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Theory of medical errors (note 1)

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Abstract

The unique individuality of patients' psychophysiology and the human factor of the physician are primary causes of medical errors. Our current understanding of these causes is insufficient to develop reliable control programs. Among the strategies to reduce errors, the most critical is admitting and openly discussing them among peers; however, this approach is complex and challenging to implement.

The goal of this publication is to introduce a new classification of certain aspects of the emerging theory of medical errors, aimed at enhancing the understanding of this issue.

The issue of medical errors is complex and often misunderstood, leading to irrational approaches to solving it—namely, attempting to decrease errors through punishment. A rational, comprehensive approach should include: quality control of initial education, enhancement of the mentorship system, development and continuous refinement of clinical

guidelines, exploration of error issues in medical school and during postgraduate training, training in error analysis itself, and quality control over the analysis of adverse outcomes without attributing blame or administering punishment.

For effective error analysis, categorizing errors by their primary causes is pragmatically valuable. Errors due to subjective reasons constitute the most complex and inadequately studied part of this issue. It's important to note that the mechanism of an error may not align with its cause. This text provides examples of common error mechanisms, highlighting the distinction between causes and mechanisms and underscoring the importance of identifying the mechanism.

Studying the theory of medical errors is equivalent to mastering a distinct scientific discipline. It systematizes known knowledge in new, previously unexplored interrelations. The theory aims to improve understanding of the problem initially among physicians. Without grasping this issue, expecting a balanced and objective societal stance towards physicians' errors is challenging.

Keywords: theory of medical errors; admitting errors; error analysis; causes of errors; mechanisms of errors.

Introduction.

The issue of errors has been a companion to the field of medicine throughout its entire developmental history, as well as accompanying individual doctors throughout their careers. Even in countries with advanced economies and continuous advancements in medicine, the issue of medical errors remains relevant today. The importance of this issue is evidenced by the level of governmental political decisions aimed at enhancing patient safety[1].

The problem of errors has been the subject of intensive discussion worldwide over the last 20-25 years. In countries with advanced economies, this is linked to a particular stage of societal and healthcare development. In the post-Soviet space, it is more associated with the transition to a market economy and the noticeable weakening of the former system of error control. Unfortunately, the control system has not yet been modernized to align with significant societal changes.

It has been over 20 years since the report by the Institute of Medicine in the USA (1999) on the high prevalence of medical errors and the development of a comprehensive program to improve the situation. The program aimed to reduce the number of preventable medical errors by 50% over the next five years. However, publications in recent years indicate modest achievements[2-4]. This is related to the complexity and challenging nature of controlling medical errors. The difficulty of managing the human factor (the doctor) and the unique individual psychophysiology of patients represent complex knowledge domains. The current level of understanding does not allow for the development of a program for their satisfactory control.

The problem of errors in medicine is complex for doctors, and even more so for the non-medical part of society. In this connection, the risk of a negative effect from openly discussing the issue of errors in society is high. The possible manifestation of such a negative effect led to the removal in the PubMed search system of annotations and texts of many publications on this topic, leaving only bibliographic data. For instance, there are no annotations or texts of articles[5-10] with expressive titles like “It's time medicine stopped burying its mistakes”.

Articles with the “The Institute of Medicine Report on Medical Errors: misunderstanding can do harm”[11,12], “Elbows fly in medical-errors game”[13], “Legislators begin their effort to curb medical errors”[14], “To Err Is Human: uniformly reporting medical errors and near misses, a naïve, costly, and misdirected goal”[15] titles have been published.

The subjective attitude of doctors towards this problem contributes to the uncertainty of positions, not only in the medical environment but also across society as a whole. Insufficient understanding of the problem hinders (slows down) its solution. Among the measures to reduce the number of errors, the main ones are admitting and open discussions (within the medical environment)[4,16-21]. This axiom was affirmed by N.I. Pirogov in his works 180 years ago, and subsequently by several generations of Soviet doctors. The remaining measures are aimed at organizing the conditions and creating a culture for admitting mistakes and analyzing them. The latter is possible if doctors and health care managers have sufficient understanding of the theory of medical errors. The second-mentioned should be taught not only at a medical university but also as part of postgraduate training[17,22-24].

An indication of the complexity in solving the problem of errors is the repeated call, spanning over 20 years in publications, to shift from a culture of shame, guilt, and punishment for mistakes to a culture centered on learning from them[15-18,23,25-27]. The criminalization of medical errors in the post-Soviet space is similar to that in the United States.

The purpose of the publication is to present a new systematization of selected knowledge from the developing theory of medical errors which will improve understanding of the problem.

The material used for analysis and drawing conclusions on them consisted of literature on medical errors, our own experience in analyzing errors, observations from practice, the results of repeated discussions of the problem on professional medical websites and in medical teams.

The methods of scientific analysis of the problem and the formation of the theory of medical errors were axiomatic and general logical methods (analysis and synthesis, induction and deduction, analogy).

