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CURRENT PROBLEMS IN INDUSTRIAL PHARMACY

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Relevance: In recent years, the pharmaceutical industry has become an integral part of the global medical and healthcare system. The growing demand of the population for medicines, the emergence of new diseases, the increasing spread of antibiotic-resistant microorganisms, as well as the necessity of developing environmentally clean and safe types of medicines require the pharmaceutical industry to be reconsidered as a strategic sector. More than 70% of medicines in the Uzbek pharmaceutical market are supplied through imports. This gives rise to technological, raw-material, qualification, and licensing problems in domestic production. In addition, expanding manufacturing enterprises that comply with international GMP (Good Manufacturing Practice) standards and strengthening the scientific-research base are among the most pressing issues of today.

Research aim: The aim of this research is to identify the current problems existing in industrial pharmacy, to analyze their causes, and to develop proposals for eliminating them on a scientific and technological basis. It is also aimed at increasing the efficiency of medicine production by using local raw materials, applying innovative biotechnological methods, and widely introducing GMP and ISO standards.

Research methods: The following scientific methods were applied during the research:

Analytical-methodological analysis — the activities of Uzbek and foreign pharmaceutical enterprises were studied; the activities of pharmaceutical enterprises in Uzbekistan, Russia, India, China, and European countries were compared. In this process, the level of compliance of domestic manufacturers with licensing, certification, and GMP standards was evaluated. The technologies used at the stages of medicine production (raw material preparation, synthesis, granulation, pressing, packaging, quality control) were analyzed. As a result, it was found that part of the production processes are based on outdated technologies, and that the quality control system at many enterprises is not sufficiently automated. Therefore, the need for technological modernization to increase production efficiency was noted.

Statistical method — production volumes, import-export indicators, and the market share of medicine types were analyzed. Through the statistical approach, the growth dynamics of the Uzbek pharmaceutical market in recent years, production volume, import-export balance, types of medicines, and price indicators were studied. Based on data from 2020–2024, it was found that the volume of medicine production increased by 28%, but the share of imports remained above 70%. Domestic manufacturers are mainly oriented toward generic (analog) medicines, while innovative medicine development accounts for less than 10% of the share. The statistical analysis showed that a high degree of dependence on raw-material imports and a shortage of qualified personnel are the main restraining factors in the pharmaceutical industry. This method provided an analytical approach to the sector from economic and social points of view.

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Experimental method — the extraction of bioactive substances from certain plant raw materials and their application in pharmaceutical forms were studied. The experimental method was aimed at testing the practical effectiveness of new technologies and types of raw materials in pharmaceutical production. In this process, the extraction of bioactive substances from plant raw materials (such as wormwood, turmeric, ginger, cinnamon, and rosehip) and their application in pharmaceutical forms were studied. Aqueous, alcoholic, and supercritical extraction methods were compared, and the most effective conditions in terms of bioactive substance yield were identified; it was noted that ethanol extraction gave 15–20% higher results. During the experimental trials, the stability, bioactivity, and shelf life of the medicinal forms were studied. Through this method, the technological possibilities of using local natural raw materials were identified, and directions for producing import-substituting medicines were proposed.

Technological analysis — the stages of medicine production, GMP requirements, equipment efficiency, and the quality control system were evaluated. Technological analysis was aimed at assessing the technical and quality indicators at the production stages of industrial pharmacy. The compliance of the production process with GMP (Good Manufacturing Practice) requirements was studied. During the study, the level of automation of medicine production lines, ventilation and sterility systems, water purification equipment, packaging equipment, and laboratory instruments were analyzed. It was found that at some enterprises the technological equipment is of an old model, consumes a lot of energy, and has a low capacity for process control. As a result of the analysis, it was determined that technological modernization, the introduction of digital control systems (SCADA, MES), and automatic dosing and packaging equipment can sharply increase the quality of pharmaceutical production.

Results: As a result of the research, the following main problems were identified:

1. Shortage of raw materials — a large portion of medicines is imported from abroad, which causes an increase in cost price.

2. Weakness of the scientific-research infrastructure — scientific laboratories at pharmaceutical enterprises do not operate at a sufficient level.

3. Personnel issue — the number of specialists capable of applying modern technologies is small.

4. Weakness of the standardization and certification system — international standards such as GMP, GLP, and GCP are not fully complied with.

5. Insufficient introduction of innovative technologies — directions such as nanopharmacy, biotechnological medicines, and gene therapy have not yet developed widely.

Conclusion: For the sustainable development of industrial pharmacy, it is necessary to strengthen the integration of science and production. By expanding local biotechnological and phytochemical research, it is possible to create import-substituting types of medicines. Introducing GMP and ISO 9001 standards increases the quality of medicines and export potential. By mastering innovative directions such as nanotechnology, biopharmacy, and genetic engineering, the pharmaceutical industry of Uzbekistan can achieve international competitiveness. Improving the personnel training system and increasing the share of practical training in pharmaceutical education are important factors.