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Statement of Responsibility

The legal and scientific responsibility of the manuscripts belongs to the authors.

Declaration

We are pleased to invite you on Friday, May 16, at 09:00 a.m. to the "The 3rd International Conference Multidisciplinary Academic Studies (IMAS 2025)" at TITU MAIORESCU UNIVERSITY of Bucharest, Faculty of Law and Economic Science Targu Jiu Târgu Jiu town. The conference is in a hybrid system, with physical and online participants through Microsoft Teams.

Researchers from eight different countries presented their studies; Romania, Türkiye, North Macedonia, Kosovo, Indonesia, Pakistan, Uganda and Nigeria.

Conference theme: Legal, economic and medical transformations of contemporary society between tradition and reform

Conference topics: Law, Economics, Accounting, Business Administration, Finance, Econometrics, Nursing, Health Management.

The written and presentation languages are Romanian and English.

IMAS Conference Books are indexed in EBSCO and ProQuest eBook Database.

Appreciation

I am very privileged to express my sincere appreciation as I address this gathering to provide a resolute expression of gratitude to the exceptional individuals who have contributed to the success of the IMAS 2025 Conference. I would like to express my sincere gratitude for the steadfast commitment and exceptional contributions demonstrated by the Congressional Coordinators, Congressional Committees, and Authors.

The unwavering dedication and significant contributions of individuals have played a pivotal role in the conference's remarkable achievements. The level of dedication exhibited by the individuals in devoting their knowledge, effort, and resources towards creating a valuable and instructive event for all participants is deserving of admiration.

When reflecting on my appreciation, I am prompted to acknowledge the significant influence that their cooperative endeavours have exerted on the progress of our mutual objectives and the circulation of innovative knowledge within their individual domains. The extent of their engagement and the exceptional performance they have exhibited are indicative of their steadfast dedication to the advancement of academics and society at large.

In conclusion, I express my utmost appreciation to all individuals who have contributed to the success of IMAS 2025. The combined endeavours and fervour exhibited by all those involved serve as the fundamental basis for the achievement we have attained, and as a result, we express our sincere appreciation. I want to express my gratitude for your assistance.

Lect. Cristian DRĂGHICI, PhD
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WOMEN'S REPRODUCTIVE HEALTH SERVICES AFTER THE EARTHQUAKE

Semih TURGUT[1], Zekiye TURAN[2]

ABSTRACT

Introduction-Aim: The aim of this study is to identify the difficulties experienced by women in accessing reproductive health services in cases such as earthquakes, together with their effects on women's reproductive health, rather than the general effects of earthquakes that we frequently encounter today, and to present solutions to eliminate these difficulties and find new solutions to these problems.

Materials and Methods: In this study; A search was conducted between 1 January 2020 and 15 February 2025 using the search engines "CINAHL Plus", "PubMed", "National Thesis Center", "Google Scholar" and "Medline" with the keywords "earthquake", "disaster", "women", "reproductive health", "women's health". Turkish and English written sources were used in the research.

Findings: All people in society are at risk in disaster situations, but the elderly, children and women are vulnerable and at greater risk in terms of financial situation, shelter, survival and protection. It is therefore crucial to involve vulnerable groups earlier in care, treatment and livelihoods, and to minimise risks to reproductive health. Addressing needs such as shelter, nutrition and hygiene of vulnerable groups as early as possible will solve existing problems and prevent additional problems that may arise.

Women's reproductive health and services must continue to be provided in a healthy, effective and efficient manner, not only in normal living conditions, but also in living conditions that are changing and are likely to change. It was noted that there were disruptions in women's access to reproductive health services and deficiencies in the services received during and after the earthquake. These disruptions and deficiencies show that earthquakes have a negative impact on reproductive health, as in many other areas. As a result of the earthquakes experienced in

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our country, it has been found that there are insufficient studies and alternative solutions to eliminate the negative effects of earthquakes on women's health and reproductive health.

Conclusion: Emphasis should be placed on activities such as earthquake preparedness and prevention. Health professionals should be trained in women's reproductive health in earthquake zones. In the post-earthquake period, women's reproductive health needs should be assessed and access to necessary services should be ensured. Studies should be conducted to prevent sexually transmitted infections and family planning services should be provided.

Keywords: Earthquake, Disaster, Women, Reproductive Health, Women's Health

1.INTRODUCTION

Earthquake is a natural disaster that can occur at any time, has no prior certainty, is uncontrolled and causes many negative consequences. It is known as one of the natural disasters that can deeply affect humanity and cause the most deaths (Ak & Aslan, 2024). In addition, it also negatively affects psychological and social health. Injuries, losses and the course of the negative process experienced after the earthquake are among the scales used to determine the effects of the earthquake. There are many factors affecting the magnitude of the disaster, such as geological structure, uncontrolled population growth, unplanned and unplanned urbanization, the development level of the country, and the educational status of the people (Tor & Güneş Yüce, 2023). When these factors are generally collected, they are known as disaster risk elements. Disaster risk is defined as "the probability of losses that a certain hazard may cause to people, human settlements and the natural environment in proportion to their damage or vulnerability, if it occurs within a certain period of time in the future (AFAD, 2022b). As the number and nature of these factors increase, the negative consequences of the earthquake will also increase. When we look at the general effects of the earthquake, it generally causes many negative situations (Kara & Nazik, 2023).

Earthquakes cause many negative consequences in the region where they occur regardless of gender, but their devastating effects on women are much greater than on men. Difficult problems such as survival efforts, migration, changes in living conditions, difficult environmental conditions, nutrition and shelter problems arise (Gündüz, 2022). The effects of an earthquake need to be examined in three periods. The first period, which occurs immediately after the earthquake and is the most severe, is the acute period. Afterwards, the subacute period, known as the recovery phase, occurs. The general effects of the earthquake begin to be felt in

this phase. The last stage is the chronic period and is also known as the stage where life gets back into order, the effects of the earthquake continue and people try to live a life similar to their pre-disaster life (Alkan & Tandoğan, 2023). The first month after an earthquake is very important. Search, rescue and survival activities are intense. In this process where individual and community health is important, the most important need is the person's effort to survive. In the following periods; paying attention to elements such as hygiene, shelter, nutrition, health and gaining awareness are encountered in the subacute period (Gündüz, 2022). The last part of the disaster process, the chronic phase, is a process of returning to normal life habits and characteristics, rehabilitation, acceptance and recovery (Alkan & Tandoğan, 2023). Studies on the Kahramanmaraş-centered earthquake that occurred in Türkiye in 2023 reported that women were more affected by the earthquake than men, had more difficulty accessing health services, and gender-based inequality increased (Balikuddembe, Reinhardt, Rehinhard, Vahid & Di 2024). Not only that, it has been determined that more than half of the people who receive follow-up and treatment in health centers are women. The rate of women who do not have official records but provide follow-up and treatment on their own is also quite high (Tor & Güneş Yüce, 2023). Based on this, there were disruptions in access to health services, shelter, nutrition, access to aid, personal hygiene, importance given to infectious diseases and family planning during and after the earthquake (Çepni & Yavuz, 2021). According to AFAD data, the results of the Kahramanmaraş earthquakes with magnitudes of 7.7 and 6.4 have revealed the most up-to-date developments and status of the earthquake-related process. In addition to these two earthquakes, numerous aftershocks have occurred. The devastating effects of disasters on women's health have been revealed in this process (Cengiz & Peker, 2023).

If we examine the problems experienced by women in the post-earthquake period more closely; it is observed that there are problems related to reproductive health, problems experienced during the menstrual period, lack of genital hygiene, an increase in the rate of genital infection; lack of and limited access experienced in the antenatal, intrapartum and postnatal period, an increase in fetal and maternal morbidity and mortality rates, birth and postpartum complications, sexual dysfunctions and an increase in mental disorders such as depression. It is observed that breastfeeding behavior decreases due to the lack of privacy and private living space, and that the milk rate of breastfeeding mothers decreases (Kaplan, Alkasaby, Düken, Kaçkın, & Riad, 2024). In the post-earthquake period, the negative consequences of the earthquake on women's health in sheltered areas such as tent cities or container cities should be

determined. In the following period, activities should be carried out to eliminate the negative consequences experienced by people in order of priority. This activity should be provided by health professionals who are experts in the field and should continue in this way (Ak & Aslan, 2024). An approach should be taken into consideration in the cultural and social factors in the region where the earthquake occurred; support should be provided by acting according to the sense of privacy, the principle of benefiting the individual and society, and most importantly, the state of the psychological structure (Alkan & Tandoğan, 2023).

Health professionals and experts working in natural disasters such as earthquakes should aim to eliminate the negative consequences of earthquakes by making the general and common goals of reducing the negative effects of earthquake-related disasters on women's lives, revealing the difficulties they experience in accessing health services and supporting activities aimed at eliminating these difficulties as well as offering new solution suggestions, and taking initiatives to eliminate psychological problems experienced in the post-earthquake period. In the study, research was conducted towards these goals and data was obtained and the study was completed by bringing them together (Aydın & Aytaç, 2023).

2. MATERIALS AND METHODS

In this study; A literature review was conducted between January 1, 2020 and February 15, 2025 using the search engines “Google Scholar”, “PubMed”, “Scopus”, “CINAHL Plus”, “National Thesis Center” and “Medline” using a combination of keywords such as “Natural Disaster”, “Women and Natural Disaster”, “Women's Health Services”, “Natural Disasters and Women's Health”. Full texts were accessed in the literature review. In the review, Turkish and English were used as the writing languages and sources that met the desired criteria were used.

3. FINDINGS

3.1.1 Earthquake Effects on Reproductive Health

Adolescence

When looked at; menarche is a concept that should be taken seriously and is affected by this negative process. Menstrual hygiene is a very important issue. Infection can occur due to lack or absence of hygiene. Menstrual discharge control is difficult and it has been determined that there is inadequacy in protection against this discharge. In this case, needs priorities should be determined (Ak & Aslan, 2024). Health professionals who have important responsibilities in

disaster management such as earthquakes; in addition to many responsibilities such as first aid, emergency response, triage, general health education and consultancy, they can also provide important contributions to women's health during earthquakes by taking part in basic services such as protecting women's health and providing menstrual hygiene management (Çepni & Yavuz, 2021).