Rational solution to the problem of errors

Insufficient understanding of the problem of errors in medicine leads to the selection of an irrational approach to solving it. An undifferentiated approach to medical errors contributed to the tendency to equate errors with a crime of carelessness, i.e. contributed to the criminalization of mistakes. Simplifying a doctor's work to the point of meeting standards and believing that a doctor's conscientiousness excludes mistakes is fallacious. Such misconceptions give reason to hope that the number of errors can be reduced only by tightening responsibility for them.

Admitting and analysis of errors are the main measure of error prevention. Underestimating the importance and complexity of this measure leads to an overestimation of the preventive role of punishment for errors. It is difficult for the non-medical part of society to understand that analyzing errors in the medical environment is a complex and not always productive process. Analyzing errors presents challenges even in the absence of any risk of punishment. Admitting and qualitatively analyzing errors is impossible under the threat of punishment, especially criminal punishment. As a result, the criminalization of doctors' mistakes leads to the opposite effect, i.e. concealing complications and errors. The number of unacknowledged and unanalyzed errors will increase, resulting in the repetition of the same and similar mistakes.

A rational solution to the problem of errors (reducing their number) is an integrated approach. The latter includes a number of important aspects (1-6) (Figure 1), including quality control of initial education and improvement of the mentoring institution.

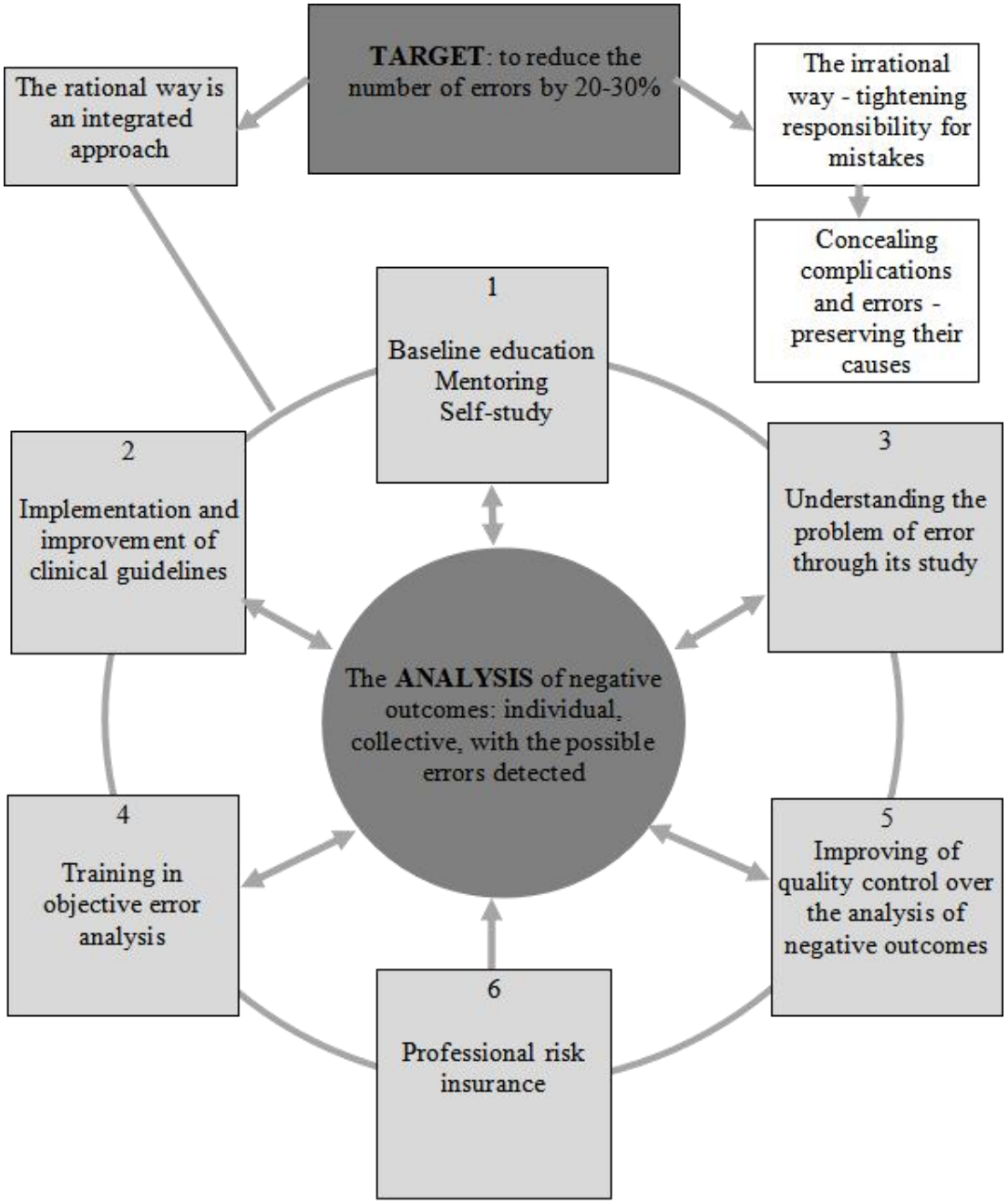

Figure 1. Individual and collective analysis of negative outcomes - the basis for the prevention of possible errors

