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TELEMEDICINE IN PHTHISIOPULMONOLOGY MOLDOVA: MEDICAL EFFECTS AND LEGAL FRAMEWORK

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Summary.
Telemedicine, defined as the provision of medical care through information and communication technologies, has become an effective tool for improving the management of respiratory diseases. In Moldova, where the prevalence of tuberculosis, chronic obstructive pulmonary disease (COPD), asthma, and cystic fibrosis remains high, the implementation of telemedical solutions can expand access to specialized care, enhance patients' adherence to therapy, and reduce the burden on the healthcare system. This article analyzes international studies, national legal frameworks, and the experience of pilot projects. The advantages and barriers are identified, including insufficient infrastructure, low digital literacy, legal uncertainty, and the risk of criminal liability of physicians for negligence. Measures are proposed to improve legislation, strengthen infrastructure, and introduce a system of professional liability insurance.
Keywords: telemedicine, phthisiopulmonology, Republic of Moldova, tuberculosis, COPD, asthma, criminal liability.

Rezumat. Soluții de telemedicină pentru ftiziopneumologie în Republica Moldova: oportunități și limitări.
Telemedicina, definită ca acordarea la distanță a asistenței medicale prin utilizarea tehnologiilor informaționale și de comunicații, devine un instrument eficient pentru îmbunătățirea tratamentului bolilor pulmonare. În Republica Moldova, unde se menține o incidență ridicată a tuberculozei, bolii pulmonare obstructive cronice (BPOC), astmului și fibrozei chistice, implementarea soluțiilor de telemedicină poate crește accesul la îngrijiri specializate, îmbunătăți aderența pacienților la terapie și reduce povara asupra sistemului de sănătate. Articolul analizează studii internaționale, acte normative naționale și experiența proiectelor pilot. Sunt identificate avantaje și bariere, inclusiv infrastructura insuficientă, nivelul scăzut de alfabetizare digitală, incertitudinea juridică și riscul răspunderii penale a medicilor pentru neglijență. Sunt propuse măsuri pentru perfecționarea legislației, dezvoltarea infrastructurii și instituirea unui sistem de asigurare a răspunderii profesionale.
Cuvinte cheie: telemedicină, ftiziopneumologie, Republica Moldova, tuberculoză, BPOC, astm, răspundere penală.

Резюме. Телемедицинские решения для фтизиопульмонологии в Республике Молдова: возможности и ограничения.
Телемедицина, понимаемая как дистанционное оказание медицинской помощи с использованием информационно-коммуникационных технологий, становится эффективным инструментом для улучшения лечения заболеваний легких. В Республике Молдова, где сохраняется высокая заболеваемость туберкулезом, хронической обструктивной болезнью легких (ХОБЛ), астмой и муковисцидозом, внедрение телемедицинских решений способно повысить доступность специализированной помощи, улучшить приверженность пациентов к терапии и снизить нагрузку на систему здравоохранения. В статье анализируются международные исследования, национальные нормативные акты и опыт пилотных проектов. Определены преимущества и барьеры, включая недостаточную инфраструктуру, низкий уровень цифровой грамотности, неопределенность правового регулирования и риск уголовной ответственности врачей за халатность. Предлагаются меры по совершенствованию законодательства, модернизации инфраструктуры и созданию системы страхования профессиональной ответственности.
Ключевые слова: телемедицина, фтизиопульмонология, Республика Молдова, туберкулез, ХОБЛ, астма, уголовная ответственность.

Introduction.

Telemedicine has long ceased to be perceived as an exotic phenomenon and is now considered a key element in the transformation of the healthcare system [3]. The World Health Organization defines it as the use of digital technologies to exchange medical information and provide remote care [22]. Telemedicine includes video consultations, mobile applications, remote health monitoring, and collaboration between specialists in electronic systems [21]. International experience shows that such technologies can improve treatment outcomes for patients with chronic respiratory diseases, including tuberculosis [23], chronic obstructive pulmonary disease (COPD) [11], bronchial asthma [2], and cystic fibrosis [5]. Their advantages include closer monitoring of patient condition, maintaining high adherence to therapy [18], and timely detection of complications. The effectiveness of telemedicine is confirmed by the results of numerous systematic reviews and practical projects [10].

