

The coordination of labor protection activities is carried out by a specialized UN agency, the International Labour Organization, which was founded in 1949. The International Labour Organization aims to disseminate the principles of social justice, human rights recognized at the international level, and labor rights through improving working conditions, bearing in mind: regulation of working hours, combating unemployment and job cuts, protecting workers from occupational diseases and accidents at work, equal pay without discrimination, salary guarantee, organization of vocational training, etc.

The International Labour Organization estimates that about 2.3 million people in the world die each year as a result of workplace accidents or work-related diseases—an average of 6.000 people every day. Also, every year, about 340 million industrial accidents and 160 million victims of occupational diseases occur worldwide. At the same time, material losses from lost working days, treatment costs, and compensation payments exceed \$1.25 trillion (approximately 4% of global GDP) [2].

The causes of significant economic losses are, first of all, harmful and dangerous working conditions. The number of people engaged in work with harmful and dangerous conditions of production and, accordingly, the economic losses of enterprises in the pharmaceutical industry are growing steadily. All this indicates serious shortcomings in the implementation of the state's labor protection policy.

A comprehensive (systematic) approach to the entire spectrum of preventive measures is laid down at the legislative level, but their implementation is not carried out properly, as is envisaged in the implementation of innovative solutions and processes in the science, technology, and economy of the country. The pharmaceutical business cannot effectively develop and become part of the modern world economy without complying with the norms and laws on labor protection, as well as without timely implementation of best practices, the use of the latest means of protection, and taking

appropriate measures to create safe working conditions at a pharmaceutical enterprise. Therefore, labor protection is an obligatory element of the social responsibility of the pharmaceutical business.

In Ukraine, many scientists are studying the issues of the latest technologies in the field of labor protection and their scientific justification. This topic has been explored by researchers such as Pistun I.P., Katrenko L.A., Kit Yu.A., Vakhoneva T.M., Levchenko O.G., Polukarov O.I., Zatsarny V.V., Polukarov Yu.O., etc. [3-5]. However, due to a lack of funding, the number of such studies is insufficient. Currently, a comprehensive, innovative approach to the full range of preventive measures in the field of labor protection at a pharmaceutical enterprise remains relevant.

Aim. The purpose of the study is to analyze the existing occupational health and safety system at the pharmaceutical enterprise and to determine ways to improve it using digital technologies.

Materials and methods

Research materials: data from the website of the State Service of Ukraine on Labor Issues [6], data from the website of the portal for labor protection specialists "Labor Protection Service" [7], data from the website of the scientific and practical magazine "Labor Protection" [8], data from the website of scientific and of the practical magazine "Handbook of an occupational health and safety specialist" [9], Law of Ukraine No. 2694-XII of October 14, 1992 "On occupational health and safety" [10], Order of Ukraine No. 839-21 of October 28, 2021 "On Approval of the Procedure for the Implementation of Electronic Document Management in the System of Labor Protection Management" [11], etc.

The methods of information search, systematization, comparison and generalization were used.

Results and discussion

The creation of the system of labor protection management at the enterprise is aimed at: formation by the senior management of a labor protection policy regarding obligations, intentions and measures in the field of labor protection, determination of the purpose of the work of the system of labor protection management at the enterprise, objects and bodies of management, tasks and measures on occupational safety, functions and methods of management, creation of organizational structure of management, development of effective systems of motivation, control and accounting, analysis, audit and monitoring, risk assessment, implementation of computerized management technologies, ensuring appropriate control over the efficiency of the system of labor protection management at the enterprise, creating conditions for its reliable functioning and continuous improvement.

The main functions of the system of labor protection management at the enterprise include: forecasting and work planning; organization and coordination of work; accounting, analysis, and evaluation of occupational safety indicators; monitoring of occupational safety and functioning of the system of labor protection management at the enterprise; and stimulation of labor protection. [12].

The implementation of the national concept of development in the field of occupational safety management requires solving the problem of developing modern

computerized systems of labor protection management in order to maximize the efficiency of such systems at both the state and regional, industry, and production levels. This will reduce as much as possible the impact of the so-called "human factor" on decision-making in existing occupational health and safety management systems, which will certainly lead to a reduction in production risks. The use of computerized systems of labor protection management can ensure maximum responsiveness and maximum possible optimization in decision-making when using a risk-based approach that is known to consist of two elements: risk assessment (analysis of the occurrence and extent of risk in a particular situation) and risk management (analysis of the situation and development of solutions that are aimed at reducing risk to an acceptable minimum).