Pregnancy Period

Women who are pregnant are also negatively affected by this process. During this period, not only the health of the mother but also the health of the baby is very important. The protection and maintenance of this health should be seen as the most basic goal. Problems that may be experienced regarding maternal and fetal health, an increase in the number of preterm labor, an increase in the rate of fetal/maternal morbidity and mortality, complications related to birth and problems related to breastfeeding after birth may occur (Ahmed & Khdhir,2023). Healthcare professionals should be careful about this issue and take precautions against risks to prevent such problems or take action to provide solutions in the shortest and most appropriate way after such problems. The control and follow-up process that should be carried out during pregnancy should be continued as much as possible, and health professionals should exhibit a multidisciplinary approach for a healthy birth and baby (Kipay,2023).

Mental disorders resulting from stress and losses negatively affect the pregnant woman by causing inadequate gestational weight gain, developmental delays, anomalies, premature and stillbirths. Birth and postpartum periods are as important as pregnancy. Studies show that more than half of maternal deaths occur in the postpartum period. Postpartum hemorrhage and infection control are very important in preventing complications. Postpartum depression may have consequences that are more likely to occur than during normal pregnancy (Kaplan, Alkasaby, Düken, Kaçkın, & Riad, 2024).

Breastfeeding Period

Breast milk, which is the most effective food for the development of babies, is affected in terms of quantity and structure during this period. It can cause breast milk to decrease or even cease, and it can cause the baby to be negatively affected by this process by changing the mother's nutritional status. It may be difficult to reach alternative methods other than breast milk during this period. Other alternative methods such as formula, which require equipment to prepare and

attention to hygiene, are likely to experience problems. Thus, it is likely to experience problems such as malnutrition, dehydration, and developmental delay (Ak & Aslan, 2024).

Reproductive Age

For women who are both reproductive age and menopausal, gynecological problems are highly likely to occur. Dealing with these difficulties can cause disruptions during extraordinary times such as natural disasters (Çepni & Yavuz, 2021). Gynecological problems affect reproductive health and cause a decrease in the quality of life of individuals. It is known that problems related to sexual intercourse are increasing. Postmenopausal and especially elderly women have more difficulties in accessing health care services. Accordingly, there are cases where there is a disruption in the follow-up and treatment process or the absence of this process at all (Ak & Aslan, 2024).

Access to family planning services, one of the basic health rights of individuals, may be completely eliminated or limited after a disaster. Inadequate or no access to contraceptive methods may cause unwanted pregnancies and induced abortions, as well as increase pregnancy-related complications. There are studies that support the decrease in contraceptive use during this period and the emergence of unwanted pregnancies as a result. During this period, couples should be educated by experts on contraception, and situations such as unwanted pregnancies should be prevented by meeting the requests and needs of individuals in the shortest and most appropriate time frame possible (Kara & Nazik, 2023).

During and after the earthquake, genital infection cases are frequently seen, especially in women of reproductive age. The main reasons include factors such as inadequate hygiene, polygamy, a large surface area of the vaginal mucosa, and the occurrence of such infections in men without symptoms. The closeness of the anus and vagina line also increases the likelihood of infection. In addition to these conditions, there are studies showing an increase in the likelihood of sexually transmitted diseases (HIV, hepatitis B, syphilis, gonorrhea, chlamydia, etc.) (Bulgurcu & Acun, 2024)

3.1.2. Psycho-social Impact of Earthquake

Earthquakes continue to have physical, psychological and physiological effects not only at the moment they occur but also in the following period. The psychological destruction and this difficult process can last a lifetime. It is known that earthquakes cause psychological problems

as well as physiological and social problems (Aydın & Aytaç, 2023). In women and children, temporary or permanent mental disorders may occur. Mental disorders such as depression, anxiety disorder, post-traumatic stress disorder, anxiety and hallucinations may occur (Lebni, Khorami, Azar, Khosravi, & Ziapour, 2020). It is highly probable that such problems will occur in the acute phase. The most common condition is post-traumatic stress disorder, which can cause irreversible problems in the person due to the negative consequences of the earthquake. The basis of post-traumatic stress disorder is the perception that "the world will end" and everything will be destroyed. The most important symptom of this disorder is the mental repetition of the process experienced at the time of the earthquake, sleep problems, angry mood, concentration problems and insensitivity to the environment. There are studies that support the fact that men also face such problems, but they are less likely to experience them than women, but they recover more slowly (Cengiz & Peker, 2023).

The earthquake centered in Kahramanmaraş in Türkiye in 2023 deeply affected approximately 11 provinces, and in the study titled “Examining the depression levels of adults in the post-earthquake period”, it was determined that women face more stress and are prone to depression than men, and that their access to psychological support is more limited. It was also determined that women aged 35 and over face and experience more psychological problems than women under the age of 35. It has been reported that women experience suicide, helplessness and burnout syndrome more (Cengiz & Peker, 2023).

3.2. Protection and Maintenance of Women's Health in the Post-Earthquake Period

Health should be protected and maintained in extraordinary periods such as earthquakes, as in normal life. Action should be taken for optimal health and this should be disseminated. Priority is determined for women according to their needs and a follow-up process is initiated and an individual approach is demonstrated (Kara & Nazik, 2023). The most important step of the process is taken by determining the physiological and psychological needs of the woman within the framework of holistic care. Needs regarding reproductive health should be determined according to the period and age. Priority needs are determined for adolescence, reproductive age, pregnancy, birth/breastfeeding and subsequent processes and an approach is provided. All women should be provided with training and consultancy on issues such as protecting and developing reproductive health and healthy life behaviors (Ak & Aslan, 2024).

4. CONCLUSION

This study has revealed the multidimensional problems encountered in women's access to reproductive health services after large-scale earthquakes and the effects of these problems on women's physical, mental and social health. The findings show that women's reproductive health-specific needs are often overlooked in the provision of post-disaster health services, and the current health system is inadequate to provide a holistic response to these needs (Ak & Aslan, 2024). In particular, the fact that pregnant women cannot benefit from regular check-up services, births occur without healthcare personnel or in inadequate conditions, and limited postnatal care services have brought about serious maternal and infant health risks (Kara & Nazik, 2023).

Interrupted access to family planning services has led to an increase in the rate of unwanted pregnancies, while also causing women to lose control over their own bodies. Furthermore, lack of privacy in accommodation, limited access to menstrual hygiene products and lack of safe sanitation facilities have left women unable to meet even their basic hygiene needs (Ahmed & Khdhir,2023).

Considering that sexual and gender-based violence increases in disaster settings, the lack of structures for the multifaceted protection of women is striking (Çepni & Yavuz, 2021). The limited availability of psychosocial support services has made it difficult for women to cope with the feelings of loss, trauma and insecurity they experience. In this context, it becomes clear that not only physical health but also mental health services should be planned in a gender-sensitive manner after a disaster. This study shows that disaster management processes should be reconsidered to include not only emergency intervention but also long-term reconstruction plans. The foundations for protecting women's reproductive health rights and securing their access to services should be built (Aydın & Aytaç, 2023).

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BEING A FEMALE WORKER IN TÜRKİYE

Sinem YAĞIZ[3], Zekiye TURAN[4]

Abstract

Aim: This review aims to examine the position of women in business life in Türkiye, including the advantages and disadvantages they encounter, as well as the problems faced by women who are the majority in the health sector.

Method: The literature review was conducted between January 1 and February 15, 2025, using the PubMed, Google Scholar, DergiPark, and Scopus databases. After the literature review, information and findings about women working in Türkiye were compiled.

Findings: Women's employment is a fundamental element of social development and economic growth. Women's participation in business life brings advantages such as creating fairer societies, enhancing social welfare, establishing positive role models for future generations, and increasing awareness of gender equality. Although an increase in women's employment rates has been observed in Türkiye in recent years, working women face various difficulties such as structural obstacles, gender discrimination, unequal wages and negative perspectives. Being a woman worker in Türkiye is also shaped within the framework of gender roles, sociocultural reasons and economic conditions. In particular, social expectations such as motherhood and childcare can negatively impact women's working lives and development. As it becomes increasingly complex for women to achieve a work-life balance, their continuity and advancement in this field are also restricted. One of the areas where women's employment is concentrated in Türkiye is the health sector. Women working in this sector face many situations that negatively affect their professional satisfaction, such as intense and irregular working hours, psychological violence (mobbing) at work, glass ceiling syndrome and low representation rate in management.

Conclusion: When comparing the advantages and disadvantages of being a working woman in Türkiye, despite their positive contributions, working women face numerous

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challenges due to the influence of traditional gender roles. While increasing the employment of women and granting them equal rights with men is a positive development, there should be sanctions in place to prevent women's social rights from being disadvantaged compared to men in terms of employment. To increase the motivation of women employees and ensure continuity, it is essential to promote women's employment, prevent gender inequality, and implement more comprehensive policies in the workplace.

Keywords: Women's employment, women workers in Türkiye, working life, gender inequality, women's labour, glass ceiling syndrome, mobbing, women's labour force

INTRODUCTION

Women's entry into the workforce is of great importance for both economic development and social development. Women's participation in the workforce not only yields individual benefits but also contributes to the well-being of society and the pursuit of justice. However, women's entry into the workforce in Türkiye faces various obstacles due to reasons such as gender roles, traditional family structure, insufficiently supportive policies and inequalities between sectors. The fact that women's labour is generally invisible in all areas, concentrated in low-wage and insecure jobs, and the disconnection between education and work life make it difficult for women to have a permanent and substantial place in business life. This compilation aims to examine the social, cultural, and economic aspects of being a female employee in Türkiye, to identify the fundamental problems women face in the business world, and to address the occupational inequalities experienced in the healthcare sector, offering potential solutions.

METHOD

In this compilation study, a qualitative literature review method was employed to identify the social, economic, and cultural challenges faced by women workers in Türkiye. The literature review was conducted between January 1 and February 15, 2025. In this process, the PubMed, Google Scholar, DergiPark, and Scopus databases were utilized to access up-to-date and reliable academic resources on the subject.

Keywords such as "women's employment", "women's workers in Türkiye", 'working life', "gender inequality", "women's labour", "glass ceiling syndrome", "mobbing" and "women's workforce" were used in the searches. Local and foreign studies that met the determined criteria were evaluated; priority was given to research and review articles that focused explicitly on the Turkish context.

FINDINGS

The information obtained from the literature review will be discussed under the titles of ‘Being a Female Employee in Türkiye, ‘Difficulties of Being a Female Employee’, ‘Factors Affecting Women’s Participation in the Workforce’, and 'Problems Experienced by Women Working in the Health Sector’. This approach aims to comprehensively reveal the real situation of women employees in Türkiye in business life by compiling the data and findings highlighted in the literature under each title.

