Telemedicine and Telepharmacy in Modern Healthcare: Innovations, Medical Technologies, Digital Transformation

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Abstract. The article presents an overview of modern approaches to the development of telemedicine and telepharmacy as innovative forms of providing medical and pharmaceutical services at a distance. The historical stages of the formation of telemedicine, its integration into pharmaceutical practice, the main principles of telepharmacy and the formats of its implementation are highlighted. The advantages of using telepharmacy are considered, including increasing the availability of pharmaceutical care, optimizing resources, improving the quality of pharmaceutical care, and reducing the burden on the healthcare system. The challenges and limitations of the development of telepharmacy were analyzed, including legal, ethical, and technological aspects, issues of licensing and personal data protection. Special attention is paid to the international experience of implementing telepharmaceutical services in the USA, EU countries, Canada and Australia. The current state and prospects for the development of telepharmacy in Ukraine in the context of the digitalization of healthcare are described. A special emphasis is placed on the role of artificial intelligence in supporting clinical decisions, automating pharmaceutical consultations, and introducing virtual pharmacists. Recommendations are proposed for the integration of telepharmacy into the national healthcare system and pharmaceutical practice.

Keywords: telemedicine, telepharmacy, innovation, medical technology, electronic prescription, pharmaceutical care, remote consultation, digital health, artificial intelligence, pharmacovigilance.

Introduction. Modern challenges are caused by global crises against the backdrop of the COVID-19 pandemic, war, covid, post-covid, long-covid, comorbid disorders, demographic changes. They have increased the need for new approaches to the provision of medical and pharmaceutical care. Telemedicine and telepharmacy have become important tools in ensuring the accessibility, continuity, and efficiency of healthcare, especially for patients in remote regions or with limited mobility [1-4].

The rapid introduction of digital medical technologies contributes to the revision of traditional models of providing medical and pharmaceutical services and forms a new paradigm of relations between the patient, doctor, and pharmacist. This creates both new opportunities and challenges related to legal regulation, innovation, artificial intelligence, ethics, quality of care and digital literacy of the population [5-9].

Telemedicine is the use of electronic information and communication technologies to provide and support medical care when participants are at a distance [10, 11].

Telepharmacy is a direction of telemedicine that covers the provision of pharmaceutical services (consultation, dispensing medicines, monitoring the intake of medicines, pharmacological supervision, pharmaceutical management, marketing) using remote technologies. This concept includes both synchronous and asynchronous forms of interaction between a pharmacist and a patient through video, audio, or text communications.

Telepharmacy (from the Greek "tele" – distance, Latin "pharmacia" – pharmacy) is an independent scientific and practical direction of pharmacy regarding the remote (remote) provision of quality pharmaceutical care with the assistance of a complex of organizational? and financial measures, information and telecommunication technologies and infrastructure. In other words, telepharmacy is a tool for supporting the relationship of a pharmaceutical specialist with a patient and a medical specialist if they do not have direct (personal) contact with each other. Telepharmacy is aimed not only at patients who are in hard-to-reach and geographically remote regions or residential

areas of large cities, but also at the elderly, patients who are being treated at home or in conditions where they are unable to leave their homes, people with disabilities, medical and pharmaceutical specialists, etc. Telepharmacy, like telemedicine, is a component of electronic health care [12, 13].

The purpose of the study was to analyze modern approaches, challenges, innovations, technologies, and prospects for the development of telemedicine and telepharmacy in the context of the digital transformation of health care.

To achieve this goal, the following tasks have been set:

- to outline the historical aspects and stages of the development of telemedicine and telepharmacy;
- to analyze modern formats and directions of application of telepharmacy;
- to consider the legal, ethical, technical, and educational challenges that accompany the implementation of digital solutions;
- to summarize international experience and determine the prospects for integrating telepharmacy into the Ukrainian healthcare system;
- to assess the potential of artificial intelligence in the context of the development of remote pharmaceutical care.

Materials and methods. To compose the article, the methods of systematic review of scientific, regulatory and publicist literature from open sources (PubMed, WHO, US National Library of Medicine, WHO websites, Ministry of Health of Ukraine, Google Scholar) was used, as well as an analytical review of regulatory documents, scientific publications and reports of international organizations dedicated to digital transformations in healthcare. The study considered the experience of both developed countries (USA, Canada, EU countries, Australia) and Ukraine.

The selection of literary sources was carried out using the following keywords: telemedicine, telepharmacy, digital health, eHealth, e-prescription, pharmaceutical care, pharmacovigilance, AI in pharmacy, electronic medical consultation, remote provision of pharmaceutical care. The analysis was conducted considering the period 2005-2025 with an emphasis on the latest publications reflecting the latest technological achievements and legal changes.

Methodologically, the study is based on:

- descriptive and comparative analysis of terminology, legal field, and technological solutions in the field of telemedicine and telepharmacy;
- retrospective analysis of the development of the concept of telemedicine and its evolution to modern forms of remote pharmaceutical care;
- content analysis of key documents of WHO [10], IOM [11] and the Ministry of Health of Ukraine;
- expert approach based on the generalization of the conclusions of leading scientists and specialists in the field [14].

The results of the study were summarized in a structured review with elements of critical analysis, including the benefits, risks, legal and organizational aspects of integrating telemedicine and telepharmacy into healthcare.