Today, the most promising area for the development of computerized systems of labor protection management is the widespread use of multifunctional integrated comprehensive safety systems and their components, which is confirmed by the general trends in the further development of systems of labor protection management in the most developed countries of the world [13].

Modern level of development of integrated systems of comprehensive security, including in Ukraine, for example, «Danube-XXI» - «VENBEST», «Legos» - «Ukrspetsmontazh 1. Security Systems», «Inspector +»- ISS «Ukr-Invest-Consulting», «ForSec»-«Security Formula» «FortNet», etc., will allow them to be used in modern systems of labor protection management at the enterprise as to increase the level of security and fire safety of industrial facilities and at the same time to improve conditions and occupational safety in production and to address occupational health issues, industrial sanitation, reducing the level of occupational injuries and occupational diseases, as well as to improve the social protection of workers.

At the initiative of the State Labor Service back in 2021, the order of the Ministry of Economics «On Approval of the Procedure for the Implementation of Electronic Document Management in the System of Labor Protection Management» was adopted [11]. From there began the digitalization of systems of labor protection management.

Digitalization in labor protection is a transformation of the system of labor protection management that involves the use of digital technologies to optimize management, improve the productivity of the pharmaceutical enterprise, improve working conditions, and reduce the number of occupational diseases and accidents.

Consider the application of digital technologies in the field of labor protection in a pharmaceutical enterprise, their advantages, disadvantages, and possible consequences. The most promising areas of development of digital technologies in the field of labor protection in the pharmaceutical enterprise are:

1. A system of automated preliminary and periodic medical supervision, including targeted and in-depth supervision.
2. Technology for monitoring physical factors of the production environment [14].
3. A modular intelligent system of automation of industrial safety, labor, and environmental protection processes.
4. Technologies for monitoring health indicators of employees of the pharmaceutical enterprise, including Holter monitoring of the cardiovascular system during the period of production activity.

5. Telemetry module, which on the basis of functionality allows to determine the location of the employee, identity identification on the territory of the pharmaceutical enterprise, monitor the fall, and diagnose the physical condition of workers.

6. Technology of psychophysiological expertise to determine the professional suitability of employees of the pharmaceutical enterprise engaged in dangerous works in accordance with Art. 5 of the Law of Ukraine «On Labor Protection» [10].

7. Improving the system of training, retraining, advanced training, and conducting socio-psychological trainings and training seminars for the pharmaceutical enterprise employees on the basis of modern digital technologies, which allow the staff and operators to interact with accurate equipment samples.

8. Industrial safety management technologies to reduce industrial risks based on the use of international and national standards (BS OHSAS 18001:2007; ISO 31000:2009 «Risk management. Principles and Guidelines»; ISO/IEC 31010:2009 «Risk management - Risk assessment techniques», ISO 9000 «Quality management», DSTU OHSAS 18001:2010 «Occupational Health and Safety Management Systems») etc. [7].

9. Automated corporate document management system in the field of labor protection, designed to eliminate a significant amount of paperwork (up to 70%).

10. Video, audio, and other types of recording the progress of professional and production processes, providing the supervisory authority with online access to the surveillance system, remote control over working conditions and safety, increasing the frequency of assessment of working conditions at sites and workplaces with difficult, harmful, and dangerous working conditions.

11. Automation of jobs with low qualifications and intensive routine work takes into account the factors of the labor process (severity, tension, monotony, fatigue).

When implementing these directions, the following functions can be used: modeling and quantitative-qualitative assessment of occupational risks, taking into account the physiological and hygienic indicators of workers, remote control over the level of transport safety, determination of the need for repair and replacement of production equipment on the basis of assessment of potential risk and damage due to an accident, use of "smart" sensors to monitor the air pollution of the working area and water, sensors and digital sensors built into personal protective equipment against harmful and dangerous factors of the production environment, intellectual video surveillance on the use of personal protective and collective equipments of workers [15].

The following components can be used to solve labor protection problems using digital technologies, as shown in Fig.

1. The traditional sources of data for the safety system in pharmaceutical production are stationary sources of alarm and emergency information (detectors, alarms, television cameras, etc.) and mobile territory surveillance devices.

With the development of cloud digital technologies, it became possible to receive data from equipment in real time, which opened the possibility of using completely new business models. However, the complexity of the production model entails the need to improve the information protection system. The integrated protection and safety method [16] takes into account the relationship between occupational safety and information safety. For example, when information security is violated and incorrect files are transmitted to the system, this

can lead to equipment malfunctions and, as a result, cause problems in occupational safety.