This topic is particularly relevant in the Republic of Moldova. According to WHO reports, the country is among the European countries with the highest prevalence of tuberculosis [23]. Demographic and economic challenges have led to a chronic shortage of medical personnel, especially in rural areas [20], which makes it difficult for the population to access specialized care. COPD and asthma also represent serious challenges to public health, requiring long-term monitoring, regular treatment adjustments, and a comprehensive approach to managing patients [2, 11]. All this creates an objective need for new organizational models of healthcare delivery, among which telemedicine occupies a special place, providing regular monitoring and coordination of treatment without the need for physical visits.

However, the introduction of telemedicine technologies in the Republic of Moldova is fraught with a number of problems. First and foremost, these are infrastructure limitations [20], including uneven Internet coverage and the technical unpreparedness of healthcare institutions. The lack of specialized legislation remains a significant barrier: issues of liability, patient consent procedures, and quality standards for telemedicine services are currently unregulated [14-16]. Cultural and social factors, such as low digital literacy and patient distrust of the security of medical data transmission, are no less significant [7, 13].

The aim of this study is to analyze the possibilities of applying telemedicine solutions in phthisiopulmonology in the Republic of Moldova, identify key barriers, and develop practical recommendations for overcoming them.

Materials and methods

The study was conducted in an interdisciplinary paradigm combining a clinical and epidemiological review of the literature and a regulatory and legal analysis. Sources were searched in PubMed/MEDLINE, Cochrane Library, Scopus, Web of Science (Clarivate), HeinOnline, as well as in the national resources of the Republic of Moldova – IBN and LEGIS.md. The analytical focus was on recent publications on video-observed therapy (VOT), telemonitoring, and remote consultations for respiratory pathology. The legal database included laws, regulations, strategies, and regulatory clarifications. The methodological tools covered content analysis, comparative legal and historical legal approaches; a narrative review with stratification of levels of evidence was applied. WHO documents, including the Global Strategy on Digital Health 2020–2025, served as the regulatory and methodological framework. Official publications were used as legal sources, and peer-reviewed publications were used as scientific sources.

Results and discussion.

Definition and capabilities of telemedicine

Telemedicine covers a wide range of medical practices implemented remotely using modern information and communication technologies [22]. Its key objective is to optimize interaction between medical specialists and between doctors and patients, thereby improving the accessibility, efficiency, and quality of medical care.

One of the priority areas of telemedicine is the organization of remote consultations and the exchange of clinical information between healthcare institutions [3]. This format of cooperation allows doctors to quickly transfer examination results, medical images, and expert opinions, thereby speeding up the diagnostic process and ensuring clinically sound solutions. In conditions of limited access to highly specialized consultations, this mechanism is particularly important, as it helps to compensate for the shortage of human resources.

An important component of telemedicine is distance learning and professional development for medical staff [13]. With the help of specialized online platforms, doctors and other specialists have the opportunity to participate in webinars, take advanced training courses, and access current scientific data without leaving their place of work. This model promotes continuous professional growth, the dissemination of advanced clinical practices, and the

harmonization of medical training standards at the national and international levels.

The practice of remote medical observation is of particular importance [2, 11]. It involves regular remote assessment of the patient's health by the attending doctor with the possibility of scheduling an in-person appointment or additional examinations if necessary. This approach has proven to be highly effective in the management of patients with chronic diseases and in situations requiring surgical intervention, where the physical presence of the patient in a medical facility is difficult or impractical.

Telemonitoring of physiological parameters is another promising area. Using portable digital devices, patients can independently record vital signs, including blood pressure, heart rate, and blood glucose levels, at home [5, 11]. This data is automatically transmitted to the attending doctor via secure communication channels, ensuring continuous monitoring and timely intervention when abnormalities are detected. This model is particularly relevant for patients with limited mobility, minimizing the number of visits to healthcare institutions without compromising the quality of medical care.

It should be emphasized that any telemedicine intervention must comply with established quality and safety standards, including ISO/IEC 27001 requirements [9]. This implies strict protection of the confidentiality of medical information [15], the application of current clinical protocols and standards, as well as compliance with ethical and legal principles governing the provision of medical care [21]. In this way, telemedicine does not replace the traditional healthcare model, but complements it, expanding the capabilities of the system and increasing its resilience and adaptability to modern challenges.