An important measure to reduce errors involves the development, implementation, and continuous enhancement of clinical guidelines. It is advisable to study the problem of errors in the senior years of medical school and during postgraduate training. The primary focus of this teaching is specifically training error analysis without seeking blame or punishment. The next essential measure is implementing quality control over the analysis of negative outcomes. The control must also be non-blaming and non-punitive in order to truly promote the effectiveness of the analysis. Among the listed measures, professional risk insurance plays a

significant role. However, due to the imperfections in the insurance system for doctors in the post-Soviet space, it has not yet become of paramount importance.

The problem of medical errors is its misunderstanding

The problem of medical errors is complex in that it includes several closely interrelated aspects: the complexity of medicine, the vulnerability of a doctor's cognition, the psychology of a doctor's defense of their self-esteem and sense of significance (which hinders the acknowledgment of mistakes), and the mechanism underlying the formation of professional experience. Each individual aspect contains specific information. The legal aspect must also be considered, as a full discussion would be impossible without it. Taken together, knowledge about the problem of medical errors constitutes a distinct branch of science, characterized by interconnected and intricate relationships among its components. The peculiarity of this science is the evident importance of its study along with the lack of current incentives for this. Without a dedicated study of the theory of medical errors, it is challenging to attain a sufficient understanding of the problem, which is essential for identifying viable solutions.

The problem of medical errors begins with the difficulties of understanding it (Figure 2). One of the illustrations of the complexity and originality of the error problem is the following fact. Doctors encounter errors throughout their professional lives, yet by the end of their careers, few have a reasoned and definite position on this problem. In the diagram (Figure 2), the problem of medical errors is equated with a lack of understanding resulting in an irrational attitude towards errors. The diagram shows the main aspects of the first and second orders, while some aspects can be detailed up to the third and fourth orders.