Next-generation digital technologies are used in the system of training workers in various safety skills. Increasingly, video briefings and new software complexes are used, with the help of which an employee in self-training mode will be able to

master and pass a test of knowledge in all areas of labor protection and industrial safety. Currently, virtual and augmented reality (VR and AR) technologies are being actively developed, containing training games and behavioral simulations that allow you to work out the rules of behavior in specific places and situations.

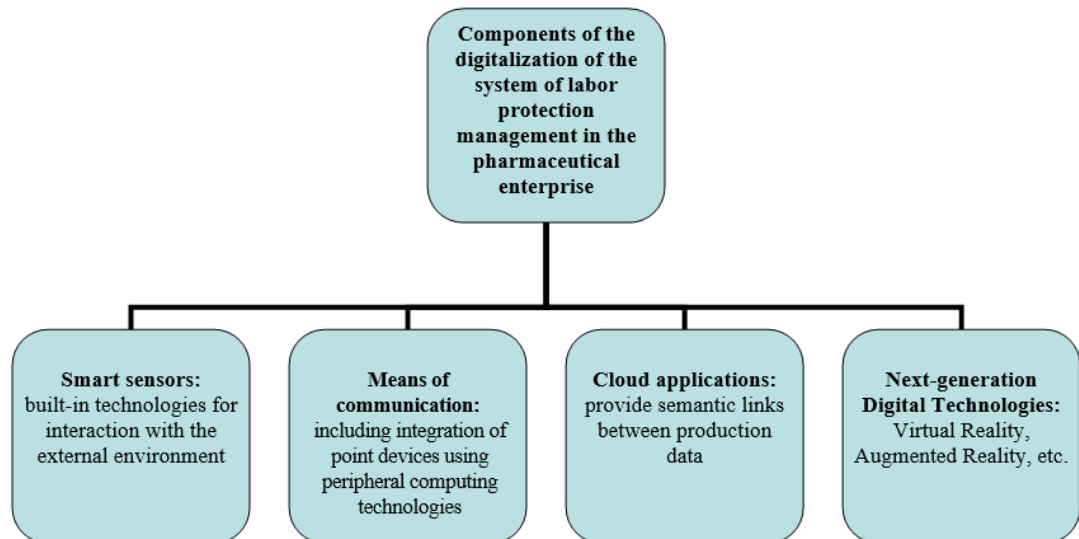


Fig. 1 Components of the digitalization of the system of labor protection management in the pharmaceutical enterprise

The first VR and AR simulators should receive representatives of professions with the greatest risk of industrial injuries. The advantage of VR technologies over traditional training methods is that it becomes possible to practice practical skills in a safe environment. Modeling real-life situations in virtual reality allows you to better assimilate information.

Currently, there are hundreds of regulatory acts on labor protection in each branch of production. For each specialty, you need to study dozens of voluminous regulatory and legal acts on labor protection.

Thanks to VR and AR technologies, an inexperienced employee can be kept out of expensive or injury-prone equipment, but at the same time, it can be taught to use this equipment efficiently and safely. The VR simulator allows you to work out the sequence of actions when performing a specific production task in the virtual world, in which the learner can participate in firefighting, practice high-altitude work, eliminate breakdowns, eliminate emergency situations, etc. [17].

Hundreds of thousands of pharmaceutical accidents occur annually in the world, the vast majority of which are the result of non-compliance with safety requirements and violations of equipment rules. In hazardous industries, accidents are mainly caused by collisions with vehicles and moving mechanisms. The main causes of accidents and deaths at the pharmaceutical enterprise are: violation of safety requirements during the operation of equipment (machines, mechanisms, vehicles); equipment maintenance violations; unsatisfactory handling.

The traditional security approach includes warning systems such as sensors, alarms, and automated workstations that are signaled or monitored. New technologies based on the principles and algorithms of machine vision are gradually being introduced to predict and constantly monitor the situation. In addition to the functions of measuring, processing, forecasting, and documenting the situation parameters, the following

technologies provide: operational calculation of the boundaries of hazardous areas; display of hazardous areas on the screen; displaying hazardous areas in workplaces using laser pointers; control of personnel access to hazardous areas with boundary changes; and planning for safe movement in these areas.

Objective forecasting of the situation is possible only with the use of intelligent sensors and technical vision systems.

Digital technologies used in labor protection in the pharmaceutical enterprise must solve the tasks of industrial risk assessment (Table 1) [18-20].

