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IATROGENESIS IN MEDICAL PRACTICE: CAUSES, TYPES, AND PREVENTION STRATEGIES

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Abstract. This article scientifically examines the problem of iatrogenesis in medical practice-harmful conditions arising in patients as a direct result of the treatment process itself. The paper provides a comparative analysis of the primary types of iatrogenesis (medication-related, surgical, diagnostic, infectious, and psychogenic), their underlying causes, and prevalence rates across various countries. Furthermore, the article evaluates internationally proven prevention strategies, including standardized clinical protocols, safety culture, and digital monitoring systems, to develop practical recommendations for the healthcare system of Uzbekistan.

Keywords: iatrogenesis, patient safety, medical errors, adverse events, drug side effects, prevention strategies, healthcare quality, safety culture.

Introduction. Although the rapid development of modern medicine has expanded the possibilities for patient treatment, it has simultaneously given rise to new types of risks. Among these risks, iatrogenesis—harmful conditions occurring in a patient as a result of medical activity—occupies a special place. Today, iatrogenesis has become one of the most critical and often overlooked problems in the global healthcare system. According to the first "Global Patient Safety Report" published by the World Health Organization (WHO) in 2024, more than one in ten patients (over 10%) treated in medical institutions experience harm, and more than half of these cases result from preventable causes (World Health Organization, 2024). This figure clearly illustrates how widespread and serious the problem of iatrogenesis is.

In quantitative terms, the situation takes on an even more alarming tone. Researchers estimate that in the period preceding the COVID-19 pandemic, 2.6 million people died annually in low-income countries due to safety failures in hospitals; in developed countries, approximately 15% of hospital costs and activities were spent on rectifying failures that occurred during the treatment process (Chen et al., 2023). According to the Institute of Global Health Innovation at Imperial College London, unsafe medical care causes 43 million adverse events per year, making iatrogenesis one of the top ten leading causes of death worldwide (Panagioti et al., 2019). Medication-related iatrogenic effects carry significant statistical weight. According to the WHO definition, iatrogenesis is often equated with adverse drug reactions (ADRs), manifesting as unwanted, harmful, and unexpected effects of medicinal products used for prevention, diagnosis, or treatment. Globally, 5–8% of all deaths occur as a result of adverse drug reactions; this figure accounts for half of all preventable harm in medical care and results in an economic loss of $42 billion USD annually (Peer & Shabir, 2018; World Health Organization, 2024).

The systematic study of the iatrogenesis problem began at an accelerated pace in the second half of the 20th century. The cornerstone work in this field—considered to have given rise to modern patient safety science—is the "Harvard Medical Practice Study," published in the New

England Journal of Medicine in 1991. Brennan and colleagues analyzed 30,121 randomly selected medical records across 51 hospitals in New York State, discovering that adverse events occurred in 3.7% of hospitalizations, and 27% of these events resulted from negligence or failure to comply with standard treatment requirements (Brennan et al., 1991). The study put forward an even more important conclusion: two-thirds of the identified injuries—meaning the majority—occurred as a result of errors and were therefore preventable (Leape et al., 1991).

The impact of this research on global health policy became even more pronounced in 1999 when the Institute of Medicine (IOM) published the report titled "To Err Is Human: Building a Safer Health System." By extrapolating data from the Harvard and Utah/Colorado studies, Kohn and colleagues calculated that between 44,000 and 98,000 people die each year in US hospitals due to preventable medical errors; this figure exceeds the annual death rates from motor vehicle accidents, breast cancer, or AIDS (Kohn et al., 2000). This report triggered a genuine awakening in the medical community and placed the issue of patient safety at the center of scientific research and healthcare policy (Stelfox et al., 2006). Retrospective studies conducted in many countries in subsequent years yielded similar results. In Australia, preventable adverse outcomes were observed in 16.6% of hospitalizations, leading to the death of approximately 5% of patients; adverse event rates were 11% in the UK, 10.7% in New Zealand, and 9% in Denmark (Aspden et al., 2004; Rafter et al., 2015). According to global estimates in 2013, 142,000 people lost their lives due to adverse effects of medical treatment—a significant increase from 94,000 in 1990, showing a notable rise over 23 years (Wikipedia, 2024). In developing countries, including the Central Asian region, the level of research into the problem of iatrogenesis lags far behind that of developed nations. In these regions, systematic monitoring and reporting mechanisms are not sufficiently developed, the number of scientific publications is limited, and a "no-blame" culture—the practice of reporting errors without fear of punishment or accusation—is only just beginning to emerge.

The main objective of this article is to provide a scientific analysis of the prevalence, classification, causes, and prevention strategies of iatrogenesis in medical practice, as well as to evaluate comparative indicators based on existing international research.