The current state of telemedicine in the Republic of Moldova

The development of e-health in Moldova began in the early 2000s. In 2004–2005, strategic documents were adopted, including the Concept of an Integrated Medical Information System (SIMI) and the "Electronic Moldova" program. They identified the need for the digitalization of healthcare, but a full-fledged national telemedicine program was not created. Attempts were made to develop a conceptual framework, including with the participation of the Telemedicine Association, but they remained incomplete.

The COVID-19 pandemic was a turning point. In the fall of 2020, the Ministry of Health introduced the practice of remote consultations in hospitals to coordinate the treatment of severe cases. With the support of international partners, intensive care unit doctors received equipment to participate in online consultations with specialists from Chisinau. Medical information was transmitted via secure channels, ensuring timely expertise and support. This experience confirmed the potential of telemedicine and became the basis for new initiatives.

After the pandemic, pilot projects were launched with the assistance of international organizations. In 2022, the "Digital Inclusion of Social Services and e-Health" project was launched with the participation of UNFPA, USAID, the Government of Sweden, and Moldcell. As part of this project, 603 elderly citizens received mobile devices and access to free consultations [1], as well as digital literacy training with the support of volunteers. The project was overseen by the e-Government Agency.

In 2022–2023, the state focused its attention on the regulatory framework. The expert community, in particular IDEP Moldova, emphasized the need to legislate telemedicine, drawing on the Romanian experience [20]. In response, the Ministry of Health initiated the development of regulations, including in the context of European initiatives such as EU4Health.

At the same time, training was provided. The N. Testemitanu State University of Medicine and Pharmacy, with the support of international partners, launched the Future HealthTech project, in which more than 200 doctors and residents learned methods of remote interaction and the application of artificial intelligence in clinical practice [7].

In this way, Moldova is gradually moving from isolated experiments to the systematic implementation of telemedicine. However, further development requires consistent steps in the legislative, organizational, and infrastructural spheres [8].

Examples of the application of telemedicine technologies

The experience of applying telemedicine in the Republic of Moldova consists mainly of pilot projects implemented with the support of international organizations. The first significant results were obtained during the coronavirus pandemic, when doctors in regional intensive care units began consulting with specialists from clinics in the capital via secure video links. This practice significantly improved the quality of treatment for patients with severe COVID-19 and became a model for the subsequent use of remote consultations in other clinical situations [6].

In 2017-2018, with the support of UNDP and the Ministry of Health, a project was implemented to introduce video-observed therapy (VOT) for the

treatment of tuberculosis. Patients sent videos of themselves taking their medication to their doctor, which resulted in an 87% adherence rate to treatment, compared to only 43% in the traditional observation (DOT) group. The success of the experiment allowed the project to be scaled up to ten regions of the country with the support of the Global Fund [18].

In 2022, Caritas Czech Republic, in collaboration with the Moldovan Home Care Association, introduced telemedicine services in rural areas. Eight medical and social centers received the necessary equipment, 24 specialists were trained, and about 4.000 remote consultations were planned for elderly patients with chronic diseases and limited mobility. This practice made it possible to reduce barriers to access to medical care and, at the same time, continue monitoring patients under pandemic restrictions [7].

Since the same year, the Voinicel Early Intervention Center, with the support of the European Union, has been implementing a program of remote counseling for families with children from rural areas of Cahul and Ungheni. Online consultations with neurologists, psychologists, and speech therapists have accelerated diagnosis and the start of corrective work, while retaining the option of referring patients for face-to-face appointments if necessary.

Great importance is attached to the training of medical personnel. In the summer of 2025, FutureCardio, FutureMentalHealth, and FutureUro summer schools were organized for 200 young doctors and residents, where they were taught methods of remote diagnosis and the application of artificial intelligence in specialized fields [7]. At the same time, universities are developing partnerships with foreign educational institutions, including plans to create a joint Chisinau-Bucharest telemedicine laboratory.

In this way, examples of the practical application of telemedicine in the Republic of Moldova cover a wide range of areas, from the treatment of infectious diseases and expanding access for rural residents to early intervention in pediatrics and the training of medical specialists. This demonstrates the country's transition to the sustainable use of telemedicine technologies in the healthcare system.