The most popular applications of such digital technologies are in hazardous production facilities and industrial facilities where accidents are the result of collisions between moving vehicles or mobile machinery. The use of digital technologies to ensure industrial safety will contribute to improving the efficiency of the occupational safety management system, reducing losses from penalties, industrial accidents, reducing injuries, as well as:

- moving the process of ensuring industrial safety in the direction of the digital economy;
- transition to a risk-oriented approach in the management of the pharmaceutical enterprise;
- reduction in the number of accidents and emergencies;
- simplification of the security warning and contingency planning processes;
- enhanced safety management through trend analysis to better understand the prerequisites for accidents;
- promote the health, well-being, and productivity of employees of the pharmaceutical enterprise;
- carrying out the necessary measures for industrial safety on time and in accordance with the requirements of the current legislation;
- implementation of a number of preventive measures and impact on the cause of events, rather than response to consequences;

- detection and elimination of inconsistencies, as well as reduction of the number of violations;
- improvement of risk management in the field of occupational safety, which ensures reduction of injuries and improvement of working conditions;
- increase efficiency and improve safety processes with the release of resources that allow you to focus on relevant issues;
- improving the quality of decisions made based on reliable real-time data for a more efficient allocation of resources;
- expanding opportunities for employees to use the latest digital technologies in the field of labor safety, which leads to the

transformation of technologies and the formation of skills necessary for solving various tasks;

- increasing the level of safety culture and creating favorable working conditions, which will undoubtedly lead to increased productivity.

In the future, we should expect the growth of digital technologies, which will be created in cooperation with suppliers of the most modern hardware and software and become more and more accessible.

Table 1. Tools of realization for implementing digital technologies to ensure the safety of production processes at the pharmaceutical enterprise

Digital technologies	Characteristic
Sensor network (detectors, video cameras, alarms) Workplace Analytics (using Sensor Systems) Artificial Intelligence (AI) and Machine Learning	Monitoring of equipment condition, compliance with safety standards, and use of personal protective equipment Evaluation of performance indicators and optimization of the workplace. Solutions to ergonomic issues. Video cameras can be equipped with modules for analyzing the work of personnel according to certain parameters. The neural network can identify employees in helmets and clothing, as provided for by occupational safety standards.
Computer Vision	If violations are detected, the video analytics module will highlight the "problem" places in the frame and send a message to the head of the pharmaceutical enterprise workshop, an occupational safety specialist.
Mobile robotic area monitoring tools Drones (unmanned devices) and robots Collaborative robots (cobots, exoskeletons)	To perform dangerous and difficult work or in dangerous conditions (weather or physical), to penetrate into hard-to-reach areas, for example, in the event of an emergency. To save time and effort when exploring large areas. For navigation and communication; to detect hazardous or emergency situations in areas not covered by stationary sensors. Automatic devices that can work together with a person. Exoskeletons repeat the shape of the operator's limbs, joints, and muscles while working with him in tandem, enhancing his physical capabilities or reducing fatigue and tension. [19].
Big Data	To prevent injuries and accidents caused by human factors, to manage the risks of accidents (using sensors).
Cloud technologies	To monitor movements of personnel and mobile equipment based on vision and radio frequency identification technologies (RFID).
Technologies of Virtual Reality and Augmented Reality	To quickly form the necessary skills for employees, to improve the efficiency of training, and to teach management of various types of techniques and mechanisms (virtual simulators). A beginner does not need to be admitted to valuable or dangerous equipment. You can simulate a dangerous situation, such as a fire, as accurately as possible. For repair and maintenance of complex equipment using an augmented reality visor [20].
Chatbots with artificial intelligence and virtual assistants Terminal equipments Portable devices and technology communication Personal digital interfaces (gadgets) Biometric devices Smart gadgets for communication (internal headphones)	To automate complex tasks, chatbots are built into applications as an assistant to users, including for individual training of workers in manual work.. Convert the information intended for the user into data for transmission over the communication line and perform the reverse conversion. Formation of an operational map of hazardous areas in relation to the digital spatial model of the area and the pharmaceutical enterprise. Measuring the degree of fatigue and body temperature in real time and sending a warning to workers and their employers. Manual control sensors are used to assess "risky" body movements. To help users hear or perform tasks that involve having to listen to others. For example, simultaneous translation devices. Authentic effective communication is the most important component of occupational safety.
IoT – Internet of Things Sensors Smart personal protective equipments - Smart PPE (glasses, helmets)	The use of an IoT module for the helmet allows you to control the wearing of personal protective equipment, identify employees, and determine their location even in conditions of limited visibility. The light indication and vibration signal on the helmet warn the employee of the danger, and the alarm button on the device allows you to quickly call for help. Accelerometers capture shocks, falls, or long-term immobility in a person, and built-in sensors determine critical changes in the parameters of the external environment. VisionAR Univet augmented reality goggles with "holographic waveguide technology" from Sony are designed to improve the efficiency of workers.