The research of the article is a fragment of research works of Private Scientific Institution "Scientific and Research University of Medical and Pharmaceutical Law" on the topics "Multidisciplinary research of post-traumatic stress disorders during war among patients (primarily combatants)" (state registration number 0124U002540, implementation period 2024-2029), and "Interdisciplinary scientific and methodological research in the field of pharmaceuticals and veterinary medicine: innovations, modernization, technologies, regulation" (state registration number 0125U000598, implementation period 2025-2031), and "Diagnosis, treatment, pharmacotherapy of inflammatory, traumatic and onco-thoracic pathology using instrumental methods" (state registration number 0125U000071, implementation period 2025-2031).

Results and discussion. Telemedicine, as a form of remote medical services, arose in response to the need to provide medical care in remote regions. Its development covers several key stages – from the first experiments with the transmission of electrocardiograms over telephone lines to modern digital platforms using artificial intelligence and mobile applications. With the rapid

development of information and communication technologies, telemedicine has gone beyond traditional clinical practice, integrating into various areas of health care, including pharmacy. This process was accompanied by a transformation of the role of pharmacists, the expansion of their competencies and the introduction of new models of interaction with patients.

Telemedicine as a concept arose in the first half of the 20th century, when the first attempts to transmit medical information over a distance using radio communication appeared. One of the early examples is the transmission of X-ray images between two cities over a telephone line in the 1940s in Pennsylvania [5].

In the 1960s, telemedicine was actively developed within the framework of NASA projects to monitor the health of astronauts. These technologies were later adapted for use in rural communities in the United States [14].

In the 1990s, telemedicine and telepharmacy began to gain wider popularity due to the development of computer technology and the Internet. A real breakthrough occurred during the COVID-19 pandemic, when many countries were forced to switch to remote medical and pharmaceutical services [1].

Telepharmacy emerged as a logical extension of telemedicine services and became a response to the need for pharmaceutical care at a distance. The first projects were implemented in the United States in the late 1990s and early 2000s. Pioneering examples included video consultations of patients with pharmacists in rural pharmacies, working under the supervision of remote licensed specialists.

Nowadays, telepharmacy includes medication consultations, interaction checks, monitoring of therapy regimens, remote prescribing and dispensing of drugs through electronic systems. This direction became especially important during the COVID-19 pandemic, when physical access to pharmacies was limited. Implementation of a pharmacist care manager model to expand availability of medications for use disorders [15].

In Ukrainian realities, the main components of telepharmacy can be:

- implementation of electronic retail trade in medicines and pharmacy products with their delivery on corporate terms or contractual terms with postal operators;
- implementation of remote pharmaceutical care aimed at the patient and his family members;
- implementation of remote pharmaceutical care aimed at a medical specialist;
- provision in real time to medical specialists and the population of comprehensive information about medicines based on evidence-based medicine, pharmacy, and pharmaceutical care;
- implementation of remote control of the implementation of prescription medicines in pharmacies of a specific network;
- promotion of continuous professional development of pharmaceutical specialists through distance learning.

The development of digital technologies and e-health is transforming classical pharmaceutical practice. The introduction of electronic prescriptions, mobile applications for monitoring medication intake, and pharmacovigilance systems based on real-time data are changing the role of the pharmacist from an executor to an active consultant and manager of pharmacotherapy [16, 17].

Digitalization also contributes to improving the quality of services: the risk of errors is reduced, communication with patients is improved, and the availability of pharmaceutical care in remote regions is increasing [10, 16].

Thus, the historical development of telemedicine has gone from technological experiments to a key component of the modern healthcare system, and telepharmacy has become a new tool for ensuring the rational and safe use of medicines.

In the modern healthcare system, telemedicine is taking an increasingly important place as an effective tool for remote provision of medical services, providing prompt access to diagnostics, treatment, and consultation regardless of the patient's geographical location. The basis of telemedicine is the use of digital technologies to transmit medical information between patients and healthcare professionals in real time or in a delayed mode [18, 19].

One of the areas of practical application of telemedicine is telepharmacy – a form of pharmaceutical care, implemented using telecommunications. Studying the key concepts and

principles of these technologies allows you to form an idea of their legal, organizational, and ethical basis [17].

Telemedicine is a form of medical service provision that involves the use of electronic information and communication technologies for diagnosis, treatment, prevention of diseases, consultation, and management of patients, when the participants in the process are separated by physical distance [11, 18, 19].

The main aspects of telemedicine are:

- synchronous and asynchronous interaction between the patient and the healthcare professional;
- remote monitoring of health status;
- exchange of clinical information in a secure digital environment;
- ensuring continuity of medical care in conditions of limited access to physical healthcare facilities [10, 20]. Telepharmacy is a component of telemedicine and involves the remote provision of pharmaceutical services, as shown in Fig. 1.