International experience

International practice in telemedicine demonstrates its effectiveness in the treatment and monitoring of lung diseases. Video-observed therapy (VOT) allows doctors to monitor the intake of medication by tuberculosis patients via video: the patient records the process of taking the medication and sends it to the doctor. Systematic reviews confirm that VOT provides comparable or better adherence to treatment compared to traditional "directly observed treatment" (DOT). A 2024 study by Sundaram et al. shows that in most of the clinical trials analyzed, the treatment completion rate using VOT exceeded 90%, and patients reported convenience and reduced psychological pressure [10]. Lygidakis et al. reached similar conclusions, emphasizing that remote programs were particularly effective during the COVID-19 pandemic in maintaining treatment continuity while reducing patient contact with healthcare personnel and the risk of infection. The US Centers for Disease Control and Prevention (CDC) reports that electronic directly observed therapy (eDOT) not only allowed treatment to be monitored, but also saved money on transportation costs, with a course completion rate of over 95% [6].

For COPD, telemonitoring and remote counseling reduce the frequency of hospitalizations and improve patient quality of life [4]. A Cochrane review by McLean et al. notes that telemedicine promotes early detection of exacerbations, improves self-management, and reduces the burden on the primary care network. Another study shows that patient participation in online communities and regular interaction with medical staff via mobile apps leads to a reduction in hospitalizations and increases patient activity.

For asthma, telemedicine solutions include mobile apps for tracking symptoms, treatment plans, and peak expiratory flow monitoring [2]. According to a systematic review, telemedicine improves asthma management by enhancing adherence, symptom monitoring, and remote education, although evidence on cost reduction remains limited. Remote monitoring technologies allow doctors to adjust inhaled medication doses in a timely manner and patients to receive personalized recommendations and feedback.

Cystic fibrosis, a genetic disease requiring a comprehensive approach, has also benefited from the introduction of telemedicine [5]. Melnikov's review emphasizes that regular virtual visits allow for monitoring of patient status, improved adherence to daily therapy, and faster detection of deterioration. At the same time, it is noted that telemedicine cannot completely replace a physical examination, especially when microbiological tests are required, and requires a stable internet connection. The authors emphasize that elderly patients and people with low digital literacy may experience difficulties in using such services.

National situation and legal aspects

In the Republic of Moldova, telemedicine is still being implemented in a fragmented manner. In

its strategy for 2021-2030, the Ministry of Health identifies the need to digitalize the healthcare system and introduce electronic medical records [12]. However, the absence of a specific law on telemedicine services leaves doctors and patients in a state of legal uncertainty. The existing laws "On Medical Services" and "On Personal Data Protection" only partially address the use of information technology, but do not contain specific provisions regarding remote diagnosis and consultations. Unlike Moldova, in Romania and Lithuania there are already separate laws regulating the provision of telemedicine services, quality standards, and the distribution of responsibility among participants in the process.

The legal regulation of telemedicine in the Republic of Moldova is linked to a number of related areas. It touches on pharmaceutical law in terms of prescribing medicines, insurance law in relation to the mechanisms for paying for telemedicine services, and tax law, which determines the specifics of how private digital platforms operate. The issue of remote prescriptions requires particular attention. Although electronic prescriptions have already been introduced in the country, there remains uncertainty regarding the prescription of potent drugs without a face-to-face examination. A striking example of the complexity of regulation was the 2023 debate on the possibility of drug-induced abortion through telemedicine, which demonstrated the need for clear and transparent regulations.

In the future, the telemedicine bill should contain a clear distinction between acceptable and unacceptable forms of remote intervention. Acceptable forms include follow-up appointments, psychotherapeutic consultations, monitoring of chronic conditions, and adjustment of prescribed treatment [14, 15]. At the same time, it is unacceptable to use telemedicine technologies for the initial diagnosis of serious diseases without a face-to-face examination, for performing surgical operations (with the exception of robotic telesurgery), or for prescribing narcotic analgesics without visual control.

Given the lack of a structured regulatory framework, Moldova can draw on the experience of countries that have achieved significant success in regulating this area. The example of Romania is particularly relevant, where in 2020 amendments were made to Law No. 95/2006 "On Health Care Reform," legalizing telemedicine and defining its permissible forms [20]. The country has developed educational programs to train specialists in the field of telemedicine and is implementing projects to create telemedicine centers in rural areas. The Romanian side has expressed its willingness to cooperate with Moldova in adapting the regulatory framework to local realities. In December 2022, Moldavian experts proposed the creation of an interdepartmental working group with the participation of parliament and the executive branch to prepare comprehensive legislation on telemedicine based on the Romanian model.