BEING A WOMAN WORKER IN TÜRKİYE

Women's employment is a fundamental element of social development and economic growth. Türkiye's ability to achieve sustainable economic growth and sustain its development is directly related to the active participation of women, who constitute half of the social structure, in economic life (Aksoy et al., 2019). Increasing the female workforce and finding employment opportunities contribute not only to individual well-being but also to the improvement of social welfare. Women's participation in business life is of great importance in terms of creating positive role models for future generations, raising awareness of gender equality, increasing household incomes, reducing poverty and using economic resources more efficiently. On the other hand, in societies where women's labour is ignored, this situation is considered a significant economic loss (Sar, 2021). When we examine the labour force participation rates of women, who constitute almost half of the world's population, it is evident that inequality in this area remains a serious problem.

Difficulties of Being a Female Employee

It is a common situation in many societies that women benefit less from social and economic development than men (Pınar, 2008). The traditional domestic roles attributed to women throughout history have relegated their participation in economic activities to the background. Women's employment continues to be an area shaped by gender inequalities on a global scale. Especially after the Industrial Revolution, women continued to fulfil their domestic responsibilities while trying to participate in economic life. This dual burden causes women's labour to face gender-based discrimination both at home and in the labour market. (Korkmaz & Budak, 2022). Although women have become more visible in social life, this situation has not fully ensured that they have equal rights with men.

Historically, it has been observed that there has been no radical change in the position of women in society, and existing inequalities are perpetuated in various ways today (Açıkgöz, 2010). The understanding that women's primary role in patriarchal social structures is still limited to home and family also directly affects their positions in business life (Korkmaz & Budak, 2022). The fact that women try to manage both their family responsibilities and their business life simultaneously puts them in a structurally disadvantaged position. The tasks attributed to women within the framework of gender roles cause them to face inequality in many areas, from education to employment.

The deprivation of girls from education, guidance of women in choosing a profession, and obstacles to their entry into business life are among the main reasons for the low employment of women. In addition, the inadequacy of social policies for women and the lack of current legal regulations depend on this process (Çakır, 2011). Thus, it prevents women from achieving economic freedom and prepares the ground for them to work in insecure, low-wage, and flexible-time jobs (İğde, 2011). Implementing policies that encourage girls to enrol in school and prevent them from having to work in insecure, low-wage and flexible-time jobs in the future by ensuring that they complete their education; thus, the obstacles to women reaching economic freedom will be reduced (Şentürk, 2016).

Factors affecting women's participation in the workforce

Increasing women's employment is not only an economic necessity but also a critical issue in ensuring social justice. Women's participation in the workforce not only contributes to economic growth but also enables the transformation of gender roles and the construction of a more just society (Jordan, 2002). Women's economic empowerment not only increases their freedoms but also supports their effective participation in decision-making processes within the family and society as a whole. In this context, encouraging women's employment should be addressed not only to alleviate the financial burden on the family, but also in a way that provides women with respect, economic independence, and social status. The participation of both men and women in production processes makes significant contributions to both the family economy and the broader development of society (Gözüm, 2024).

Being a female employee in Türkiye is shaped by gender roles, sociocultural reasons and economic conditions. Although there has been an increase in female employment rates in Türkiye in recent years, working women face various difficulties such as structural obstacles, gender discrimination, unequal wages and negative perspectives. Gender roles are one of the most fundamental limiting factors for women's participation in business life. In the traditional family structure, women are often seen as individuals responsible for household chores and childcare, and these responsibilities contribute to a perspective that evaluates women's productivity primarily within the household (Korkmaz & Budak, 2022). While women's activities within the home are often viewed as unpaid jobs, men's participation in production outside the home is often seen as a financially rewarding activity. This situation sharpens gender roles and reinforces the patriarchal structure (Işık & Serdaroğlu, 2015).

The marital status of women also appears as a determining factor in their participation in the workforce. It is observed that women who are married, single or divorced face different difficulties in accessing the workforce. The employment process becomes more complicated, especially for women who are married and have children, due to traditional expectations. Many tasks, such as caring for elderly individuals at home, child-rearing responsibilities, and maintaining household order, are traditionally assigned to women by social expectations, which can make it difficult for women to participate in the workforce sustainably. The age factor is also considered an important factor affecting women's participation in the workforce. As women age, they either cannot participate in the workforce at all or struggle to make stable

progress due to increasing family responsibilities, particularly marriage and having children. (Korkmaz & Budak, 2022)

Women who manage to find a place in the labour market are now faced with other types of difficulties. Most women work in low-wage and insecure jobs, and sometimes as unpaid family workers; they cannot receive compensation for their labour. This situation pushes women into an economically fragile position. Especially in sectors where informal women's employment is widespread, women's access to social security is limited, which creates serious problems in terms of job security and professional development. (Yüksel, 2020). One of the most effective steps that can be taken to increase women's participation in the labour force in Türkiye is to enhance their educational level. Women who have increased access to educational opportunities become more equipped and have the opportunity to work in qualified jobs. This situation not only supports individual development but also makes a positive contribution to the general standard of living in society. (Sar, 2021)

Problems Experienced by Women Working in the Health Sector

One of the areas where women's employment is concentrated in Türkiye is the health sector. Women working in this sector encounter many situations that negatively affect their job satisfaction, such as intense and irregular working hours, psychological violence (mobbing) at work, glass ceiling syndrome and low representation in management. When the family responsibilities, housework and childcare tasks imposed on women in society are taken into consideration, these irregular working hours have become a threat to both women's physical and mental health. This situation highlights that women face greater difficulty in establishing a work-life balance compared to their male colleagues.

Although women comprise the majority of the healthcare sector, their representation in management positions remains quite limited. This situation is explained by the "glass ceiling syndrome". The glass ceiling refers to the invisible obstacles that prevent women from reaching senior management positions, despite possessing sufficient education, experience, and competence. These obstacles are shaped by prejudices that are not explicitly expressed but cause women to be systematically excluded from promotion processes (Utma, 2019). Wirth (2001) evaluates the glass ceiling as a structural manifestation of gender inequality.

In addition to the glass ceiling, another important problem faced by female healthcare workers is mobbing, or psychological harassment. According to Baypınar's (2003) definition, unwanted behaviours towards employees, gender-based approaches, attitudes such as assigning degrading tasks, and practices that are incompatible with good intentions and ethical rules are evaluated within the scope of psychological violence (mobbing). Especially among nurses, burnout due to mobbing occurs not only because of excessive work, but also because of the mismatch between the demands expected from them and the limited resources they have. (Slusarz et al., 2022)

CONCLUSION AND RECOMMENDATIONS

When comparing the advantages and disadvantages of being a working woman in Türkiye, despite their positive contributions, working women often struggle with numerous problems due to the influence of traditional gender roles. Increasing women's employment in Türkiye is of great importance in terms of both economic development and ensuring gender equality. One of the most fundamental factors preventing women from participating in the workforce is that patriarchal structures and traditional gender roles are still effective. To overcome these structural obstacles, women's vocational training and skill development opportunities should be increased, and nurseries and similar social services aimed at balancing work and family life should be expanded.

In areas where women work intensively, such as the healthcare sector, problems like mobbing, the glass ceiling, and irregular working hours in the workplace negatively impact women's motivation and productivity. Therefore, institutions need to provide their employees with a fair workload, a respectful working environment and psychological security.

Removing the invisible obstacles that women face in business life is not only an individual necessity but also a social one. As a result, policies aimed at increasing women's participation in the workforce should be comprehensive and multi-dimensional, taking into account the dynamics of the social structure. These policies should include steps such as strengthening legal regulations, popularising flexible working models, developing education and social support programs and increasing gender equality awareness. Only in this way can women participate in economic and social life as more active, free, and equal individuals, making significant contributions to the development of our country.

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PARENTAL REFUSAL TO VACCINATE THEIR CHILDREN: REASONS AND SOCIAL IMPLICATIONS

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Abstract

Introduction and Aim: Vaccination has an important place in human life, both as a concept with many benefits and as one of the top ten public health achievements in the world. Vaccine refusal is defined as the absolute refusal of individuals or parents to administer all vaccines. In this review, we aimed to discuss the causes and social effects of vaccine refusal.

Method: Between December 25, 2024 and February 15, 2025, "Journal Park", "Scopus", CINAHL Plus", 'PubMed', 'National Thesis Center', 'Google Scholar' and 'Medline' databases were used to search the literature. After the literature review, information and findings on the causes and social effects of vaccine refusal were compiled.

Findings: The reasons for vaccine refusal are complex and vary depending on the geographical and cultural context. The main reasons for vaccine refusal can be listed as distrust of vaccines, concerns about side effects, doubts about vaccine content and the pharmaceutical industry, religious and cultural factors, distrust of the health system and professionals, not seeing infectious diseases as a risk, social media and misinformation dissemination, and reliance on alternative medicine methods.

In particular, parental refusal to vaccinate results in children not being fully immunised, which has a major impact on the healthy quality of life of children and their families. The social consequences of vaccine refusal include a reduction in the level of immunity in society, the re-emergence and spread of infectious diseases, an increase in the burden of disease, disruption to health services, failure to achieve desired public health outcomes and increased pressure on health workers. It is predicted that, in the long term, non-vaccination could become a social crisis, reducing the number of social workers and increasing the cost of health services. In

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addition, it creates ethical dilemmas in maintaining the balance between 'freedom' and 'public health', as it conflicts with the general health of society when parents make decisions about their children's health.

Conclusion: Parental vaccine refusal is generally due to misinformation and lack of trust. To overcome this problem, accurate information from reliable, science-based sources must be disseminated to the masses and strong strategies must be developed to counter anti-vaccine misinformation.

Keywords: Vaccine, vaccine refusal, infectious disease, public health

INTRODUCTION

Vaccines are one of the most effective and safe methods of protection against infectious diseases. However, in recent years, some individuals have become distrustful of vaccines or completely refuse to be vaccinated, which has become an important problem in terms of public health. This attitude, defined as anti-vaccinationism, negatively affects not only the health of individuals but also the overall immunity of the society. In particular, the increase in the number of parents who do not vaccinate their children leads to the re-emergence of previously controlled diseases, which poses a risk to public health. Misinformation spread through social media, beliefs with no scientific basis and distrust in the health system are effective in the spread of this situation. This study aims to make a comprehensive assessment of the causes of anti-vaccination in the world and in Türkiye, the effects of this situation on public health and solutions.

METHOD

In this review study, a qualitative literature review method was used to examine the causes of anti-vaccination in the world and Türkiye and its effects on public health. The literature review was conducted between March 1 and April 20, 2025. During the research process, PubMed, Google Scholar, DergiPark and Scopus databases were utilized to access current and reliable academic publications on the subject.