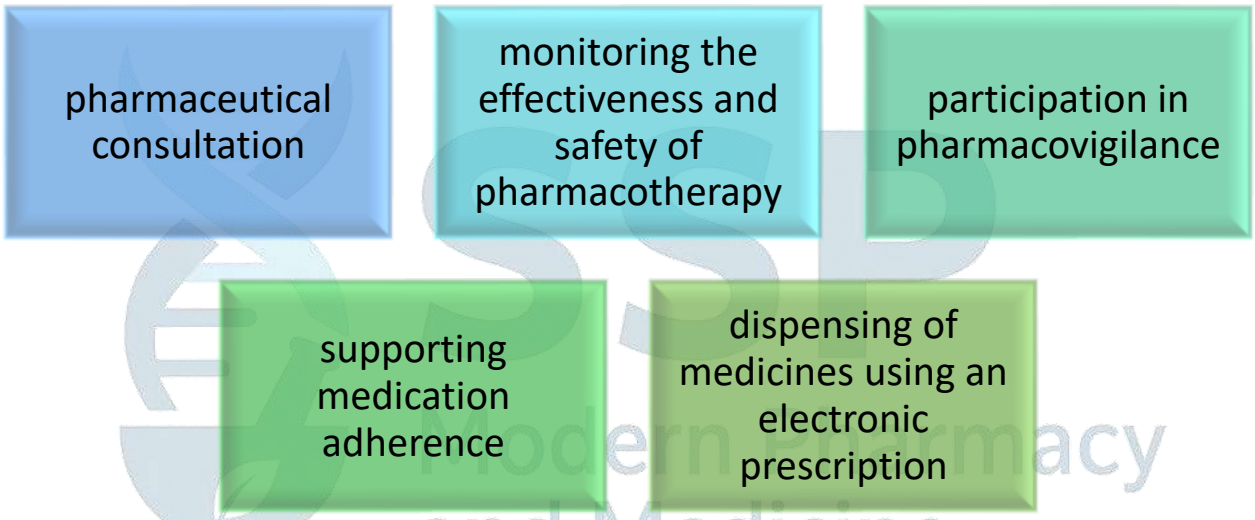

Fig. 1. Pharmaceutical telepharmacy services.

Telepharmacy contributes to increasing the accessibility of pharmaceutical care, especially for rural residents, people with limited mobility and patients with chronic diseases [14, 21].

Both concepts – telemedicine and telepharmacy – are based on the use of digital technologies to provide medical services at a distance. Their common features are:

- remote format of interaction;
- the need for secure digital platforms;
- the importance of confidentiality of medical information;
- orientation to a patient-centered model.

However, there are also differences. Telemedicine covers a wider range of medical care, including diagnostics, treatment, prevention, and rehabilitation, while telepharmacy focuses on aspects related to the use of medicines, their dispensing, control, and consultation [5, 22, 23].

At the present stage, telepharmacy is implemented through various digital formats shown in Fig. 2.

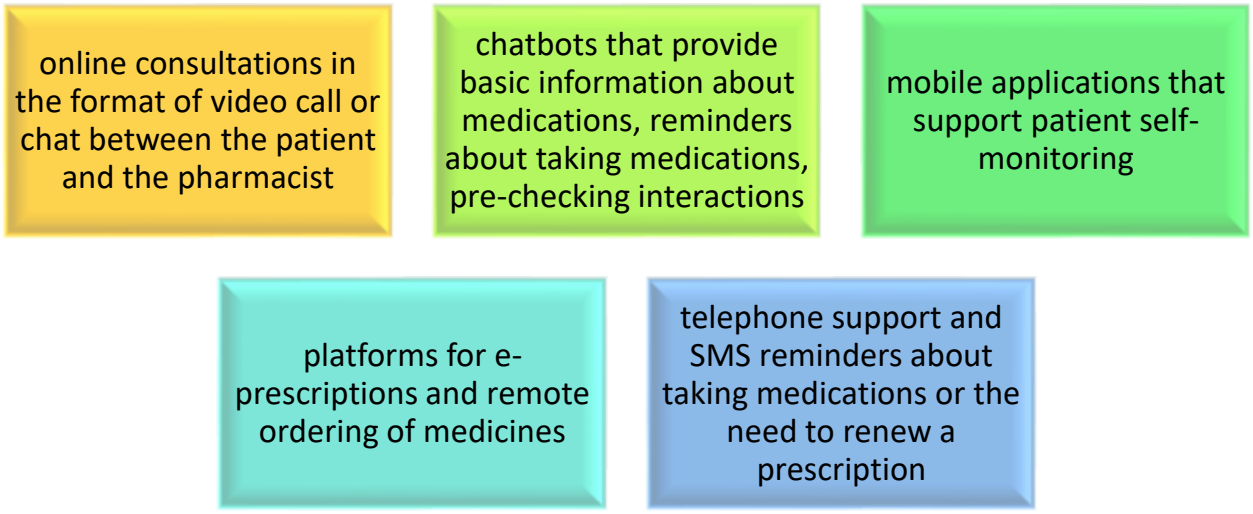

Fig. 2. Digital formats for implementing telepharmacy.

Such tools increase the convenience and effectiveness of the interaction between the pharmacist and the patient, reduce the number of errors in treatment, and promote adherence to the therapeutic regimen [24].

Telepharmacy opens new opportunities for pharmaceutical practice, contributing to increasing the availability of professional care, especially for patients in remote or rural areas. One of the key areas of its implementation is telephone and video consultations, with the help of which pharmacists can provide information on the use of medicines, assess drug therapy, identify potential problems with adherence to the treatment regimen, and carry out pharmacovigilance. Such forms of interaction help strengthen the role of the pharmacist as an accessible consultant on medical issues, especially in conditions of limited contact with a doctor or during epidemiological challenges [25].

The Empirical foundations of telemedicine interventions for chronic disease management and telepharmacy is the provision of medical and pharmaceutical consultations via telephone or video. This form of interaction allows patients to receive quality pharmaceutical services without having to visit a pharmacy in person. This is especially important for people with limited mobility, patients with chronic diseases, or residents of remote areas [26, 27].

Recommendations on the correct use of medicines are an important component of telephone and video consultations. Doctors and pharmacists provide patients with clear information on dosage, frequency of administration, interactions with other drugs or food, and possible adverse reactions. This process helps to reduce the number of medical errors and increase adherence to treatment [28, 29].

Interpretation of medical prescriptions is another important element. Patients often do not fully understand the doctor's instructions, especially when they have multiple diagnoses or are receiving combination therapy. In such cases, the pharmacist helps to clarify the prescription, avoid incorrect medication intake, and advise on optimizing therapy [30-36].