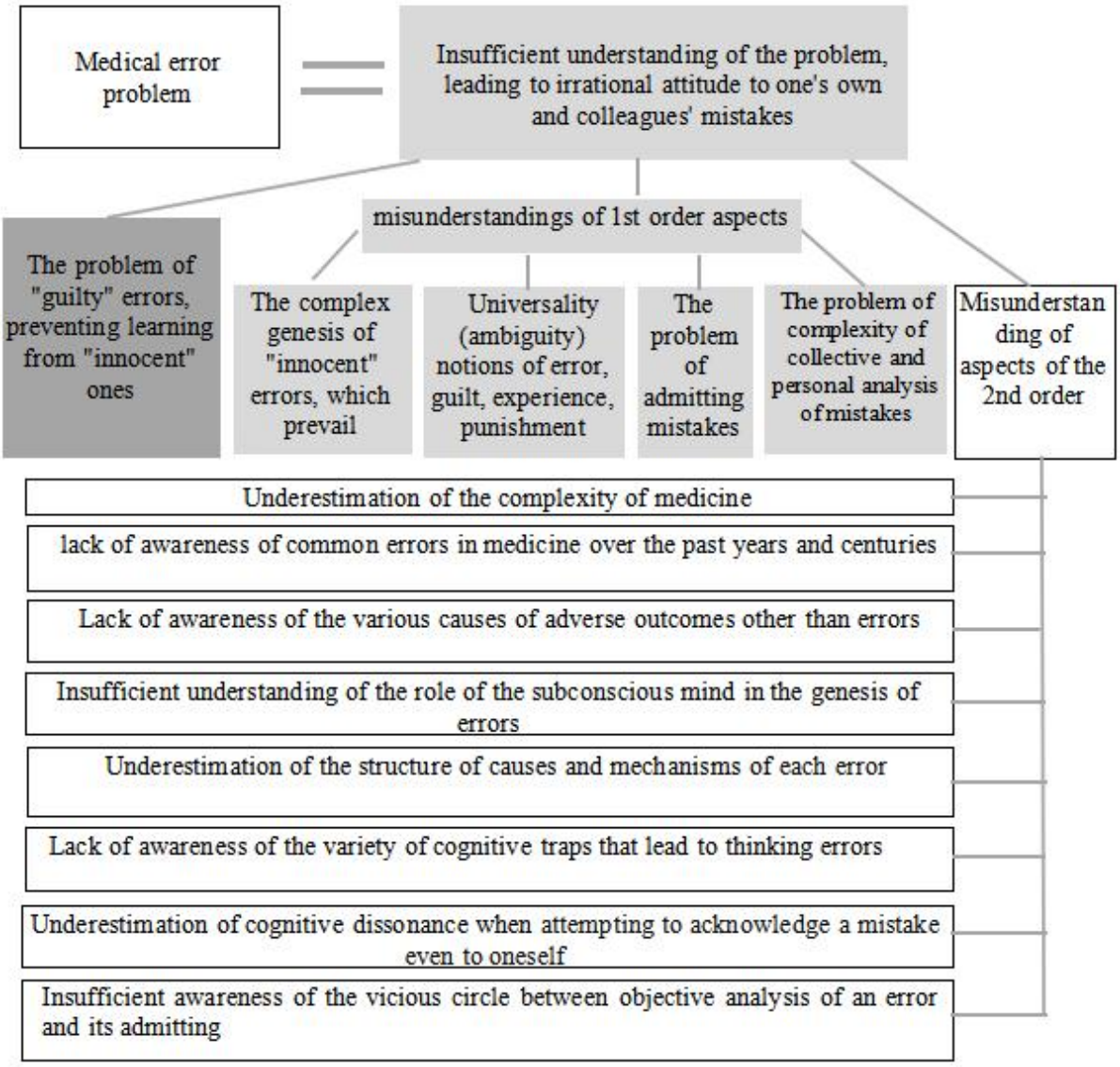

Figure 2. Diagram of the medical error problem

Doctors who have not specifically studied the problem of errors may not understand how law enforcement authorities, relying on the criminal code, turn an error into a crime. The concepts of “negligence” and “frivolity” are not explicitly defined in the articles of the criminal codes of the Republic of Kazakhstan and the Russian Federation; however, they are indicated in the commentary to the article on “crime due to carelessness”. It is this article that is typically invoked when accusing a doctor. In other words, accusing a doctor of negligence and/or frivolity transforms their mistake, according to the criminal code, into an offense – “causing grievous harm to health or death through carelessness”.

Without delving deeper into the issue, it is challenging to understand how the same mistake can be classified as a “guilty mistake” in some circumstances and an “innocent mistake” in

others. For example, the same diagnostic error occurring in the typical course of a common disease, made by a novice doctor and an experienced specialist, has different degrees of guilt.

An “innocent mistake” is frequently a thinking mistake. Human thinking itself in many ways remains a mystery to science. When detailing the conditions for the application of concepts such as “mistake”, “experience”, “guilt”, and “punishment”, an understanding of their ambiguity emerges. It is important to subdivide and classify each of these concepts into subtypes to clearly understand their meaning in the current context. For instance, guilt can be of three types: internal moral guilt, guilt in the legal field, and guilt induced by colleagues. This categorization enables an understanding of how the same mistake made by a doctor can be considered “guilty” and “innocent” simultaneously. According to this classification, all errors in medicine are considered “guilty” in the moral sense, whereas there are very few “guilty errors” in the legal field. That is, the majority of mistakes are deemed "innocent" in the legal realm. The feeling of guilt induced by colleagues can be either justifiably and objectively warranted or, conversely, unjustly and subjectively biased.

Without an in-depth examination of the problem, it is hard to discuss the question “Why is the act of admitting a mistake always difficult?” Underestimating the complexity of medicine may be the basis of the naive “errors are rare, I should not make mistakes, I am not making mistakes” attitude. Awareness of the known mistakes that the medical elite of their time made throughout the history of medical development could change the attitude toward the ability of an individual doctor to work accurately.

Apart from physician errors, there are four other groups of reasons that contribute to or result in unfavorable treatment outcomes. Knowledge of these reasons will facilitate effective analysis of failures and reduce anxiety regarding the potential discovery of errors.

Thinking errors are often unconscious. In the chain of logical (erroneous) judgments, crucial links are frequently included subconsciously. The role of the subconscious in the genesis of thinking errors has not been studied sufficiently. Cognitive traps are commonly triggered subconsciously. The subconscious and cognitive traps - this area of knowledge is not typical for the vast majority of medical specialties. Therefore, few doctors are well acquainted with it. Publications on the role of cognitive traps in the genesis of physician errors have only begun to emerge in recent years.

An error is a complex phenomenon, involving multiple factors that may contribute to varying degrees in its genesis. Understanding this could lead to more efficient analysis and identification of the error mechanism.

It is crucial to comprehend the following vicious circle (Figure 3): an objective analysis of an error is feasible only upon its admitting, and admitting is possible if there are facts justifying the author of the error, which are established only through an objective analysis. Understanding the vicious circle will enable one to seek solutions, whereas ignorance of it can perpetuate the problem indefinitely.