Keywords such as “vaccine refusal”, “vaccine opposition”, “vaccine hesitancy”, “public health”, “infectious disease”, “vaccine and trust”, “vaccine status in Türkiye” were used in the searches. Among the studies accessed, studies conducted in the context of Türkiye and review articles were prioritized, and domestic and foreign sources were evaluated. The selected publications were analyzed by taking into account the timeliness, methodological validity and contribution to the subject.

RESULTS

The information obtained from the literature review will be discussed under the headings ‘Vaccine Opposition and Vaccine Hesitation’, ‘Historical Process of Vaccine Opposition’, ‘Vaccine Opposition in the World and Türkiye’, ‘Reasons for Vaccine Opposition’ and ‘Effects of Vaccine Refusal on Public Health’. This approach aims to compile the prominent data and findings in the literature under each heading, and to comprehensively reveal the causes, historical development, current situation, and broad effects of vaccine refusal on public health in Türkiye and globally.

Opposition to Vaccination and Vaccine Hesitation

The World Health Organization (WHO) defines opposition to vaccination as individuals refusing or delaying vaccination despite having access to vaccination services (WHO, 2016). This includes not only individuals who explicitly refuse vaccination, but also parents who accept vaccination but have various concerns. Vaccine hesitancy is a multidimensional phenomenon that includes emotions such as reluctance, skepticism and mistrust. This phenomenon may vary depending on time, place and type of vaccine and is influenced by various factors such as the level of indifference of individuals, their access to health services and their level of trust in vaccines (Tanrıkulu & Tanrıkulu, 2021).

Although often used interchangeably, the concept of “vaccine refusal” refers to the complete rejection of the administration of all vaccines and therefore not vaccinating individuals, especially children, whereas “anti-vaccination” is considered in a wider range and includes behaviors such as refusal, postponement or hesitation regarding vaccines (Öktem, Karaoğlu & Uçtu, 2023). Vaccine refusal is considered not only as an individual decision but

also as a social issue that affects the health of other people around the individual, especially the child. In this context, anti-vaccination and vaccine hesitancy go beyond individual attitudes and can have serious negative consequences on public health. Anti-vaccine attitudes can be developed on medical, legal, religious or political grounds, and this phenomenon has a historical background parallel to the emergence of vaccines (Tanrıkulu & Tanrıkulu, 2021; Öktem et al., 2023).

Historical Process of Vaccine Opposition

Vaccine opposition has a much longer history than it is believed. This situation emerged in 1796 when Edward Jenner developed the first vaccine using the bovine pox virus (Ayçiçek, 2021). At that time, some clergymen, especially E. Massey, argued that diseases were a test of God and that vaccination was an intervention in this order (Büyükkalay, 2022). Injecting people with substances of animal origin into the body was believed to be an act against God's will. This concern was also supported by cartoons. For example, caricatures such as an old woman who grows horns after vaccination or a child with a cow's face were used to scare the public (Altın, 2024). Similar reactions were also seen in the Ottoman Empire; some people objected to the smallpox vaccine, and for this reason, it was not hesitated to make legal regulations ordering fines for those who did not get vaccinated (Büyükkalay, 2022).

In the 19th century, many Western countries made vaccination compulsory to prevent infectious diseases (Beler, 2024). For example, the first vaccination law was enacted in England in 1840, and in 1853 vaccination became compulsory and those who did not vaccinate were fined or imprisoned (Öktem, Karaoğlu & Uçtu, 2023).

Some people reacted to this situation and thought that individual freedoms were being restricted. In this process, anti-vaccination groups such as the “Anti-Compulsory Vaccination Association” were established. John Gibbs' book “Our Medical Liberties” was one of the publications supporting these movements. In 1885, a large anti-vaccine protest was organized in Leicester, England with the participation of approximately 100 thousand people (Altın, 2024; Büyükkalay, 2022).

In the US, compulsory vaccination laws were enacted after the great smallpox epidemic in 1870, but there were debates about individual rights here as well. In 1905, the US Supreme Court ruled in Jacobson v. Massachusetts that individual freedoms could be limited for public health. The UK, on the other hand, granted parents the right to "conscientious objection" with a regulation in 1898 (Altın, 2024; Ayçiçek, 2021; Öktem, Karaoğlu & Uçtu, 2023).

Throughout the 20th century, as the number of vaccines increased, anti-vaccine movements gained strength in parallel (Büyükkalay, 2022). In 1982, in the USA, debates on the DTP (diphtheria, tetanus, pertussis) vaccine were brought to the public agenda with the documentary DTP: Vaccine Roulette and the book A Shot in the Dark, which were broadcast on the NBC channel. In these content, serious side effects such as seizures and permanent brain damage were claimed to have occurred in children after vaccination. Although these symptoms are classified as rare and temporary side effects, the long-term effects have not been scientifically confirmed. However, these allegations, spread through the media, have undermined confidence in vaccines and led to both a decrease in vaccination rates and an increase in lawsuits against manufacturers. Similarly, there was a loss of confidence in the pertussis vaccine in the UK, and the vaccination rate dropped from 81% in 1974 to 31% in 1980 (Altın, 2024; Kart, 2024).

Vaccine hesitancy is an important issue in modern public health and has been shaped by specific events in the historical process (Etesaminia & Bağcı Derinpınar, 2021). In 1998, a paper published by Andrew Wakefield and colleagues claiming that the MMR vaccine was associated with autism was found to lack scientific validity and was eventually retracted. This situation damaged public confidence in the vaccine and led to an increase in the number of measles cases (Doğan, Aksucu & Güney, 2023). In the 1990s, thiomersal, used as a preservative in vaccines, was the subject of controversy; although scientific evidence did not support its association with autism, it was removed from vaccines in the USA and Türkiye as a precautionary measure (Kart, 2024).

The trend of vaccine refusal in Türkiye has shown a significant increase, especially after 2010 (Güngör, Ersoy & Pala, 2021). Court decisions and negative discourses spread through the media have increased vaccine refusal rates, leading to the re-spread of vaccine-preventable diseases such as measles (Erkekoğlu, Erdemli Köse, Balcı & Yirün, 2020). The decline in vaccination rates on a global scale is also worrying. In 2023, the number of unvaccinated

children increased by 600,000, while the number of children who did not receive the third dose of DTP vaccine reached 6.5 million and the number of children who did not receive any dose of vaccine reached 14.5 million (UNICEF, 2023). These data show that the negative effects of vaccine hesitancy on public health continue.

Vaccine Opposition in the World and Türkiye

Vaccine hesitancy has become an important public health problem worldwide. Doğan et al. (2023) and Etesaminia and Bağcı Derinpınar (2021) examined the effects of anti-vaccination and social factors on society from different perspectives. These studies reveal that vaccination rates have declined in nearly 90% of countries due to hesitancy about vaccines, leading to the re-spread of vaccine-preventable diseases, especially measles. While more than 140,000 people died from measles in 2018, the number of cases tripled in 2019 (Aygün & Tortop, 2020).

In 2016, immunization rates in Türkiye were quite high for many childhood vaccines, but by 2017 they had declined. This decrease is particularly striking for BCG and some combined vaccines (Beler, 2024). Increased hesitancy towards vaccination affects the incidence of infectious diseases not only locally but also globally. For example, in 2018, some of the measles cases reported in countries such as the US, Venezuela and Brazil resulted in death (Aygün & Tortop, 2020). In the same year, the number of measles cases worldwide doubled compared to the previous year (Beler, 2024). In Türkiye, measles cases, which were quite low in 2009, showed a significant increase in 2018 (Beler, 2024). This picture reveals the effects of the decline in vaccination rates on public health. These data reveal that vaccine hesitancy is not only an individual choice, but also a global threat with serious consequences for public health (Çıtak & Aksoy, 2020).

In Türkiye, the concepts of vaccine ambivalence and vaccine refusal came to the agenda especially in the 2010s (Atasever et al., 2021). In 2015, a legal development - a prosecutor refused to vaccinate his twin children against Hepatitis B and won the case - was a turning point in the popularization of this process. In the same period, increasing anti-vaccine discourse in the media damaged public trust in vaccines (Atasever et al., 2021; Güngör et al., 2021). Vaccine refusal cases have increased rapidly over the years: 183 vaccine refusals in 2011 increased to 23,000 in 2018. According to experts, if this increase continues, it is possible that vaccination

rates will fall below 80% and some infectious diseases will become epidemic again. Indeed, the incidence of measles has increased from 0.01 per 100,000 in 2016 to 0.10 per 100,000 today. In 2018, 44 measles cases were reported in only three months, and this number reached 716 by the end of the year (Ayçiçek, 2021; Kardaş Özdemir & Aşut, 2021; Hayat Öktem et al., 2023).

The Turkish Demographic and Health Survey (TDHS) 2018 data clearly reveals the decline in immunization. Only 66.9% of children aged 12-23 months are fully vaccinated; this rate decreases to 49.6% among children aged 24-35 months. Furthermore, 2% of children in this age group have never been vaccinated. This reflects both vaccine refusal and access problems. Socioeconomic status is also a determinant of vaccination rates. While the rate of full immunization is 57.3% in low-wealth families, it is 76.8% in the highest wealth level families. This difference reflects inequalities in access to health services. Only smallpox vaccination is currently legally mandatory in Türkiye. There is no legal obligation for other vaccines. In 2015, the Constitutional Court ruled that vaccines cannot be made compulsory without a clear legal regulation, which has kept the issue on the agenda. In line with these developments, the Ministry of Health established a website called “asi.saglik.gov.tr” to provide accurate information to the public. This platform aims to raise social awareness against vaccine opposition with scientific content (Tanrıkulu & Tanrıkulu, 2021; Etesaminia & Bağcı Derinpınar, 2021; Doğan, Aksucu & Güney, 2023).

Reasons for Vaccine Opposition

Vaccine opposition is a complex phenomenon that leads to delayed or complete rejection of vaccines despite access to vaccination services. This situation has emerged with the interaction of various individual, social and environmental factors (Kömürlüoğlu and Yalçın, 2024; Atasever et al., 2021).

One of the most important reasons for opposition to vaccination is parents' beliefs that vaccines are unsafe or harmful (Hasar et al., 2021). In particular, false beliefs that vaccines cause serious illnesses such as autism, infertility, chronic or neurological diseases are common. In addition, unfounded allegations about substances such as thiomersal, aluminum and porcine gelatin in vaccines and suspicions of commercial interests of the pharmaceutical industry have fueled these concerns. The idea that vaccines are unnecessary or ineffective, or even that vaccinated children get sicker, and bad experiences or side effects in previous vaccination

practices have also increased distrust (Taşçı & Gökler, 2021; Atasever et al., 2021; Kardaş Özdemir & Aşut, 2021).