An essential component of telepharmacy is the possibility of remote dispensing of medicines. The patient can receive a consultation, send an electronic prescription, and place an order for the delivery of medicines to their home or to a dispensing point [37-42].

The features of the process without the physical presence of the patient are the need for reliable identification of the person, verification of the validity of the prescription, maintaining the confidentiality of data and proper documentation of each transaction. The pharmacist performing remote dispensing must comply with all standards of pharmaceutical care, including checking the

completeness of the prescription data and the suitability of the medicines for the clinical situation [43-52].

The legal aspects of dispensing medicines through online platforms depend on national legislation. In most countries, this issue is strictly regulated, regarding the categories of medicines allowed for distance sale, requirements for electronic prescriptions, certification of online pharmacies and quality control of services. In Ukraine, for example, online prescription dispensing has become possible thanks to the introduction of electronic prescriptions and a state register of pharmacies connected to eHealth [53-57].

The electronic prescription system is the foundation for the development of telepharmacy. It provides a convenient, safe, and controlled mechanism for prescribing and dispensing medicines, which reduces the risk of counterfeiting and promotes automation of processes [58-65].

The mechanism for issuing and verifying e-prescriptions is based on the interaction between the doctor, the pharmacy, and the patient within a single digital healthcare system. The doctor creates an electronic prescription in the system, the patient receives a prescription code (sometimes via SMS), and the pharmacist scans this code in the pharmacy software and dispenses the medicine. All information is stored centrally, which allows for control over the process of prescribing and dispensing medicines [66-74].

The interaction between the doctor, pharmacist and patient becomes more transparent and faster. The doctor sees whether the patient has received the drug, and the pharmacist sees whether there have been any changes in the therapy. The patient, in turn, has access to his own prescription history. This interaction improves pharmacovigilance, reduces drug duplication, and allows for prompt changes in treatment [75-81].

One of the challenges of modern medicine is the low adherence of patients to the prescribed treatment. Telemedicine and Telepharmacy offer tools for remote monitoring of drug intake, which allows for timely detection of violations in therapy [82-86].

Monitoring technologies include mobile applications that record medication intake, electronic dispensers with reminders, smart devices that transmit data to the pharmacist. Some applications are integrated with eHealth systems and allow medical staff to see whether the patient has taken the medication on time [87-92].

The role of pharmacists in monitoring medication adherence is not only to inform, but also to build trust and motivation. Through remote communication, the pharmacist can regularly contact the patient, answer questions, provide tips and conduct real-time monitoring [90, 91].

Telepharmacy opens new opportunities for the implementation of pharmacovigilance – a system for monitoring the safety of medicines.

Detection of side effects through remote monitoring is possible thanks to digital questionnaires, chatbots, mobile applications, in which patients can report symptoms or reactions. Such signals are automatically processed and transmitted to the pharmacist or to a single database.

Collaboration between doctors, pharmacists, and patients for early detection of problems allows not only to identify undesirable reactions, but also to assess the effectiveness of therapy in real-life conditions. This is especially important for new or complex treatment regimens that require close supervision [93].

Thus, telepharmacy covers the entire spectrum of pharmaceutical activities, adapting it to the modern needs of society and the technical capabilities of digital medicine.

Telemedicine and Telepharmacy as an innovative form of pharmaceutical care delivery demonstrates several advantages that positively affect the accessibility, quality, and efficiency of pharmaceutical care. Its implementation contributes to strengthening the role of the pharmacist in the health care system, especially in conditions of limited resources and the need for decentralized medical services [88, 94].

One of the most obvious advantages of Telehealth Transformation is to ensure equal access to medical and pharmaceutical care for residents of rural, mountainous, or other remote areas. Traditional pharmacy infrastructure is often limited in such regions, which creates obstacles to timely

receipt of consultations and medicines. Thanks to telepharmacy, patients can contact qualified pharmacists online and receive not only advice, but also order medicines with delivery [83, 87, 95].

The remote format allows for a more efficient distribution of workload between pharmacists within pharmacy networks or even between regions. One pharmacist can serve several points remotely, consult patients, check prescriptions, and control the dispensing of drugs without the need for physical presence. This is especially important in conditions of covid, post-covid, long-covid, comorbid disorders, staffing shortages or for pharmacies that cannot afford a full-time specialist [96, 97].

Telemedicine and Telepharmacy create conditions for a more structured and controlled provision of pharmaceutical services. Access to electronic medical records, consultation protocols, integration with electronic health systems (eHealth) allow pharmacists to provide more informed recommendations, avoid errors, and increase the effectiveness of therapy. In combination with monitoring and pharmacovigilance systems, this significantly improves the quality of patient care [98].

By transferring some of the pharmacists' consultations to a remote format, the number of non-urgent visits to clinics, hospitals and pharmacies is reduced. This allows optimizing the load on the healthcare system, especially during epidemics or in emergency situations. Telepharmacy also helps prevent hospitalizations associated with medication errors, which is a significant factor in saving resources [5, 42, 77, 94, 96, 99].

The ability to get a consultation or order medications online is extremely convenient for patients with limited time, health, or mobility. Telepharmacy allows you to avoid queues, reduces waiting times, increases the comfort of the treatment, and reduces barriers to discussing sensitive issues, regarding psychotropic drugs or chronic therapy. Patients receive support in a format convenient for them (video, chat, telephone), which increases adherence to treatment and overall satisfaction with interaction with the pharmacist [15, 17, 23, 37, 41].

Thus, telepharmacy not only expands the possibilities of pharmaceutical care, but also contributes to the transformation of the traditional pharmacy model into a more flexible, digital, and patient-oriented system.