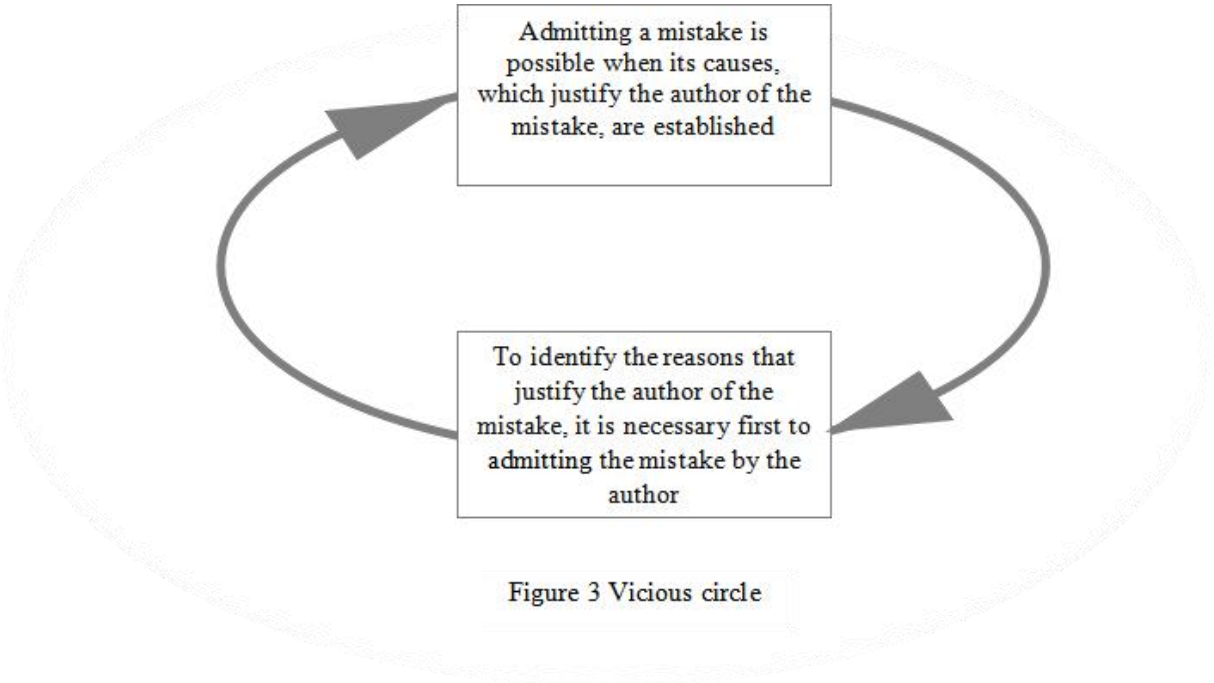

Figure 3 Vicious circle

Classifying medical errors by causes

It was emphasized above that to understand the problem, it is necessary to detail (classify) its basic concepts. “Error”, as the central concept of a problem, can be classified according to different criteria. In addition to categorizing errors as “guilty” and “innocent” within the legal framework, the classification of errors based by the main causes that cause them holds practical significance. The diagram (Figure 4) illustrates a spectrum of errors, ranging from inevitable/forced on the left to gross errors (such as the erroneous transfusion of blood from a different group) on the right. Between these extreme types, two groups of errors can be identified: those errors predominantly due to objective and those predominantly subjective reasons.