In the context of European integration, Moldova will also have to ratify a number of international agreements related to the cross-border exchange of medical information, the recognition of electronic signatures, and the standardisation of digital identity requirements. Joining the European Digital Identity Framework will open up opportunities for the integration of national telemedicine services into a single European digital space.

When developing national legislation, it is necessary to take into account the principles of the WHO's global digital health strategy. The document emphasizes that the institutionalization of digital health requires political will, a comprehensive strategy, and consideration of the challenges faced by the least developed countries. Among the priorities are the development of national digital strategies, the strengthening of digital health governance mechanisms, and the introduction of patient-centered systems. These guidelines should be adapted to the regulatory framework in Moldova and taken into account when developing technical standards.

It is equally important to clearly define the boundaries of responsibility for all participants in telemedicine interactions. Doctors bear professional and legal responsibility for the solutions and recommendations they provide, regardless of whether the care is provided in person or remotely. In inter-doctor consultations, the final responsibility for treatment remains with the attending doctor, who uses the consultant's opinion. The healthcare institution is responsible for ensuring that the technical and organizational conditions meet the requirements for the security and reliability of the telemedicine session. In the event of harm to the patient due to a technical failure or data leak, responsibility may be attributed to the institution or the information system operator. The operator, in turn, is obliged to ensure the protection of personal data, provide the patient with complete information about the system for storing it, as well as their legal and contact details [13, 15].

The patient also bears certain responsibilities: they are obligated to provide accurate information about their health and to follow the doctor's recommendations. The patient's informed consent

confirms their conscious participation in the remote form of interaction and records their acceptance of the terms and conditions for the provision of telemedicine services.

Medical effects and limiting factors

The effectiveness of telemedicine in the treatment of tuberculosis has been confirmed by both international and national studies. As part of a UNDP pilot project in the Republic of Moldova, patients using video monitoring of medication adherence demonstrated a level of adherence to therapy of around 87%, while among those who continued to visit a healthcare institution for directly observed treatment, this figure did not exceed 43% [7]. An economic analysis revealed additional benefits in the form of reduced transportation costs, shortened time for medical staff, and fewer treatment interruptions. These findings are consistent with the results of systematic reviews, which consider video-monitored therapy to be a patient-friendly and highly effective tool. However, technical limitations remain: the need for a stable internet connection, the availability of high-quality cameras and smartphones, and the need to train patients to use the platforms.

In the treatment of chronic obstructive pulmonary disease, telemonitoring makes it possible to track indicators such as peak expiratory flow rate, respiratory rate, and oxygen saturation level, transmitting the data to the doctor in real time [4, 11]. According to Cochrane reviews, such programs help reduce hospitalizations and improve patient quality of life, although they do not always result in significant resource savings. Additional data from a study by Bourne and co-authors indicate that patient participation in online communities and the use of telemedicine sessions reduces the burden on clinics: patients are less likely to seek emergency care when they receive remote consultations.

In bronchial asthma, telemedicine technologies not only allow monitoring the frequency of attacks, but also organizing patient education in real time [2]. Systematic reviews confirm that such solutions improve symptom control, quality of life, and adherence to therapy. However, there is still insufficient data in the literature on the long-term economic effects. Mobile applications that allow parents of children with asthma to record data on inhaler use and quickly contact a doctor in case of exacerbations are particularly important, especially in rural areas.

In the management of patients with cystic fibrosis, telemedicine platforms create conditions for continuous interdisciplinary interaction between pulmonologists, physiotherapists, and dietitians [7]. However, the remote format cannot replace laboratory monitoring of the respiratory tract microflora and physical examination. Studies emphasize the need to combine telemedicine with periodic visits to the clinic. In addition, barriers of digital inequality remain: elderly patients and low-income families often lack access to high-speed internet and modern devices, which limits the coverage and effectiveness of telemedicine programs.