Although telepharmacy opens wide opportunities for the transformation of pharmaceutical care, its effective implementation faces several challenges – legal, ethical, technical, and social. These limitations should be considered when developing a regulatory framework, training specialists and implementing new services in the healthcare system.

One of the key challenges is the lack of clear regulations in many countries that would regulate the activities of pharmacists in the format of remote consultation. Separate mechanisms for issuing permits for telepharmaceutical practice, regulations on the area of responsibility and service quality standards are needed. Without a clear framework, there is a risk of providing services of inadequate quality or violating ethical standards [11, 43, 61].

The pharmacist, when providing online consultation, bears the same ethical responsibility as during personal interaction. It is important to ensure the accuracy of the transmitted information and compliance with the principle of confidentiality. The patient has the right to complete, objective and comprehensive information about treatment, even in digital format. Ethical risks arise when working with automated services (chat bots), which can give simplified or inaccurate advice [5, 6, 86].

Telepharmacy involves the processing of sensitive information, in particular, electronic prescription data, medical history, patient contacts. In the context of cyber threats and technical vulnerabilities, ensuring the protection of communication channels, data encryption and user authentication are mandatory requirements. Vulnerable systems can become the object of unauthorized access, which not only violates the rights of patients, but also harms the reputation of the institution [89, 91].

A separate challenge is the issue of storing personalized medical information. Not all systems used for telepharmacy meet security standards such as HIPAA (USA) or GDPR (EU). It is necessary to establish regulations for data storage, encryption, destruction, and access with limited rights to change or copy information to third parties. Not all pharmacists are sufficiently trained to provide

online consultations. Additional training is often needed in the principles of digital communication; the use of health information systems and the interpretation of data obtained without physical contact with the patient. Defining the competencies required to perform a certain level of remote care should become part of professional standards. National legislation should provide for the legal consequences of pharmaceutical errors committed in the format of remote consultation. It should be clearly defined who is responsible in the event of an incorrect recommendation, a system failure, data loss or an unidentified request. Without addressing these issues, pharmacists may avoid providing online services due to legal risks [56, 100].

For effective operation of telepharmacy systems, it is necessary to ensure a sufficient level of digital literacy not only among pharmacists, but also among patients. In many cases, elderly people, residents of rural areas or socially vulnerable groups have limited access to technology or do not know how to use it. This creates barriers to the implementation of online services.

In addition, pharmacists need systematic training in working with new platforms, security protocols, and digital ethics principles. Without proper training, the risk of technical or communication errors increases, which can affect the quality of services and patient trust.

Telepharmacy is developing worldwide as an important component of the digital transformation of healthcare systems. Many countries have successfully integrated pharmaceutical remote services into medical practice, demonstrating the effectiveness of new models of pharmaceutical care.

The following are examples of the implementation of telepharmacy in the EU, USA, Canada, and Australia.

In the USA, telepharmacy has been actively developing since the early 2000s. Legislative changes, in particular, the adoption of provisions on the use of telemedicine services in Medicaid and Medicare health insurance, stimulated the integration of online pharmacist consultations, remote monitoring of therapy, and dispensing of medicines [14, 31].

In Canada, the telepharmacy system is supported at the provincial level, especially in remote areas. For example, in Manitoba and Saskatchewan, state-run Telehealth programs are operating, which include pharmacist consultations for patients in rural areas, which reduces transportation costs and improves the availability of services [35, 37].

In Australia, the "My Health Record" program has been introduced, which integrates electronic medical records of patients, including data on prescriptions and pharmacist consultations. Within this system, integrated pharmaceutical services are operating, allowing for remote consultation of patients and monitoring of their adherence to treatment [101].

In EU countries, telepharmacy is being gradually introduced as part of the eHealth development strategy. For example, in Germany, pharmacies operate with video consultation services with a pharmacist, and in Estonia, electronic prescription and remote pharmaceutical care are widely used [102, 103].

One example of effective integration is the "hub-and-spoke" cooperation model in the USA, when a central pharmacist (hub) remotely consults several pharmacy points (spokes) located in remote regions. This model allows for the constant presence of a pharmacist even where the physical presence of a separate specialist is economically unjustified [104].

In Canada, an integrated interaction model is successfully operating, where the pharmacist has access to the patient's electronic medical record and can remotely change or continue therapy in agreement with the doctor. This ensures continuity of care and allows for prompt adjustments to prescriptions [77, 83, 87, 105].

In Australia, pharmacists are actively involved in multidisciplinary remote management teams for patients with chronic conditions, providing consultations via online platforms and helping to customize individual treatment plans. These solutions contribute to increased adherence to treatment, reduced hospitalizations related to medication errors, and provide personalized patient support 24/7 [101].

Modern pharmaceutical platforms enable full remote patient management. Examples are shown in Fig. 3.