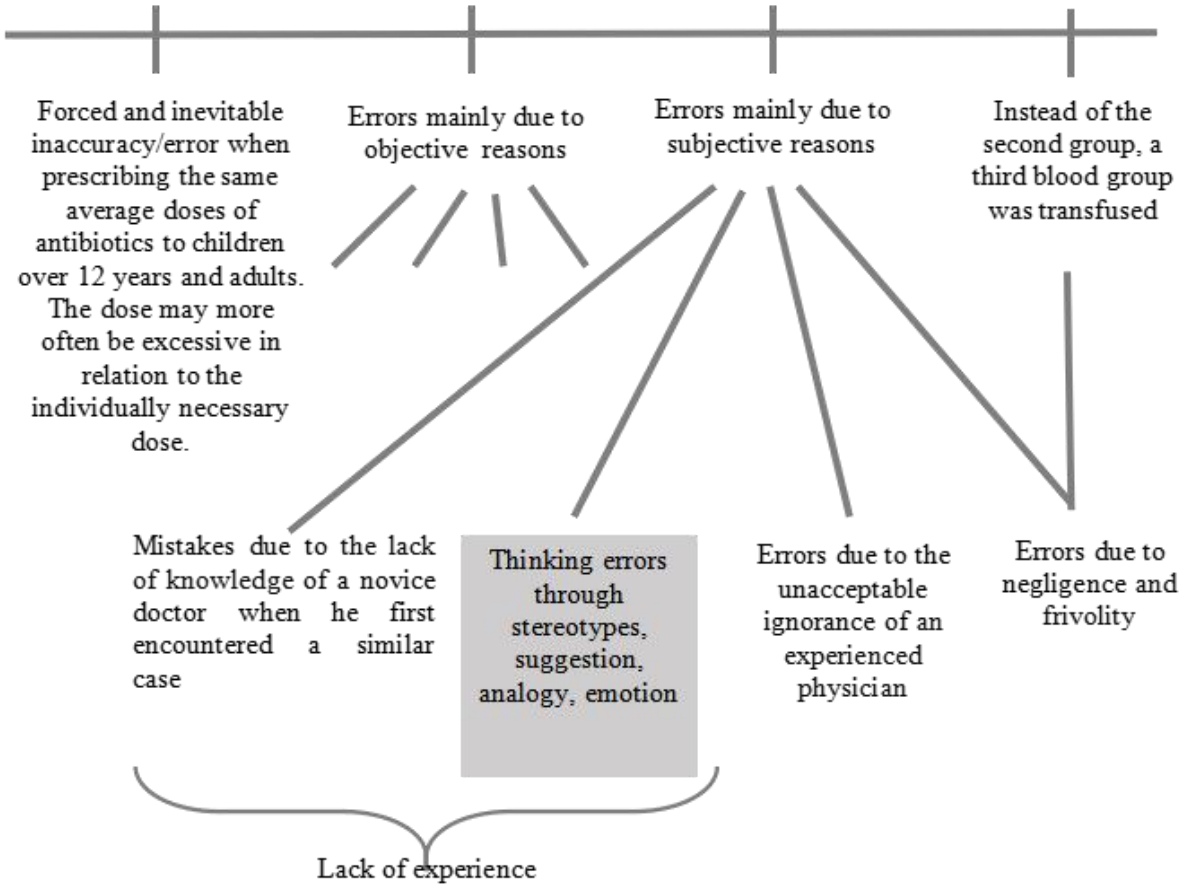

Figure 4. The range of major groups of causes of medical errors

Objective reasons for errors include relativity, limited medical knowledge of individual diseases, system errors and deficiencies in the organization of medical care, short patient stays, extremely serious patient conditions, high levels of alcohol or drug intoxication, the simultaneous presence of multiple diseases, the rarity of a disease, atypical disease courses, abnormal anatomical features, symptom concealment, aggravation, simulation, dissimulation, and other factors that do not directly relate to the personality of a doctor. System errors encompass the incorrect formation of the duty team, remoteness of emergency services from the emergency room, understaffing, malfunction or absence of diagnostic equipment, laboratory errors, etc.

Subjective causes can be divided into four subgroups (Figure 4). Thinking errors due to cognitive traps associated with stereotypes, analogies, suggestion, logic, and emotions are of great interest. The listed causes of errors have not been sufficiently studied and covered in the literature. Thinking errors and those arising from the insufficient knowledge of a novice specialist ultimately stem from lack of experience.

The error mechanism may not coincide with its cause

N.I. Pirogov is known as an outstanding Russian anatomist, surgeon, teacher, public figure, founder of military field surgery, and the anatomical and experimental direction in surgery. He is also recognized as a doctor who was one of the first to write a book about his mistakes. He owns a number of famous statements regarding medical errors, the main idea of which is the need to admit mistakes and learn from them. N.I. Pirogov attributed particular importance to the analysis of errors advocating for its elevation to a distinct branch of science and emphasized the significance of establishing the mechanisms underlying errors.

An unidentified error mechanism, being a recorded psychomotor act, has every reason to automatically (reflexively) repeat itself in the future in a similar situation. The identified error mechanism is taken into consideration in future similar cases and prevents the error from reoccurring. Analysis of errors with the establishment of their mechanisms shows that an erroneously made decision is associated, as a rule, with an overestimation or underestimation of a clinical fact (Table).

Table. Basic mechanisms of physician error

Underestimation of clinical fact(s)*
Overestimation of clinical fact(s)
Underestimating one fact against the background of overestimating another
Misinterpretation of fact(s)
Ignoring unnecessary or missing symptoms
Erroneous fact (accepting a symptom as an unknown manifestation of a presumed disease)

* - complaints, anamnesis, symptoms, consultant's opinion, data of objective examination, data of laboratory-instrumental methods of investigation, intraoperative data, etc.

For an identified diagnosis, symptoms may be unnecessary or, on the contrary, they may not be enough. In both cases, the accuracy of the diagnosis is questionable. Hence, both excess and missing symptoms should not be disregarded.

In Figure 4, within the section labeled “errors mainly due to subjective reasons”, instances such as the lack of knowledge of a novice doctor when encountering similar cases for the first time, and the thinking errors of experienced doctors stemming from stereotypes, suggestions, analogies, and emotions are indicated. The listed causes of errors are united by the concept of “lack of experience”. In these causes, one can see the lack of knowledge and/or inability to perform certain actions, which is a particular manifestation of a more general phenomenon known as “lack of experience”.

If the analysis of the error is halted at the point of stating that a doctor lacked knowledge or skills, then in many cases, this statement will address the cause rather than the mechanism of the error. If there is a mechanism that may not align with the cause of the error, it is crucial to identify it to prevent its automatic recurrence in the future.

The search for an error mechanism involves elucidating how a thinking mistake resulted in an underestimation, overestimation, or misinterpretation of a clinical fact. This is, in fact, the next step in deepening the analysis. The analysis of error causes has highlighted common mechanisms leading to the incorrect assessment of clinical facts, namely stereotypes, suggestions, analogies, and emotions. Each of these phenomena can be further detailed.