Methodology. This article is constructed based on a systematic literature review and a comparative-analytical design, aimed at scientifically evaluating the prevalence, causes, types, and prevention strategies of iatrogenesis. Two complementary primary analysis methods were utilized in the study. Within the framework of qualitative analysis, a systematic thematic coding method was applied: articles were grouped according to the type, cause, and consequence of iatrogenic events, as well as prevention directions. For each source, the research design, sample size, measurement tools, and key findings were entered into a separate table. Within the framework of quantitative analysis, the frequency of adverse events in various countries was analyzed based on comparative tables and percentage indicators. In representing the distribution by causes, relative shares and the weight of risk factors were evaluated.

Results. Among the analyzed studies, the highest frequency was observed in medication-related iatrogenic events. Results from a large-scale meta-analysis by Panagioti et al. (2019), covering 70 studies, showed that medication errors account for approximately 40% of adverse events in hospital settings. According to WHO data, more than half of such events fall into the preventable category and cause approximately $42 billion USD in economic damage globally per year (World Health Organization, 2024). Surgical iatrogenesis ranks second. The Harvard Medical Practice Study found that the share of surgical complications among all adverse events ranges from 19–25%, and approximately one-third of these events are based on the factor of

negligence (Brennan et al., 1991; Leape et al., 1991). In developed countries, the duration of additional hospital treatment due to surgical complications is extended by an average of 8–12 days (Aspden et al., 2004).

Infectious iatrogenesis, specifically infections originating within the medical facility environment, carries a distinct statistical weight. According to an ECDC study conducted in European hospitals, one out of every 18 hospitalized patients contracts an infection acquired during the treatment process that is unrelated to their original illness (ECDC, 2022). In developing countries, this indicator is 2–3 times higher than in developed nations, which is a direct consequence of non-compliance with aseptic and antiseptic standards. Diagnostic iatrogenesis is a relatively understudied but widespread type. Research examining the complications of overdiagnosis and unnecessary examinations shows that signs of overmedicalization resulting from medical care are observed in 15–30% of the population in developed countries (Morgan et al., 2015). Psychogenic iatrogenesis—harm caused to a patient's mental state due to a physician's words, attitude, or behavior—remains the type that is statistically the most difficult to measure and, therefore, is often overlooked. Based on the selected sources, the causes of iatrogenesis are divided into two broad categories: human factors and systemic factors. Between 70–80% of hospital iatrogenic events identified by Leape et al. (1991) belonged to the first category, while the remaining 20–30% were attributed to system-level deficiencies. However, modern researchers avoid interpreting this ratio simply as "human error," suggesting instead that human error should often be viewed as the invisible consequence of systemic problems (Reason, 2000).

The most consistent finding regarding the distribution of causes is communication breakdowns among medical personnel. According to the Joint Commission (2023), inadequate communication among members of the treatment team was identified as the primary cause in 80% of sentinel events—unexpected occurrences resulting in death or serious injury. This finding is observed as a consistently recurring pattern across various countries and healthcare systems. Below is a comparative table summarizing the results of national and international studies analyzed within the framework of the systematic review. The table provides a comparative representation of the frequency of adverse events, the proportion of preventable events, and the amount of economic damage across different countries.

Table 1.

Comparative indicators of hospital-acquired adverse events in various countries

Country / Region	Adverse Event Rate (%)	Preventable Share (%)	Fatal Events (%)	Primary Source
United States	2.9–3.7	58	13.6	Brennan et al., 1991; Kohn et al., 2000
Australia	16.6	51	14.9	Wilson et al., 1995
United Kingdom	10.8	48	8.0	Vincent et al., 2001
New Zealand	10.7	37	12.9	Davis et al., 2002
Denmark	9.0	40	4.6	Schioler et al., 2001

Ireland	10.3	70	7.4	Rafter et al., 2015
Developing countries (average)	8.0–23.0	83	23.0	WHO, 2024
Global (average)	10.0+	50+	—	Panagioti et al., 2019

Note: The frequency of adverse events is calculated as a percentage relative to the total number of hospitalizations. Indicators for developing countries span a wide range, reflecting the absence of unified national monitoring systems.

The table data highlights several key trends. First, developing countries not only exhibit a higher frequency of events but also a significantly higher probability of these events leading to death—a direct consequence of inadequate healthcare infrastructure and resource scarcity. Second, the proportion of preventable events reaches 70% in Ireland and up to 83% in developing countries, proving the high potential effectiveness of preventive measures. Third, while international data comparison is difficult due to methodological differences, a general rate of 10% appears to be a nearly universal threshold across various systems.

Economic and Social Consequences. The analysis reveals that iatrogenesis carries serious economic and social consequences beyond the clinical realm, elevating it to a strategic problem for the sustainability of the healthcare system. According to WHO estimates, approximately 15% of healthcare expenditure in developed countries is spent on rectifying failures occurring during the treatment process (World Health Organization, 2024). Kohn et al. (2000) estimated that the annual cost of preventable medical errors in the US—including medical expenses, loss of income and productivity, and disability—ranges from $17 billion to $29 billion.