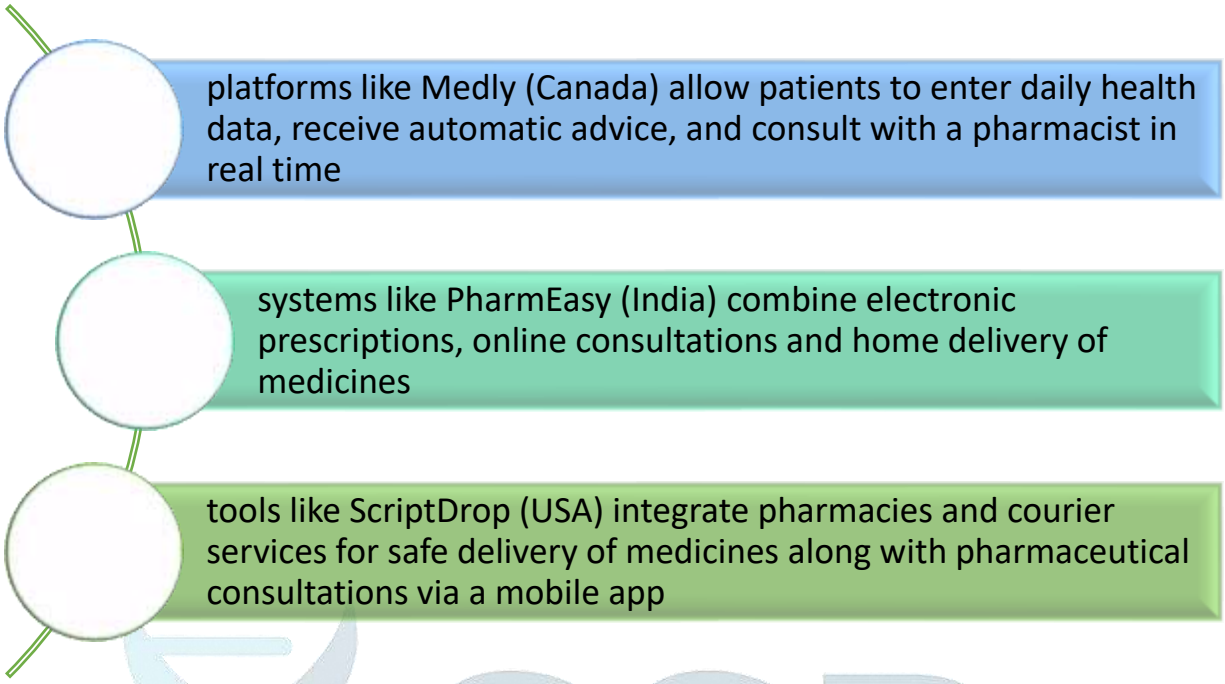

Fig. 3. Examples of modern pharmaceutical platforms that provide the possibility of full-fledged remote patient management.

Thus, international experience demonstrates that telepharmacy can become an effective tool not only for expanding access to pharmaceutical care, but also for improving its quality and efficiency in the context of digital medicine.

In Ukraine, telepharmacy began to develop actively in response to global challenges associated with the COVID-19 pandemic, the digitalization of healthcare, and the need to ensure equal access to pharmaceutical services regardless of place of residence. At the same time, the process of integrating telepharmacy remains at the formation stage and requires systematic support at the regulatory, organizational, and educational levels.

Regulatory and legal regulation of telepharmacy in Ukraine is at an early stage. The introduction of an electronic prescription in 2022–2023 was an important milestone that laid the foundation for the development of remote pharmaceutical services [105, 106].

Currently, the following normative and regulatory documents regarding telepharmacy are in force in Ukraine (Fig. 4).

However, there is still no specific law or clear by-laws regulating telepharmaceutical consultations, remote dispensing of medicines or the interaction of pharmacists in the digital environment. This creates regulatory gaps and requires improvement of the legal field.

One of the important initiatives is the implementation of the National Electronic Health System (eHealth), which provides for electronic document flow between doctors, pharmacists, and patients. Within the framework of this system, the following are actively implemented:

- ✓ electronic prescriptions for all prescription drugs;
- ✓ registration of pharmacies in the eHealth system;
- ✓ the ability to issue an electronic prescription by a doctor of any level.

Also, private pharmacy chains (for example, "Good Day Pharmacy", "Podorognyk") are implementing their own online drug ordering services with the possibility of receiving pharmaceutical advice in chat or by phone. Some networks are working on launching pilot projects for video consultation of pharmacists via mobile applications.