There is a stereotype linking a certain symptom with a particular pathology. For example, the symptom of “muscle tension in the anterior abdominal wall” is usually associated with surgical pathology in the abdominal cavity. On the contrary, a “soft belly” often excludes it. In the vast majority of cases, such stereotypes enable one to make the right decision with minimal time and resource expenditure, yet they (stereotypes) can also become the mechanism behind erroneous decisions in certain situations.

Stereotypes (tactical, technical, regarding medications, nosologies, manual techniques, etc.) are formed in all aspects of the work of a doctor of any specialty. First, there is a need to to identify the stereotype that led to the error. Next, it is necessary to find out what contradicted the stereotype and why this contradiction was ignored or not detected. Establishing the reasons for ignoring or failing to detect contradictions to stereotypes is, in some cases, the primary cause of the error, while in others, it represents the error's mechanism.

The conclusion of a consultant or a more experienced doctor, to some extent serve as suggestion—a setting for the treating physician, influencing their assessment of the disease's progression, interpretation of new symptoms, and the results of subsequent studies.

There have been cases of incorrect assessment of blood circulation in the lower extremities with delayed treatment of thrombosis or arterial damage. The cause of the error will be attributed to the doctor’s insufficient experience in assessing the blood circulation of the limb. A more precise reason could be an incorrect assessment of the pulse in the artery of the limb. The mechanism for incorrect assessment may involve mistaking the pulsation of the doctor’s fingers for the patient’s arterial pulse. During a “prolonged” search for a pulse in the arteries of the patient's lower extremities, some doctors may experience pulsation of their palpating

fingers. Knowing this mechanism will make it possible to take it into account in the future and avoid errors.

Conclusion

Solving a problem starts with understanding it. The concept of error as a phenomenon has been familiar since childhood, from the first independent steps. At the same time, in medicine, an error is a complex phenomenon, the contradictions of which are gradually revealed through specialized study. This is also due to the fact that the thought processes that lead to both correct and erroneous decisions remain a mystery. The psychological foundations of denying mistakes and making excuses also do not belong to ordinary knowledge.

The theory of medical errors comprises several sections, encompassing approximately 50 aspects, the primary ones of which are depicted in the diagram (Figure 2) of the article. Studying the theory of medical errors is equivalent to mastering a distinct branch of science [28]. In it, known knowledge appears in “new” previously insufficiently studied relationships. Mastering the latter requires specialized study. Without studying this branch of science, it is challenging to grasp the problem and find informed strategies to decrease the number of errors.

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References

[1] Farley DO, Battles JB. Evaluation of the AHRQ patient safety initiative: framework and approach. Health Serv Res. 2009 Apr;44(2 Pt 2):628-45. doi: 10.1111/j.1475-6773.2008.00931.x. PMID: 21456107; PMCID: PMC2677032.

[2] Spiess BD. Human error in medicine: change in cardiac operating rooms through the FOCUS initiative. J Extra Corpor Technol. 2011 Mar;43(1):P33-8. PMID: 21449238; PMCID: PMC4680095.

[3] Teymourzadeh E, Mehdizadeh P, Yaghoubi M, Firoozjaie IT. Assessment and Reduction of Human Error using SHERPA Technique in Chemotherapy Department of a Large Military Hospital. Iran J Nurs Midwifery Res. 2023 Jul 24;28(4):426-429. doi: 10.4103/ijnmr.ijnmr_382_21. PMID: 37694207; PMCID: PMC10484388.

[4] Rodziewicz TL, Houseman B, Hipskind JE. Medical Error Reduction and Prevention. 2023 May 2. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 Jan–. PMID: 29763131.

[5] Clough JD, Macklis RM, Nadzam DM. It's time medicine stopped burying its mistakes. Cleve Clin J Med. 2000 Apr;67(4):299-300. doi: 10.3949/ccjm.67.4.299. PMID: 10780103. Rovner J. Washington wakes up to medical mistakes. Bus Health. 2000 Jan;18(1):19. PMID: 10788134.

[6] Lemonick MD. Doctors' deadly mistakes. Medical errors kill up to 98,000 Americans yearly; a new report says that number could be cut drastically. Time. 1999 Dec 13;154(24):74-6. PMID: 10724802.

[7] Crane M. Medical mistakes. Must doctors take the rap? Looking beyond the IOM report. Med Econ. 2000 Nov 20;77(22):108-10, 115-8, 123-4. PMID: 11116441.

[8] Shuren AW. Health care delivery errors: patient safety falls prey to politics. J Pediatr Health Care. 2001 Jan-Feb;15(1):42-4. doi: 10.1067/mph.2001.112290. PMID: 11174664.

[9] Altman DE, Clancy C, Blendon RJ. Improving patient safety--five years after the IOM report. N Engl J Med. 2004 Nov 11;351(20):2041-3. doi: 10.1056/NEJMp048243. PMID: 15537902.