The perception that there is not enough information about vaccines and the idea that the facts are hidden have fed vaccine hesitancy; misinformation and unfounded claims that spread rapidly on the Internet and especially on social media have played an effective role in reaching large masses of anti-vaccine arguments, and negative news and anti-vaccine discourses in the media have also paved the way for the public to reject vaccines (Erkekoğlu et al., 2020; Hayat Öktem et al., 2023; Aydın Doğan et al., 2024).

The belief that infectious diseases are not dangerous, are part of fate, or that natural immunity is superior to immunity acquired through vaccination has led to vaccine refusal (Aygün & Tortop, 2020). Atasever et al. (2021) stated that the idea that traditional or alternative treatment methods such as breast milk, propolis, herbal products and spiritual practices would strengthen immunity or be an alternative to vaccination increased the opposition to vaccination.

The belief that vaccines are religiously objectionable or that it means defying divine providence can trigger vaccine refusal, especially when combined with false beliefs about religiously sensitive substances such as pork gelatin in vaccine content (Aygün & Tortop, 2020). Anti-vaccine discourses of religious leaders or communities also reinforce this situation (Tanrıkulu & Tanrıkulu, 2021; Civaner, 2023). Legal precedents, such as the absence of a legal obligation to vaccinate other than the mandatory smallpox vaccine in Türkiye and a prosecutor winning a case in 2015 for refusing to vaccinate her twin babies, have contributed to the rapid increase in vaccine refusal rates (Hayat Öktem et al., 2023). The Constitutional Court's finding of the lack of “legality” principle also supported this situation (Tanrıkulu & Tanrıkulu, 2021; Civaner, 2023; Çakırca, 2022). For this reason, individuals cannot be legally prevented from refusing vaccination.

Distrust of healthcare professionals and the healthcare system in general is another factor that increases vaccine hesitancy. This distrust may be reinforced by the belief that healthcare professionals do not have sufficient knowledge and equipment about vaccines or do not research the subject in depth. In addition, the lack of effective communication strategies and inadequate accurate information also play an important role in the spread of anti-vaccine sentiment (Aygün & Tortop, 2020; Kömürlüoğlu & Yalçın, 2024).

Socio-demographic factors such as parental education level, household wealth, number of children and geographical barriers may also influence vaccine hesitancy. Some studies have shown that higher levels of education increase vaccine hesitancy, while others have shown that vaccination rates decrease with lower levels of education. While vaccine hesitancy is higher in low-income families, it has also been observed that vaccination rates decrease as the number of children increases. Difficulties in accessing health services are also among the environmental factors affecting vaccine refusal (Tanrıkulu & Tanrıkulu, 2021; Etesaminia & Bağcı Derinpınar, 2021). The combination of these factors paves the way for the spread of vaccine refusal by reducing individuals' trust in vaccines and challenging their ability to make the right decision in an environment of information pollution (Beler, 2024). It is vital to develop holistic and science-based strategies to address each of these complex causes in the fight against anti-vaccination (Civaner, 2023).

The Effects of Vaccine Refusal on Public Health

Vaccine refusal and hesitation are among the important factors leading to an increase in the prevalence of infectious diseases, the emergence of epidemics, an increase in treatment and care costs, and an increase in mortality rates due to these diseases (Yorulmaz & Karadeniz, 2022). This phenomenon goes beyond individual decisions and affects the general health and social fabric of the society both directly and indirectly.

Anti-vaccination not only increases individual health risks, especially when parents refrain from vaccinating their children, but also poses serious threats to public health by reducing the level of social immunity (Ayçiçek, 2021). Unvaccinated individuals pave the way for the spread of infectious diseases, putting not only their own health at risk, but also individuals with low immunity and the general public. This situation causes preventable diseases to re-emerge, increases the burden on health systems, disrupts service delivery, and causes health workers to spend more time and energy on information and persuasion processes (Öktem et al. 2023). In addition, it leads to ethical dilemmas by bringing into question the balance between individual freedom and public health, damages the sense of social solidarity and undermines trust in scientific institutions.

Disinformation spread through social media, low health literacy and distrust of scientific information stand out as the main determinants of the increase in anti-vaccination sentiment.

This process can pave the way for socioeconomic crises not only in the field of health, but also in the long run, such as a decrease in the workforce, an increase in health expenditures and an increase in economic burden (Beler, 2024). Therefore, accurate and reliable health communication, effective public policies, legal regulations and community-based awareness-raising efforts are critical in preventing anti-vaccination.

CONCLUSION AND RECOMMENDATIONS

Anti-vaccination is no longer just an individual preference, but has become an important public health problem that threatens social immunity. This phenomenon, which is shaped by historical, cultural, religious and political factors, is fueled by misinformation and conspiracy theories spread especially on digital media, and is further deepened by the loss of trust in scientific authorities. Increased vaccine refusal leads to the re-emergence of vaccine-preventable diseases such as measles and whooping cough, increased morbidity and mortality, disruption in healthcare services and additional costs to the healthcare system. At the same time, it also brings serious ethical problems by putting the general health of the society, especially immunocompromised individuals, at risk. All these developments reveal that opposition to vaccination is a multidimensional problem that needs to be addressed at the societal level rather than the individual level.

A multi-stakeholder, holistic and sustainable approach should be adopted to combat anti-vaccination. First of all, strategic communication policies should be developed to increase public health literacy. Scientific information should be presented to the public in plain and understandable language, and disinformation spread on social media should be controlled through professional and ethical interventions. At this point, the role of healthcare professionals is vital. They should build trusting relationships with parents, listen to their concerns, provide accurate information based on scientific grounds, and follow an effective and empathetic communication strategy against false beliefs. In addition, awareness should be raised that vaccines are not an individual but a social responsibility, and community-based awareness-raising campaigns should be carried out. In order to increase trust in vaccines, public policies should be clarified, legal arrangements should be made to support vaccination practices and trust in the health system should be strengthened. For all these steps to be effective, the training

of healthcare professionals should be continuous and access to scientific information should be facilitated by improving digital media literacy.

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THE INVISIBLE FACE OF BURNOUT IN THE WORKPLACE: "QUIET QUITTING" AMONG HEALTHCARE WORKERS

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Abstract

Aim: This review aims to examine the impact of the increasingly widespread phenomenon of "quiet quitting," which has recently gained attention on social media, on healthcare workers.

Method: The literature was searched between January 1 and February 15 2025, using the "PubMed", "Google Scholar", "DergiPark" and "Scopus" databases. The search terms used were "quiet quitting," "burnout," and "healthcare workers."

Findings: Quiet quitting is characterised by employees only fulfilling the basic tasks and responsibilities required by their job description and losing the desire to make extra efforts toward their work. Although it is observable across all professions, it is particularly prevalent among healthcare workers today. Quiet quitting has been linked to various factors, including increasing workload, burnout syndrome, inadequate compensation, poor management, limited career opportunities, and work-life imbalance. In healthcare workers, these factors, combined with the COVID-19 pandemic, have created unprecedented pressure, resulting in both physical and psychological strain. The rapid spread of the virus instilled a fear of contracting the disease among healthcare workers. Particularly in intensive care units, the sharp increase in the number of patients made it difficult for healthcare workers to cope with long and exhausting working hours, resulting in a sense of insecurity. In addition to professional challenges, healthcare workers have also had to deal with extra stressors such as being away from loved ones, social isolation, societal stigma, and losses experienced during the process.

Conclusion and Recommendations: The challenges arising from both professional and environmental factors significantly affect the physical and psychological well-being of

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healthcare workers, leading to the emergence of quiet quitting. This results in decreased job commitment, team disharmony, and, most importantly, a decline in the quality of patient care.

To prevent quiet quitting, it is crucial to create a working environment that prioritises employees' well-being, promotes fairness and motivation, provides psychological support, offers career development opportunities, implements policies that support work-life balance, and strengthens recognition mechanisms.

Keywords: Quiet quitting, burnout, healthcare workers.

INTRODUCTION

Phenomena such as stress, burnout, and job dissatisfaction encountered in working life lead to a decrease in the motivation and commitment levels of employees; this situation negatively affects both individual performance and corporate efficiency. Especially, the health sector is one of the areas where such problems are experienced most prominently due to the increasing workload, intense emotional labour requirement, and constantly changing conditions. The decrease in professional satisfaction and work motivation of healthcare professionals can directly affect the quality of healthcare services and pose risks to patient safety and care standards. In this context, it is essential to investigate the new phenomena that affect the attitudes and behaviours of healthcare workers at work and the outcomes of these phenomena. This review study aims to examine the effects of the quiet quitting phenomenon, which has recently gained popularity on social media and in literature, on healthcare workers.

METHOD

The literature search for this review was conducted between January 1 and February 15, 2025. The primary academic databases, PubMed, Google Scholar, DergiPark, and Scopus, were used to access current and relevant publications. In the search process, the keywords "quiet quitting ", "burnout", and "healthcare workers" were used, which reflect the main subject of the study and cover relevant concepts specific to healthcare workers.

FINDINGS AND DISCUSSION

The information obtained through the literature review will be discussed under the subheadings of "The Concept and History of Quiet Quitting", "Causes and Symptoms of Quiet Quitting", "Effects on Individual and Community Health", "Effects on Healthcare Workers" and "Ways to Cope with Quiet Quitting". This systematic approach aims to comprehensively present the current status of the phenomenon of quiet quitting in the health sector and its reflections in the literature.

QUIET QUITTING OF HEALTH WORKERS

The health sector is a critical work area where high levels of intensity and stress are experienced due to the direct impact on human life. Healthcare workers are faced with challenging conditions, such as increased workload and emotional fatigue, which cause significant changes in the attitudes and motivations of employees towards their work. In this context, the quiet quitting phenomenon observed among healthcare workers comes to the forefront as a significant issue affecting the quality of healthcare services at both the individual and institutional levels.

1. The Concept and History of Quiet Quitting

The phenomenon of "quiet quitting", which has become widespread on social media and attracted attention with its increasing visibility in the labor market, is defined as employees refusal to go beyond the duties and responsibilities specified in their job descriptions, their reluctant fulfillment of only the minimum level of work expected of them, their belief that extra effort will not be rewarded, and therefore their continuing their work lives with the lowest level of effort (Yıldız et al., 2024). Although there are various definitions of the concept of quiet quitting, all these definitions converge on the same conceptual framework, pointing to a similar phenomenon.