We believe that the main components of the successful implementation of digital technologies in the field of occupational safety are: experience in the implementation of unique digital technologies in the field of occupational safety; expertise in making decisions in the fields of labor protection, preservation of health, and protection of the environment; improvement of management, communication, and knowledge exchange processes; digital technologies; interaction with suppliers of state-of-the-art equipment and software; formation of a safety culture among employees; promotion of the development of their competencies, etc.

Implementation of digitalization in the system of labor protection management should include the following conditions:

1) Traditional stationary sources of alarm and emergency information (detectors, alarms, and television cameras) should be supplemented with mobile robotic means of monitoring the territory (ground and air). Since the state of each item of equipment (off, on, or idle) can be controlled by digital technologies, operational maps of hazardous areas can be formed based on the processing of such data. It will also be useful to implement controls for the use of personal protective equipment based on technical vision systems. New safety systems in the form of signal devices can «report» that the employee does not use protective equipment. Such systems help prevent injuries and deaths in pharmaceutical production. If the employee removed the helmet, then the occupational safety engineer has a signal that it was this employee who removed the equipment. It can immediately respond and take action to eliminate violations.

2) Navigation and communication means should ensure continuous monitoring of personnel and mobile equipment movements based on technical vision technology and radio frequency identification (RFID) [14].

3) With the help of cloud technologies, it should be provided for the creation of an operational map of hazardous areas in relation to the digital spatial model of the pharmaceutical enterprise, multicriterial analysis of the current situation, and forecasting of a possible emergency situation.

4) At the mobile device level, special means of informing personnel should be developed.

The concept of "smart helmet" and "smart glasses" devices will ensure the prompt display of hazardous areas, the sound warning signal when an employee approaches, and the choice of the safest travel route.

Conclusion

Thus, the implementation of innovative solutions in the system of labor protection management, simplification of document flow, and digitalization of the main processes in labor safety will prevent industrial injuries, increase labor productivity, and optimize communications among employees of a pharmaceutical enterprise.

Certainly, the problem raised in this study does not reveal the whole range of issues related to the implementation of scientific and practical approaches to the national pharmacy regarding the impact of digitalization on the system of labor protection management. The complex of issues related to the substantiation of the choice of directions for improvement of the system of labor protection management at pharmaceutical enterprises in the context of the digital

economy, etc., remains unresolved, which will determine the prospects for our further research.

Directions for improvement of the system of labor protection management at a pharmaceutical enterprise using digital technologies

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Introduction: The relevance of the research is due to the need to develop and improve the system of labor protection management at pharmaceutical enterprises in the digital economy. Therefore, occupational safety should become a priority for both pharmaceutical managers and employees. After all, today it is more profitable to invest in creating safe working conditions than then carry colossal material costs in the form of fines, assistance to the families of victims, restoration of premises destroyed after accidents, repair of damaged equipment and equipment. That is why the improvement of the system of labor protection management at pharmaceutical enterprises using digital technologies is an important question of the time. **Aim.** The aim of the study is to consider the prospects and problems of implementing digital technologies in the system of labor protection management, as well as ways to increase the efficiency of using digitalization by specialists in labor protection to improve labor safety indicators at the pharmaceutical enterprise. **Materials and methods:** To achieve the aim of the study, foreign and domestic scientific literature were analyzed. Informational, retrospective, graphic, statistical, and logical methods were used. **Results and discussion.** The relevance of the digitalization of the system of labor protection management in the pharmaceutical industry has been substantiated. A review of the directions for the development of digital technologies in the field of labor protection in pharmaceutical enterprises was conducted. The components of the digitalization of the system of labor protection management in pharmaceutical enterprises were systematized. Modern tools for implementing digital technologies to ensure the safety of production processes at pharmaceutical enterprises have been analyzed. The conditions that determine the implementation of digitalization in the system of labor protection management have been identified. **Conclusion.** It has been proven that the implementation of innovative solutions in the system of labor protection management, simplification of document flow, and digitalization of the main processes in labor safety will prevent industrial injuries, increase labor productivity, and optimize communications among employees of pharmaceutical enterprises. Certainly, the problem raised in this study does not reveal the whole range of issues related to the implementation of scientific and practical approaches to the national pharmacy regarding the impact of digitalization on the system of labor protection management. The complex of issues related to the substantiation of the choice of directions of improvement of the system of labor protection management at pharmaceutical enterprises in the context of the digital economy, etc., remains unresolved, which will determine the prospects for our further research.

Keywords: pharmaceutical enterprise, system of labor protection management, digitization, digital technologies.

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