[10] Richardson WC, Berwick DM, Bisgard JC, Bristow LR, Buck CR, Cassel CK, Coye MJ, Detmer DE, Grossman JH, James B, Lawrence DM, Leape L, Levin A, Robinson-Beale R, Scherger JE, Southam AM, Wakefield M, Warden GL, Corrigan JM. The Institute of

Medicine Report on Medical Errors: misunderstanding can do harm. Quality of Health Care in America Committee. MedGenMed. 2000 Sep 19;2(3):E42. PMID: 11104488.

[11] Brennan TA. The Institute of Medicine report on medical errors--could it do harm? Tex Med. 2000 Jun;96(6):13-5. PMID: 10876367.

[12] Hallam K. Elbows fly in medical-errors game. Mod Healthc. 2000 Feb 21;30(8):32. PMID: 11010039.

[13] Pretzer M. Legislators begin their effort to curb medical errors. Med Econ. 2000 Jun 19;77(12):31-2, 35, 38. PMID: 11010473.

[14] Andrus CH, Villasenor EG, Kettelle JB, Roth R, Sweeney AM, Matolo NM. "To Err Is Human": uniformly reporting medical errors and near misses, a naïve, costly, and misdirected goal. J Am Coll Surg. 2003 Jun;196(6):911-8. doi: 10.1016/S1072-7515(03)00236-9. PMID: 12788428.

[15] Giard RW. Medische fouten: onvermijdelijk, maar bestrijdbaar [Medical errors: inevitable but preventable]. Ned Tijdschr Geneeskd. 2001 Oct 27;145(43):2062-5. Dutch. PMID: 11715589.

[16] Roman MD, Fleacă SR, Boicean AG, Mohor CI, Morar S, Dura H, Cristian AN, Bratu D, Tanasescu C, Teodoru A, Necula R, Russu O. Failure in Medical Practice: Human Error, System Failure, or Case Severity? Healthcare (Basel). 2022 Dec 9;10(12):2495. doi: 10.3390/healthcare10122495. PMID: 36554018; PMCID: PMC9778633.

[17] Rocco C, Rodríguez AM, Noya B. Elimination of punitive outcomes and criminalization of medical errors. Curr Opin Anaesthesiol. 2022 Dec 1;35(6):728-732. doi: 10.1097/ACO.0000000000001197. Epub 2022 Oct 3. PMID: 36194145.

[18] Marx D. Patient Safety and the Just Culture. Obstet Gynecol Clin North Am. 2019 Jun;46(2):239-245. doi: 10.1016/j.ogc.2019.01.003. PMID: 31056126.

[19] Boulanger J, Keohane C, Yeats A. Role of Patient Safety Organizations in Improving Patient Safety. Obstet Gynecol Clin North Am. 2019 Jun;46(2):257-267. doi: 10.1016/j.ogc.2019.02.001. PMID: 31056128.

[20] Barsky M, Olson APJ, Astik GJ. Classifying and Disclosing Medical Errors. Med Clin North Am. 2022 Jul;106(4):675-687. doi: 10.1016/j.mcna.2022.02.007. Epub 2022 May 28. PMID: 35725233.

[21] Higham H, Vincent C. Human Error and Patient Safety. 2020 Dec 15. In: Donaldson L, Ricciardi W, Sheridan S, Tartaglia R, editors. Textbook of Patient Safety and Clinical Risk Management [Internet]. Cham (CH): Springer; 2021. Chapter 3. PMID: 36315764.

[22] Arnal-Velasco D, Heras-Hernando V. Learning from errors and resilience. Curr Opin Anaesthesiol. 2023 Jun 1;36(3):376-381. doi: 10.1097/ACO.0000000000001257. Epub 2023 Feb 8. PMID: 36794873.

[23] Gohal G. Models of teaching medical errors. Pak J Med Sci. 2021 Nov-Dec;37(7):2020-2025. doi: 10.12669/pjms.37.7.4506. PMID: 34912437; PMCID: PMC8613064.

[24] Danino J, Muzaffar J, Metcalfe C, Coulson C. Patient safety in otolaryngology: a descriptive review. Eur Arch Otorhinolaryngol. 2017 Mar;274(3):1317-1326. doi: 10.1007/s00405-016-4291-z. Epub 2016 Sep 13. PMID: 27623822.

[25] Harolds JA. Quality and Safety in Healthcare, Part LXXXIII: The Culture of Safety in High Reliability Organizations. Clin Nucl Med. 2022 Oct 1;47(10):e673-e675. doi: 10.1097/RLU.0000000000003418. PMID: 33234929.

[26] Sulistiadi W, Purwadi AG, Asyary A. Addressing the Medical Errors in the Re-Organized Healthcare in Indonesia. Ann Ig. 2020 Sep-Oct;32(5):567-576. doi: 10.7416/ai.2020.2376. PMID: 32744587.

[27] Makhambetchin M.M. Theory of doctors' mistakes - a special branch of science. Zdravookhranenie Rossiyskoy Federatsii. 2019; 63(4): 214-20. (in Russian)] https://doi.org/10.18821/0044-197X-2019-63-4-214-220