Höhn first used the concept of quiet quitting in the German management literature in the early 1980s. Höhn defined this concept as "self-retirement" and "internal separation," explaining it as employees consciously giving up their commitment to the organisation and taking initiative within it, thus rejecting activities that are not considered within the scope of their primary duties (Yılmaz, 2024). However, due to the dominance of English publications in

management literature, this concept has not been widely discussed for a long time. In this context, although some academic publications and online sources claim that the concept of quiet quitting was first put forward by economist Mark Boldger in 2009 at the Texas A&M Economics Symposium, it has been revealed that these claims do not reflect the truth, in line with the interviews conducted (Çimen et al., 2023; Çalışkan, 2023; Karaşin et al., 2023; Gün, 2024). Boldger's presentation at this symposium is not about quiet quitting, but about criticisms of the Hugo Chavez-led government in Venezuela, attributing its economic problems solely to socialism (Yılmaz, 2024).

The concept of quiet quitting, which has been addressed in various dimensions in different periods in the literature, has come to the fore again with the COVID-19 pandemic that emerged in 2019 and has had a global impact, paving the way for it to be directly experienced by employees (Karaşin et al., 2023; Gün, 2024). Factors such as curfews, various social restrictions, mandatory vaccination policies, remote working models, flexible working hours, increased working hours and widespread feelings of burnout that have been implemented during this period have caused radical changes in employees perceptions of the concepts of work and labor (Yılmaz, 2024; Yavuz, 2024; Tosun et al., 2024). In this context, the meaning and value of work have begun to be questioned by employees, as working life has been profoundly affected in many areas, particularly in the healthcare sector.

In 2021, the death of a young person in China due to excessive working hours caused a wide repercussion on social media and led to intense criticism of long working hours. During this period, the concept of "quiet leaving" quickly became a widespread trend on social media platforms (Yılmaz, 2024; Yıldız et al., 2024). Zaid Khan, a young software developer and musician, played an important role in popularising it by sharing content under the hashtag "quietly leaving" on TikTok. Khan used the phrase "quietly leaving does not mean leaving; it just means preventing your life from taking over your life. Your work is not your lives! Your value is indivisible with what you produce" to survive and to reach out to the survivor and contribute to the world (Çimen et al., 2023; Acar, 2024; Yılmaz, 2024). In the same years, a social media user named Bryan Creely contributed to keeping the concept on the agenda with another video he published (Güler, 2023). Indeed, it is evident that the quiet quitting phenomenon is not as "silent" as it is often thought; with its historical development and current

prevalence, it has led to significant changes in working life and has given rise to new approaches in management-employee relations.

2. Causes and Symptoms of Quitting

Quiet quitting refers to a situation where employees lose their emotional attachment to their jobs, their motivation decreases, and they only fulfil their duties at a minimum level (Gözlü, 2023). This phenomenon occurs when various structural and psychological factors come together. In particular, long-term stress and increasing professional responsibilities lead to emotional and physical exhaustion in individuals, causing them to lose interest in their jobs and become content with only mandatory responsibilities (Gözlü, 2023; Acar, 2024). On the other hand, the absence of a practical and inclusive leadership approach within the organisation can cause employees to feel worthless and lose trust in management. In addition, not receiving enough material or moral compensation for labour reduces job satisfaction, paving the way for individuals to develop an unwilling attitude towards their jobs (Çalışkan, 2023; Altun et al., 2024).

Problems experienced in achieving a work-life balance also increase burnout levels among employees and cause organisational loyalty to weaken in individuals who cannot allocate enough time to their personal lives (Tosun et al., 2024). In addition, an inadequate communication environment in the workplace causes employees to feel excluded, and their desire to contribute to the organisation's goals decreases. Limited career development and advancement opportunities reduce employees' motivation in the long term, damage their organisational loyalty and lead to quiet quitting behaviours (Çimen et al., 2023; Gürer et al., 2024).

On the other hand, seeing quiet quitting as a completely justified and positive behaviour also has some drawbacks. Especially in work environments where teamwork is intense, individuals being content with only their job descriptions can increase the burden on other employees and create a sense of injustice. This situation can disrupt institutional functioning and trigger a sense of exhaustion in high-performing employees. In addition, in some cases, the concept of "quiet quitting" can be used as an excuse by individuals who do not want to take responsibility or who perform poorly. Therefore, it is essential to evaluate this phenomenon in a more balanced manner, taking into account both individual and organisational effects.

When all these elements are evaluated together, it becomes clear that quiet quitting is not only an individual attitude but also a reflection of systemic issues in the workplace.

3. Effects on Individual and Community Health

Various changes are observed in the attitudes and behaviours of employees at work over time due to the combination of structural and individual factors that cause quiet quitting. During this process, individuals develop a more distant and passive attitude, moving away from their previous levels of commitment to their jobs. Not attending meetings at all or participating reluctantly only out of necessity, avoiding expressing opinions, and a significant decrease in contribution to teamwork are among the first notable indicators of this change (Güler, 2023; Yıldız et al., 2024).

In addition, arriving late to work, leaving work early, not complying with deadlines, and indifference to organisational goals constitute behavioural reflections of the quiet quitting process. There is a noticeable decrease in the passion, enthusiasm, and motivation levels of employees towards their work; decreases in productivity and absenteeism due to health problems are more common (Çimen et al., 2023; Hungerford et al., 2024). In addition, the distance between colleagues and managers increases, and participation in in-house social events gradually decreases. All these indicators reveal that the individual is not only physically but also psychologically distant from work, and his/her organisational commitment is seriously weakened.

4. Effects on Healthcare Workers

Quiet quitting has a direct impact on institutions in terms of service quality, as well as on individual employees. The healthcare sector, where dynamics such as high work tempo, emotional labour requirement and constant stress are intensely experienced, is one of the areas where the effects of quiet quitting are most concretely observed. In this context, there are views that quiet quitting has been a phenomenon among healthcare professionals for a long time, and it is only now being defined as a new concept (Kumar, 2023). However, one of the most effective factors in increasing the importance of this concept on the agenda is the COVID-19 pandemic.

During the COVID-19 pandemic, healthcare workers have faced an increasing number of patients and an intense workload, resulting in extended working hours. At the same time, difficulties in obtaining and using protective equipment have increased occupational risks and negatively impacted the physical comfort of workers (Kang et al., 2023; Galanis et al., 2024). The constant high-stress environment, combined with factors such as insomnia and psychological fatigue, has strained the general health status of healthcare workers. In addition, due to the risk of infection, some healthcare workers have contracted COVID-19 in hospitals and had to isolate themselves; this has led to severe social and emotional difficulties in both their professional and personal lives, especially in family ties (Galanis et al., 2024). These conditions have directly affected the professional motivation and performance of healthcare workers, emerging as a significant factor in the rise of cases such as quiet quitting.

5. Ways to Cope with Quitting

Although the phenomenon of quiet quitting can be observed across all professional groups, it is particularly vital for healthcare professionals, who are a sensitive and vulnerable group, to address this situation effectively. In this context, it is necessary to develop holistic and employee-oriented strategies. Firstly, reinforcing the belief among healthcare professionals that their work serves a socially meaningful and important purpose will contribute to strengthening their professional satisfaction and sense of organisational belonging (Yıldız et al., 2024). In this respect, appreciating employees' achievements and making their contributions visible is an important factor in increasing organisational commitment. Likewise, clear job descriptions, fair distribution of workload and setting achievable goals will facilitate coping with job stress (Yılmaz, 2024). In addition, work-life balance should be considered through practices such as flexible working models, remote working opportunities, and leave policies for exceptional cases (Yıldız et al., 2024). Mental health support programmes and practices that promote emotional well-being also play an important role in preventing quiet quitting.

To prevent quiet quitting, it is essential to create a fair and motivating work environment that prioritises the welfare of employees. An environment of psychological trust should be established, and mechanisms should be in place to provide support when needed. At the same time, concrete opportunities should be provided for career development; training, promotion and competence development opportunities should be encouraged at the organisational level

(Çimen et al., 2023). Managers' open, honest, and continuous communication with employees, along with the clear expression of expectations and the establishment of a feedback culture, will also reinforce organisational trust. All these elements will not only prevent quiet quitting but also promote a more engaged workforce. However, they will also form the basis of a sustainable work environment that strengthens the commitment and long-term motivation of healthcare workers to the organisation.

CONCLUSION AND RECOMMENDATIONS

The phenomenon of quiet quitting in healthcare workers, combined with increased workload, burnout and loss of motivation, negatively affects both individual performance and the quality of healthcare services. This situation, which has become evident during the pandemic, reflects structural and organisational problems in the health sector and poses an important threat to the sustainability of the system. Therefore, reducing the effects of quiet quitting requires strategic interventions not only at the individual level but also at the organisational level.

In this context, to prevent quiet quitting behaviour in healthcare institutions, comprehensive policies should be developed to enhance the motivation and commitment of employees. Balanced distribution of workload, adoption of flexible working models and strengthening psychosocial support mechanisms should be the priority steps. In addition, trust-based and continuous communication between managers and employees should be established, and achievements should be regularly recognised. Increasing career development opportunities and expanding vocational training will make significant contributions to reducing the tendency towards quiet quitting. Such holistic approaches will enhance the quality of work life for healthcare workers at both the individual and organisational levels, as well as improve the effectiveness of service delivery.

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Post-stroke mental disorders

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Abstract

Cerebrovascular accident/stroke is one of the most common and disabling medical conditions, which has a significant effect on public health, both through mortality and through the disabilities it produces.

"Stroke" is the term for focal, global symptoms and clinical signs due to arterial occlusion or vascular rupture, which causes cerebral suffering through hypoperfusion or resulting from compression by hemorrhage.

Stroke is described by the "Global Borden of Diseases" as a neurological dysfunction due to a non-traumatic injury caused by a cerebral infarction or hemorrhage in the intracerebral or subarachnoid circulation.

Due to the connectivity between various brain systems, a lesion in a single part of the system can manifest as a dysfunction of the entire system. In other cases, behavioral changes due to a focal lesion can be attributed to the affected area. The affected area is viewed as a circle that is surrounded by ischemic penumbra. Here, most cells evolve towards irreversible death, before neuroprotective agents act. These ischemic areas are characterized by 5 mechanisms of transformation: *excitotoxicity; oxidative stress; apoptosis; neuroinflammation; phagocytosis.*

The aim of the study is the early detection of mental disorders that occur post-stroke, in order to prevent the appearance of profound disabilities that affect the quality of life.

The retrospective observational study included 221 patients admitted to the Acute Psychiatric Department of the Targu-Jiu County Emergency Hospital.