Management solutions

A comprehensive approach is needed to overcome existing barriers and successfully integrate telemedicine into phthisiopulmonology practice. First and foremost, a special law on telemedicine services needs to be developed and adopted to establish the legal status of remote consultations, define quality standards, technical equipment requirements, and certification procedures. The law should contain clear rules for the distribution of responsibility between the doctor, the medical organization, and the telemedicine platform operator, which will eliminate legal uncertainty.

An important step is the introduction of a professional liability insurance system for healthcare professionals providing remote services [13]. This practice is widely used in European countries and ensures a balance of interests: doctors are protected from unfounded claims, and patients are protected from the risk of not receiving compensation in the event of adverse outcomes.

It is also necessary to adapt clinical protocols and treatment standards to the conditions of telemedicine [14, 15, 20]. They should include instructions for conducting video consultations, data transfer procedures, recording patient consent, and maintaining medical records. The protocols should cover not only tuberculosis, but also diseases such as COPD, bronchial asthma, and cystic fibrosis [2, 5, 11].

An essential condition for the development of telemedicine is public-private partnership in the field of infrastructure [1, 7]. First and foremost, this involves establishing sustainable broadband connectivity in rural areas, equipping healthcare institutions with modern video systems, and integrating telemedicine platforms with electronic medical records.

Staff training requires special attention [7, 13]. Doctors, nurses, IT specialists, and lawyers must receive specialized training that covers issues of remote interaction, personal data protection, and the legal aspects of using electronic evidence. At the same time, it is necessary to improve the digital literacy of

patients and conduct information campaigns aimed at building trust in telemedicine technologies and understanding the responsibilities of both parties.

Areas of development

The future development of telemedicine in phthisiopulmonology should be based on systematic scientific research [18]. The primary focus should be on randomized controlled trials that will allow for a comparison of the effectiveness of video-monitored therapy, telemonitoring, and standard approaches not only for tuberculosis but also for other lung diseases, including COPD, asthma, and cystic fibrosis. The results of such studies will help determine the optimal models of remote care and their economic feasibility.

Equally important is the development of a legal framework for electronic document management [15]. Mechanisms for recording electronic consent and storing digital evidence that will be recognized as admissible in court should be explored. A comparative analysis of international experience will allow the best solutions to be adapted to the legal system of Moldova.

Another promising area is the study of professional liability insurance models in telemedicine [13]. The task of such studies should be to determine fair rates and compensation mechanisms that take into account the specific risks of remote practice.

Special attention should be paid to studying the social and cultural factors that influence the acceptance of telemedicine [7]. These include patient trust, digital literacy, and the stigmatization of tuberculosis in society. The results of such studies will help develop effective communication strategies.

Finally, the integration of telemedicine with artificial intelligence and big data technologies opens up new horizons. The use of predictive algorithms to monitor breathing parameters in real time, prevent exacerbations and outbreaks of tuberculosis, optimize patient routes, and manage resources can take phthisiopulmonology practice to a whole new level [20]. These areas should form the basis for future interdisciplinary projects combining medicine, law, and information technology.

Conclusion.

Telemedicine is one of the most promising areas for modernizing healthcare in Moldova. Experience in recent years has clearly demonstrated its effectiveness and high demand. Remote solutions provide rural residents and vulnerable groups with access to qualified care without having to go anywhere, expand opportunities for doctors to hold consultations and engage in continuous training, and increase adherence to treatment: video-monitored tuberculosis therapy recorded an 87% adherence rate, compared to 43% with traditional monitoring. For the state, telemedicine means preventing complications, cost rationalization, and improving service quality.

Systemic steps are needed to realize its potential. Pilot practices should be scaled up and integrated into the standard of care at all levels, from regional hospital to rural clinics. This requires reliable broadband connectivity, modern equipment, staff training and motivation, increased digital literacy and patient trust, as well as clear legal rules to ensure safety and certainty.

It is positive that these tasks have already been recognized as a priority: legislation is under development, European funds are being attracted, and universities are training personnel. In the coming years, telemedicine should become an integrated part of the system: video consultations for residents of remote villages, home sensors for chronically ill patients, and real-time support for ambulance crews. Consistent reforms will make this a reality and allow Moldova the opportunity to take the lead. Ultimately, patients, doctors, and the healthcare system will benefit from a more flexible, sustainable, modern, and equitable model of care.

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