Socially, iatrogenesis erodes patient trust in the medical system. Studies show that many patients affected by iatrogenic harm (more than 70% in some studies) delay or entirely avoid seeking healthcare in the future, which can exacerbate primary illnesses (Panagioti et al., 2019). Although this "secondary harm" effect is not reflected in direct iatrogenic statistics, it exerts a long-term negative impact on public health indicators.

Discussion. According to the research results, iatrogenesis is a multifaceted problem manifesting at all levels of medical practice, from prescribing medication and surgical procedures to diagnosis and patient communication. The most critical finding is that more than half of adverse iatrogenic events belong to the preventable category; they are not inevitable consequences of medical system errors but conditions that can be avoided (Panagioti et al., 2019). The practical significance of this conclusion is immense: the essence of the problem lies not in the utopian goal of "totally eliminating errors," but in a strategy of managing risks through early detection and systemic control mechanisms.

Comparative analysis of countries showed that the frequency of adverse events ranges on average between 9% and 17%. This figure depends less on the financial capacity or technical level of the healthcare system and more on the maturity of the systemic safety culture. Specifically, as seen in the examples of Ireland and New Zealand, countries with high levels of economic development can have frequency rates almost identical to those of other nations. This confirms that organizational culture and the human factor, rather than infrastructure, play the decisive role. Effectiveness of Prevention Strategies. Based on the analysis of scientific literature, prevention approaches with proven effectiveness can be divided into three main areas:

Systemic Approach: The most widely used and proven method is the implementation of standardized clinical protocols and checklists. Haynes et al. (2009) proved in a multi-country study that the use of a safety checklist implemented by anesthesiologists for high-risk surgical patients reduced complications by 36% and mortality rates by 47. This effective tool is currently recommended by the WHO as the "Surgical Safety Checklist" in over 190 countries.

Cultural Approach: The "no-blame principle"—the opportunity to report errors freely in an environment devoid of fear of punishment—fundamentally increases the effectiveness of learning from mistakes in medical institutions. Experience from British and Scandinavian countries shows that in environments where medical personnel can openly discuss their errors, safety incident reporting increases by 60–70%, providing a valuable data source for developing preventive measures (Reason, 2000).

Digital Approach: Artificial intelligence-based clinical decision support systems, Electronic Health Records (EHR), and automated drug interaction detection systems have opened new opportunities for patient safety over the last decade. Studies indicate that medication prescription errors can be reduced by 50–80% through automated control systems (Bates et al., 2021). However, these technologies are not yet widely implemented in developing countries.

In the healthcare system of Uzbekistan, the systematic monitoring and scientific study of iatrogenesis are only beginning to take shape. Current national statistical data does not fully cover intra-hospital adverse events as a separate category, making it difficult to assess the true scale of the problem. At the same time, ongoing healthcare reforms in Uzbekistan—from hospital specialization to the strengthening of primary healthcare—provide a favorable foundation for reorganizing the system based on patient safety principles. In the regional context, three directions stand out as top priorities: first, implementing a unified national system for recording and analyzing adverse events; second, integrating a systematic patient safety culture module into medical education programs; and third, ensuring consistent integration with international patient safety standards, particularly the requirements of the WHO "Global Patient Safety Action Plan."

Conclusion. This research has scientifically confirmed that iatrogenesis is a widespread yet frequently underestimated problem in modern medical practice. Recognizing patient safety as a core indicator of healthcare quality, the concept of viewing iatrogenesis not merely as an individual healthcare worker’s error but as a complex set of systemic factors is becoming a central principle of modern medical ethics and healthcare management.

The study puts forward three primary conclusions. First, half or more of iatrogenic events fall into the preventable category, demonstrating that investing resources into prevention is justified not only ethically but also economically. Second, the scale of the problem depends more on the maturity of the safety culture than on the financial status of the medical system, implying that realistic solutions exist even for middle-income countries. Third, the integration of digital technologies, standardized clinical protocols, and an institutionalized safety culture can significantly reduce iatrogenic harm, as proven by international evidence. The primary recommendation for clinical practice is to maintain continuous professional training for physicians and nurses regarding the types, risk factors, and prevention of iatrogenesis, while institutionally ensuring the opportunity for open discussion of errors at the facility level. For healthcare policymakers, the development of national patient safety programs and their harmonization with international standards is recommended. The most critical direction for future research involves establishing a local epidemiological database through prospective cohort

studies in Uzbekistan and the Central Asian region, as well as evaluating the adaptation of artificial intelligence-based monitoring systems to the local clinical environment.

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