Inclusion criteria were stroke confirmed by neuroimaging methods, mental disorders confirmed by psychological tests. Early detection and treatment of mental disorders lead to a complete rehabilitation of patients, thus increasing the quality of life.

Keywords **:** stroke, inflammasome, apoptosis, rehabilitation.

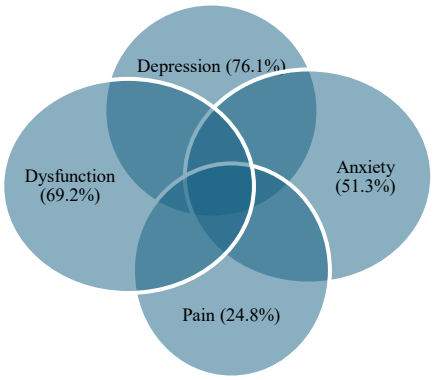
Cerebrovascular accident (CVA/stroke) is one of the most common and disabling medical conditions, which has a significant effect on public health, both through mortality and through the disabilities it produces.

"Stroke" is the term for focal, global symptoms and clinical signs due to arterial occlusion or vascular rupture, which causes cerebral suffering through hypoperfusion or resulting from compression by hemorrhage.

Stroke is described by the "Global Borden of Diseases" (GBD) as a neurological dysfunction due to a non-traumatic injury caused by a cerebral infarction or hemorrhage in the intracerebral or subarachnoid circulation.

The "Catherine Morg Saclely" studies have shown that early post-stroke psychological complications (anxiety, depression), as well as long-term psychological complications (cognitive deficit and vascular dementia) are particularly disabling.

Epidemiological studies have shown that complications that occur in the first months post-stroke are particularly important and worth considering, such as:



The increased incidence of stroke, associated with increased mortality and morbidity, makes this chronic condition an wound on the entire human society.

Concomitent with human evolution, cerebrovascular disease spread, creating areas of development of collateral arterial circulation as a consequence of vulnerability to the ischemic factor.

The appearance and development of collateral circulation has significantly reduced the intellectual dysfunctions that can occur after a stroke.

Every year, 15 million of the population is affected by stroke, with epidemiological data showing that a third of patients die and another third suffer significant mental and psychological disabilities.

In 2018, approximately 795,000 strokes were reported, of which 610,000 were patients with their first stroke. One in 4 patients has their first stroke and 87% of strokes are ischemic in origin.

Stroke is a disease that is constantly increasing, along with the increase in life expectancy. The increase in stroke incidence is directly proportional to age, from an incidence of 0.9% in patients aged 29-30 years to an incidence of 29.8% in patients aged 80 years.

Men are at higher risk of developing stroke than women. The disabilities produced after stroke are severe; 70% of survivors have permanent occupational disabilities, and approximately 25% have vascular dementia.

Apart from neurological syndromes, with their post-stroke manifestations, we also encounter a series of psychological manifestations that accompany stroke.

At the end of the 19th century, Huuglins Jackson systematized the mental disorders of stroke into two forms: either intellectual disorders or emotional disorders. Meyer identifies several disorders associated with stroke (Delirium, dementia, aphasia) that demonstrate that they are the result of direct cerebral aggression, but also other disorders (such as depression, paranoia) whose appearance may be due to combinations of factors, including: disorders due to direct aggression on the left frontal lobe and subcortical connections, but also family history and premorbid vulnerabilities. Kraepelin stated that cerebral atherosclerosis is accompanied by manic-depressive manifestations. Bleurer recognizes the connection between stroke and depression, the melancholic states which frequently appearing after stroke. In addition to the identified post-stroke mental disorders, which can have multiple causes, neurologists have identified mental disorders that are unique to post-stroke. Goldstein describes the catastrophizing reaction as an set of emotional symptoms such as frustration, depression, and the body's inability to cope, which leads to serious defects in cognitive and physical functioning.

Another unique post-stroke disturbance described by Hecaen and Denny-Brown is apathy, total indifference, loss of interest in family and friends, and minimizing physical disability.

After stroke, there are certain neuropsychiatric syndromes that follow ischemic stroke. The symptomatology varies depending on the vascular territory where the trauma occurs and the vascular etiology.

In presenting the neuropsychiatric syndromes that occur post-stroke, we must take into account the 4 axes: the axis of affective disorders, the axis of behavioral and personality disorders, the axis of cognitive disintegration and acute confusional states, the axis of perception disorders, derealization and depersonalization (as we encounter in systemic delirium).

There is a causal relationship between mental disorders and the occurrence of stroke, so that the occurrence of hemiplegia associated with anasocnossis, mania and daily transformations suggests a dysfunction of the right hemisphere, while depression and apathy suggest a dysfunction of the fronto-subcortical circuit and limbic circuits.

For the occurrence of these syndromes, another causal argument is obvious, the fact that these psychiatric syndromes are more severe in the initial phases of stroke, when variables such as edema, lesion, and location make the neurological and cognitive deficit more evident than before the intervention of the neuronal plasticity and neuroregeneration process.

The multidisciplinary team, integrating the psychiatrist, neurologist, neurophysiologist, neuropsychologist and neuroradiologist, is very useful not only for diagnosis, but especially for the investigation of post-stroke emotional disorders.

Neuropsychiatry deals with the study of mental disorders that occur as a result of an organic brain lesion, for which there is a close causal link between the symptoms of the brain lesion and cognitive and neurological deficiencies, the disorder representing a significant change from the pre-stroke condition, producing considerable distress in the social, occupational and other important areas of functioning.

Due to the connectivity between various brain systems, a lesion in one part of the system can manifest as a dysfunction of the entire system.

During the neuroregeneration process, other areas can be recruited to compensate for deficits.

Thus, there are neurotransmitter systems that modulate neuroregeneration: attention (through norepinephrine and acetylcholine), motivation (through dopamine), affectivity (through serotonin), originating from subcortical nuclei and spreading throughout the brain.

To explain the occurrence of these post-stroke psychiatric disorders, we need to understand the molecular biology of ischemic ATS, the most common type.

In the absence of prompt intervention, this event is followed by a cascade of events, which can cause tissue death known as ischemic penumbra.

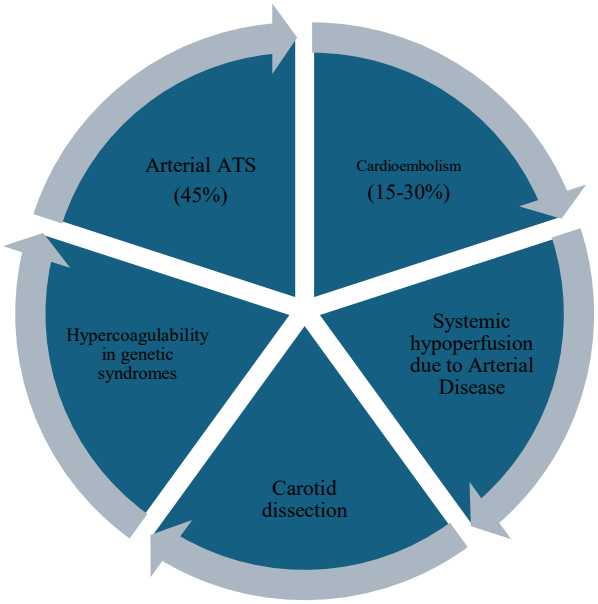
Therefore, stroke treatment includes 3 directions: preventive measures, stroke management, and post-stroke rehabilitation measures.

In other cases, behavioral changes due to a focal lesion can be attributed to the affected area. The affected area is seen as a circle that is surrounded by ischemic penumbra. Here, most cells evolve towards irreversible death, before neuroprotective agents act. These ischemic areas are characterized by 5 mechanisms of transformation: *excitotoxicity; oxidative stress; apoptosis; neuroinflammation; phagocytosis.*

There are two pathophysiological substrates: ischemia and hemorrhage. In the first circumstance, there is a discrepancy between the intracellular oxygen demand and the oxygen influx due to the occlusion of a vessel by thrombus or embolus. In the second case, blood extravasation, the consequence of a vascular rupture, produces compression of the underlying cerebral parenchyma.

Cerebral ischemia is the most common physiopathological entity of brain injury.

Five distinct categories of stroke have been described in the TOAST classification:



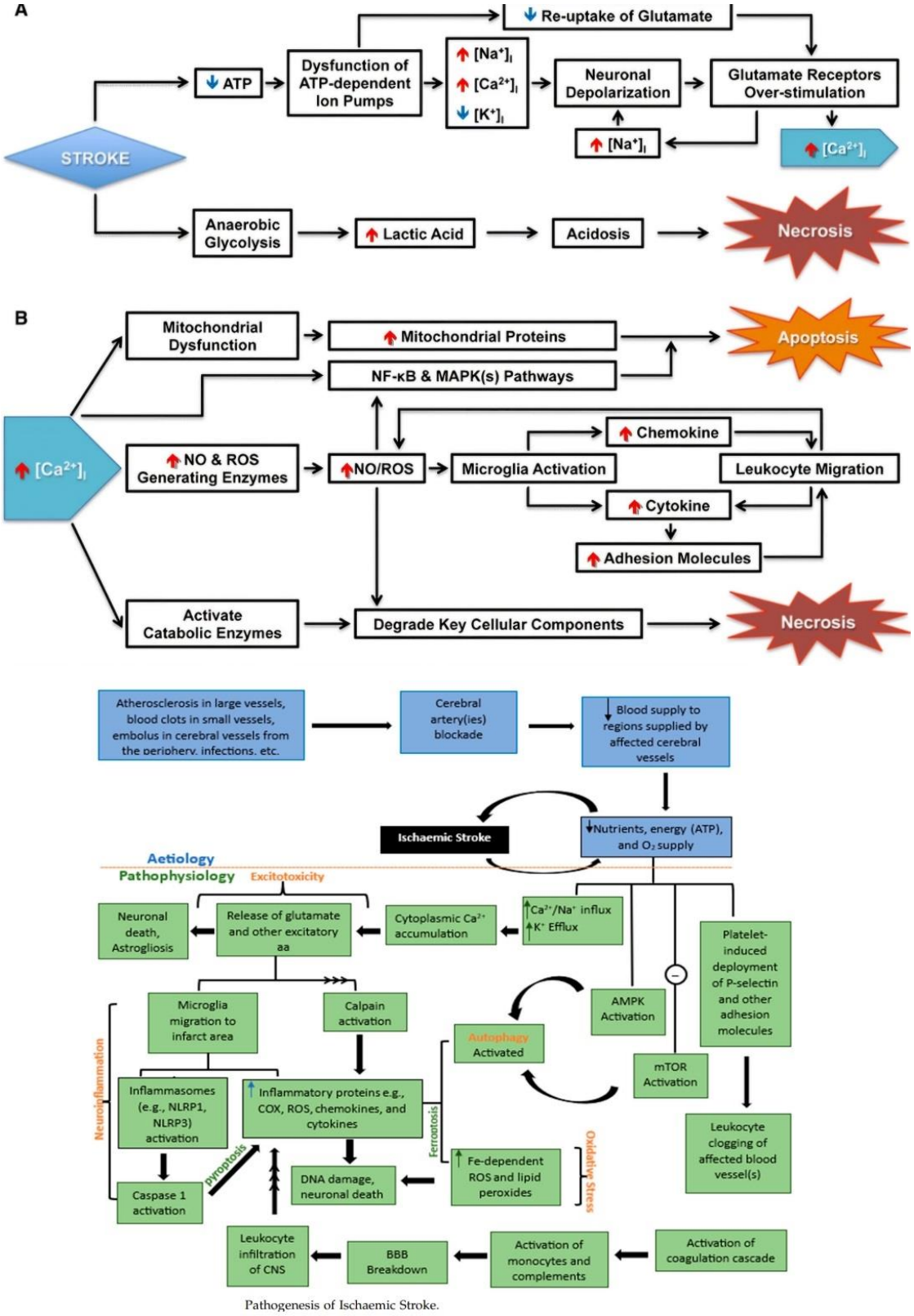
The immune system contributes to the etiopathogenesis, not only by mediating the inflammatory cascade, but also by causing immunosuppression due to the effects of the vegetative nervous system, activating the lymphoid system to a greater degree.