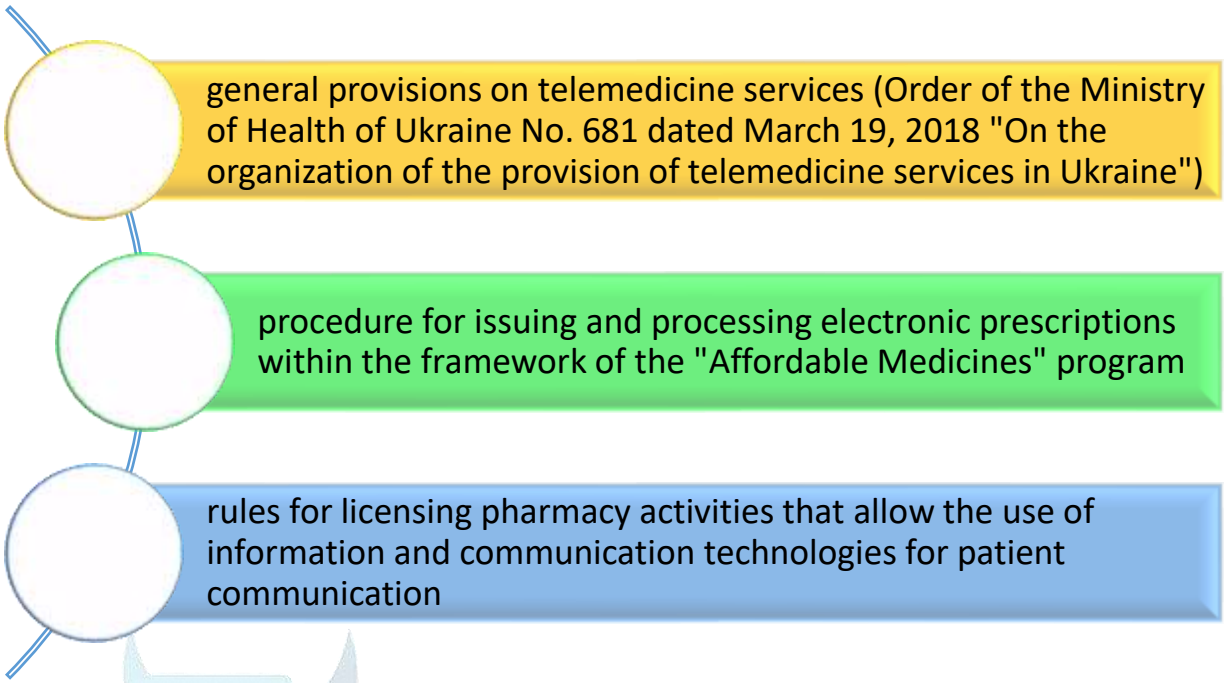

Fig. 4. Normative and regulatory documents on telepharmacy in force in Ukraine.

Pharmacy networks in Ukraine play an important role in stimulating the development of telepharmacy. They have sufficient financial and organizational resources to implement IT solutions, create platforms for online consultations, integrate mobile applications, and develop drug delivery.

Pharmaceutical education also needs to adapt to new realities. As of 2025, pharmacist training programs are only beginning to integrate disciplines related to telemedicine technologies, digital communication, and information security. It is necessary to create specialized courses and improve the skills of existing pharmacists to work in digital medicine [107, 108].

The main barriers to the implementation of telepharmacy in Ukraine are (Fig. 5).

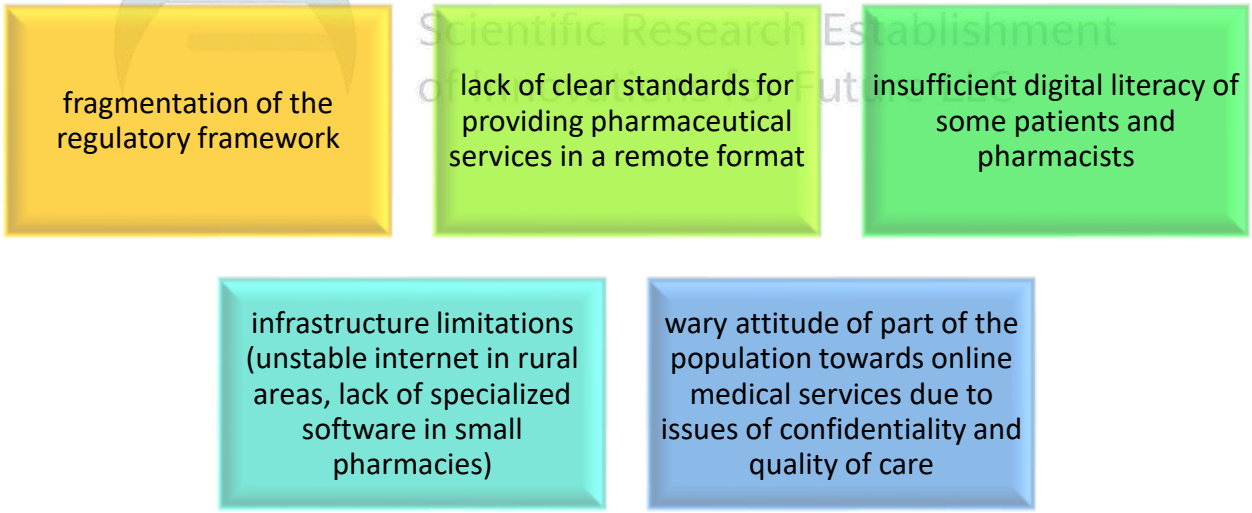

Fig. 5. Barriers to the implementation of telepharmacy in Ukraine.

Overcoming these barriers requires a coordinated state policy, a broad information campaign, the development of educational programs and the active participation of professional pharmaceutical associations.

Thus, telepharmacy in Ukraine has significant potential, but its implementation requires an integrated approach to solving legal, organizational, technological, and educational challenges.

The development of artificial intelligence opens new opportunities for improving telepharmacy, expanding the functional capabilities of pharmacists and increasing the accessibility of pharmaceutical care. AI technologies are integrated into all stages of remote pharmaceutical practice – from supporting clinical decision-making to automated consultations and creating virtual pharmacists.

Artificial intelligence can help pharmacists make informed clinical decisions by (Fig. 6).

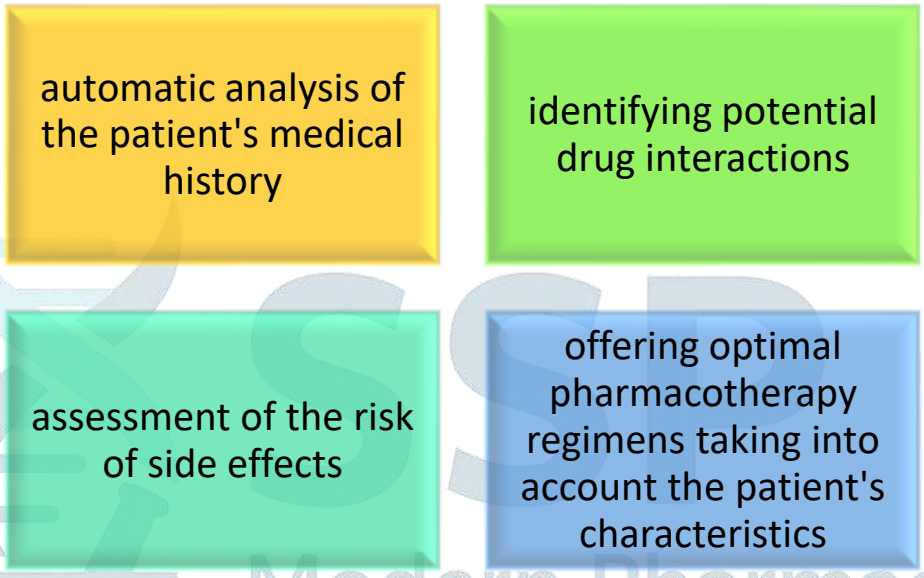

Fig. 6. AI-based assistance to pharmacists.

AI-systems integrated with electronic medical records can quickly process large amounts of data and offer personalized recommendations, which reduces the risk of errors and improves the quality of care [109].

Such tools are especially useful when supporting patients with polypreparations, complex treatment regimens or rare diseases.

AI allows you to automate the initial stages of pharmaceutical consultation using chatbots and voice assistants. Such tools can:

- answer standard questions about dosage, dosing regimen and possible side effects;
- remind you about the need to take medications;
- check symptoms and provide recommendations for contacting a doctor or pharmacist.

For example, in the USA, AI-based systems such as PillPack Assistant help patients track their medication schedule and receive prompt support [110].

The use of such systems allows pharmacists to focus on more complex cases, while typical requests are processed automatically and efficiently.

Virtual pharmacists are AI platforms that simulate the activities of a real pharmacist in the field of consultations, monitoring of medication intake and patient support. Based on deep learning, such systems can:

- interpret electronic prescriptions;
- assess drug interaction issues;
- provide individualized recommendations depending on the patient's health status.

Virtual pharmacists are actively implemented in large pharmacy chains and telemedicine services in the USA, Australia, and Canada. For example, the Ada Health project offers consultations

that consider medical history, current prescriptions, and symptoms, automating the patient's first contact with the pharmaceutical support service [101].

The use of virtual pharmacists allows (Fig. 7).

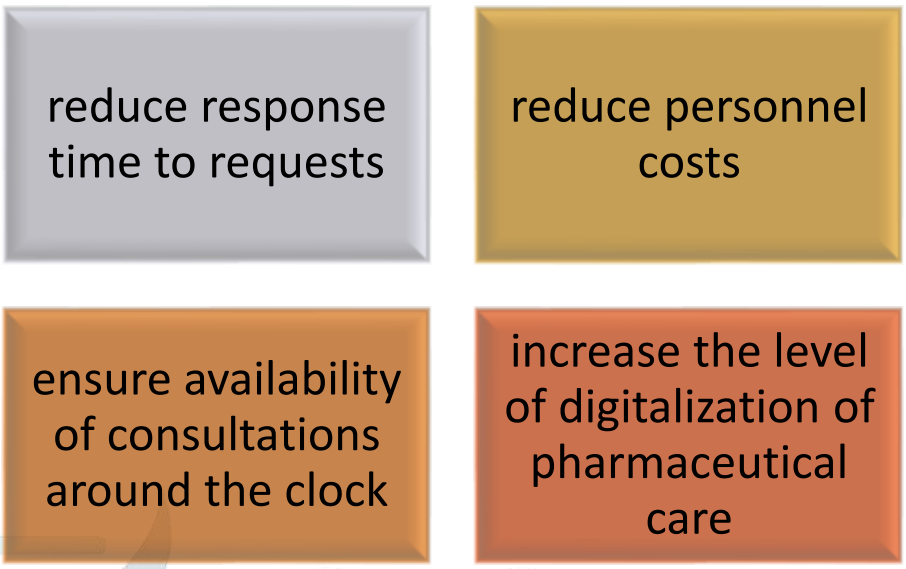

Fig. 7. Virtual pharmacist capabilities.

However, it is important to remember that the use of AI in pharmacy requires a clear ethical and legal framework to ensure the accuracy of recommendations, protect patient data, and maintain human control in the decision-making process.

Conclusions. Telepharmacy is one of the key areas of transformation of pharmaceutical care in the digital age. It opens wide opportunities for increasing the accessibility, efficiency, and quality of pharmaceutical services, for patients in remote regions, people with limited mobility, and chronic diseases.

Among the main advantages of telepharmacy are:

- ensuring access to qualified pharmaceutical care regardless of place of residence;
- optimizing the use of pharmacy network resources;
- improving the quality of pharmaceutical care using digital tools;
- reducing the burden on healthcare institutions;
- increasing the convenience and adherence of patients to treatment.

At the same time, the implementation of telepharmacy is accompanied by several challenges, including:

- the need to improve regulatory and legal regulation;
- protection of patients' personal data in the digital environment;
- definition of pharmacists' responsibility during remote consultations;
- overcoming barriers to digital literacy among patients and specialists.

The prospects for the implementation of telepharmacy in Ukraine are encouraging. The development of the electronic health system (eHealth), the introduction of electronic prescriptions, the interest of pharmacy chains in innovative service formats and the emergence of new technologies based on artificial intelligence create favorable conditions for the expansion of pharmaceutical care at a distance.

To integrate telepharmacy into the Ukrainian healthcare system and pharmaceutical practice, it is advisable to take the following measures:

- develop and implement separate regulatory legal acts regulating the activities of pharmacists in the field of remote consultation and dispensing of medicines;
- ensure the protection of patients' personal data in accordance with international standards;
- create training and advanced training programs for pharmacists to work in the digital environment;

- stimulate the participation of pharmacy chains in pilot projects of telepharmacy;
- develop information and educational campaigns to increase the level of digital literacy among the population.

Thus, telepharmacy has all the prerequisites to become an important component of the integrated healthcare system in Ukraine, contributing to increasing the accessibility, safety, and quality of pharmaceutical care.

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