Cell death from stroke ischemia is due to a complex of interactions between a series of pathological events.

1. Excitotoxicity

We know that in acute ischemia, decreased circulation causes decreased energy due to hypoxia, which interferes with the production of ATP (adenosine triphosphate).

In ischemia, there is a change in the ion gradient of ion channels, including Ca-ATPase and sodium/calcium and sodium/potassium ATPase changes in plasma, as well as in the membrane organelles of damaged neurons. This leads to an excess influx of Ca into the neuron and an activation of ionic Ca, causing an excess of glutamate and a decrease in its reuptake.



Pathogenesis of Ischaemic Stroke.

This series of events constitutes excitotoxicity due to excessive stimulation of N-methyl-Daspartate receptors (NMDAR) in the postsynaptic membrane of neurons, generating reactive

oxygen species (ROS), which cause oxidative stress, which leads to the interruption of mitochondrial function and neuronal death.

Excessive activation of NMDA receptors contributes to the breaking of neuronal plasticity, affecting memory and learning, which leads to stroke-associated cognitive decline.

2. Oxidative stress

Oxidative stress is a factor that intervenes in ischemia, the disruption of the balance between oxidant and antioxidant, especially in brain cells rich in polyunsaturated fatty acids.

Factors such as low antioxidant levels and high oxidant levels (iron) increase oxidative metabolism, which contributes to cell death.

Ischemia leads to loss of Ca2 homeostasis, increased Ca in the brain, which activates the ROS production pathway and oxidative danger (through oxidative radicals, which cause the extension of the lesion in the brain).

Cellular ROS increase during ischemic attack due to decreased glucose and oxygen and exacerbation of oxidative stress.

The production of superoxide anion is attributed to Xanthine oxidase (XO) and NADPH oxidase (MOX).

The loss of ATP during ischemia causes an accumulation of hypoxanthine and xanthine, substrates for XO, which leads to the accumulation of ROS.

Mitochondria, called the "power-house", play an essential role in energy homeostasis.

Loss of respiratory function and mitochondrial membrane potential leads to a cascade of events, with ROS production and ATP depletion.

There is activation and increased permeabilization of the mitochondrial membrane with caspase activation and apoptosis.

3. Neuroinflammation

The subsequent brain insult due to neuroinflammation is controlled by neuroinflammation of ROS, chemokines, and cytokines.

This process involving immune cells, microglia and lymphocytes causes neuronal death.

Microglia polarization with M1 particles was associated with the extension of ischemic injury.

Neuronal death is associated with increased morbidity and mortality.

Stroke neurobiology - The role of the immune system in neuroinflammation

Neuroinflammation can be defined as a response to insult that derives from various pathogenic noxious agents, depending on the pathology of ischemic stroke.

Neuronal death is responsible for initiating the inflammatory cascade, triggered by chemokines, cytokines and ROS (reactive oxygen species).

Various, varied cell types that are involved in the pro-inflammatory process are part of the hereditary immune system, which is responsible for necrosis and apoptosis, leading to increased brain size and severe cognitive deficits and disabilities.

Several diseases in which autoinflammatory pathology occurs are mediated by molecules (such as cytokines) that have proinflammatory characteristics.

Among these, interleukin 1β plays a crucial role in modulating the inflammatory pathway, through interaction with the inflammasome.

Thus, it was observed that the NLRP $_3$ inflammasome (NLR family pyrin domain containing 3) plays a crucial role in neuroinflammation after stroke, causing apoptosis of glial cells and neurons.

In these cells, oxidative stress and endoplasmic reticulum stress, through the production of inflammatory molecules and the activation of interleukin 1S, the significant increase in ROS production and the continued activation of NLRP $_3$ aggravate the danger of brain damage.

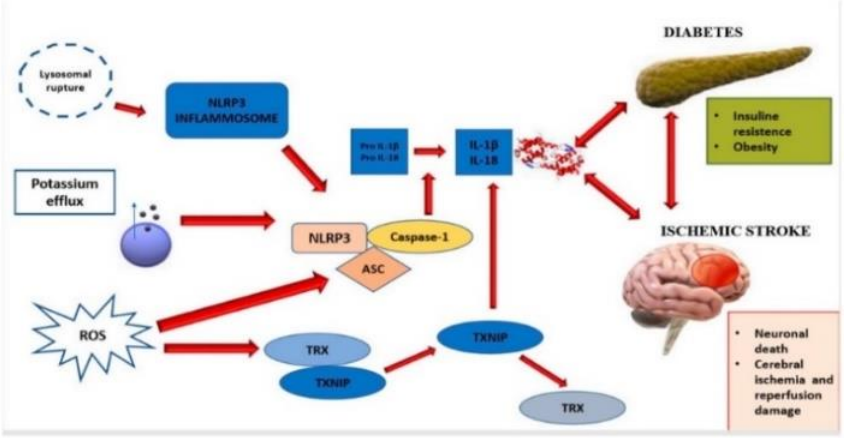
The inflammasome is responsible for increasing levels of TNF (tumor necrosis factor), a cytokine that plays a crucial role in insulin resistance and endothelial dysfunction.

We believe that the involvement of the inflammasome in neuroinflammation represents a process responsible for a poor prognosis.

Note that glyburide, sinomenine, and other molecules that reduce insulin resistance play a role in stopping the spread of necrotic lesions and improving neuronal loss.

It has been observed that the constitutional immune system plays an important role in ischemic stroke.

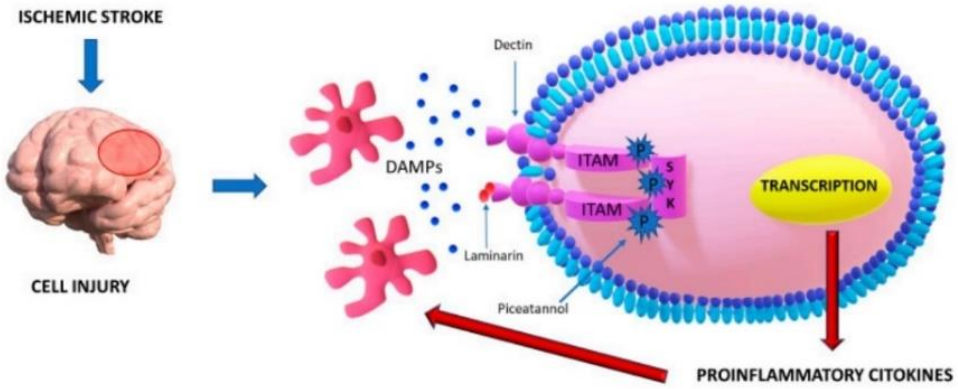
Among the physiological mechanisms involved in ischemic stroke, neuroinflammation is of great importance in determining the lesions produced in neurons, microglia, and endothelial cells.



The NLRP3 inflammasome plays a fundamental part in the process of neuroinflammation consequent to a cerebrovascular accident, particularly in diabetic patients in which enhances the progression of metabolic disorder.

A good prognosis occurs in patients with acute stroke after inhibition of the inflammatory pathway.

One of the inflammatory pathways that plays a crucial role in neuroinflammation is mediated by Dectin-1 and Syk (Spleen-tyrosyne kinase), a protein with tyrosine kinase activity, which is representative in microglia. Many proinflammatory signals and cyclic DAMP constitute a danger signal that has been identified in dendritic cells, the expression of C-type-lecithin-1 (Dectin-a), which interacts with Syk. Dectin that has a major impact in the activation of inflammatory pathways, a type II receptor can be observed in several cell types of T lymphocytes, dendritic cells, monocytes, granulocytes, neutrophils and epithelial cells.



Dectin-1, also known as Dendritic cell-associated C-type lectin-1, a receptor activated by the interaction with DAMPs (damage-associated molecular patterns), is responsible for an innate immune response when brain damage such cerebral ischemia occurs.

Under physiological conditions, a small concentration of the mentioned molecules exists in the brain parenchyma and is activated in conditions of danger.

They have been shown to have an impact on the activation of the HLRP $_3$ inflammasome, after an interaction with Beta-glucan, leading to increased ROS synthesis and increased interleukins.

Dectin-1 inhibition may ameliorate the danger because it antagonizes macrophage activity, preventing axonal destruction and demyelination of nerve fibers and stimulating neurogenesis.

Syk leads to the destruction of cellular molecules and leads to necrosis by activating the neuroinflammatory cascade.

Various Xin-Chun studies propose examining various mediators of inflammation such as Syk, Dectin-1, TNF-Alpha (tumor necrosis factor), INOS (nitric oxide synthase) in cerebral ischemia.

The harmful effects of these mediators that occur after ischemia lead to microglia activation and increased neuroinflammation.

By antagonizing Dectin-1 and Syk activity through antagonists such as the Dectin-1 antagonist Laminarin (LAM) and the Syk inhibitor Piceatannol (PIC) – this leads to a decrease in pro-inflammatory molecules and attenuation of microglia activation, leading to a reduction in neurological deficits.

4. *Apoptosis*

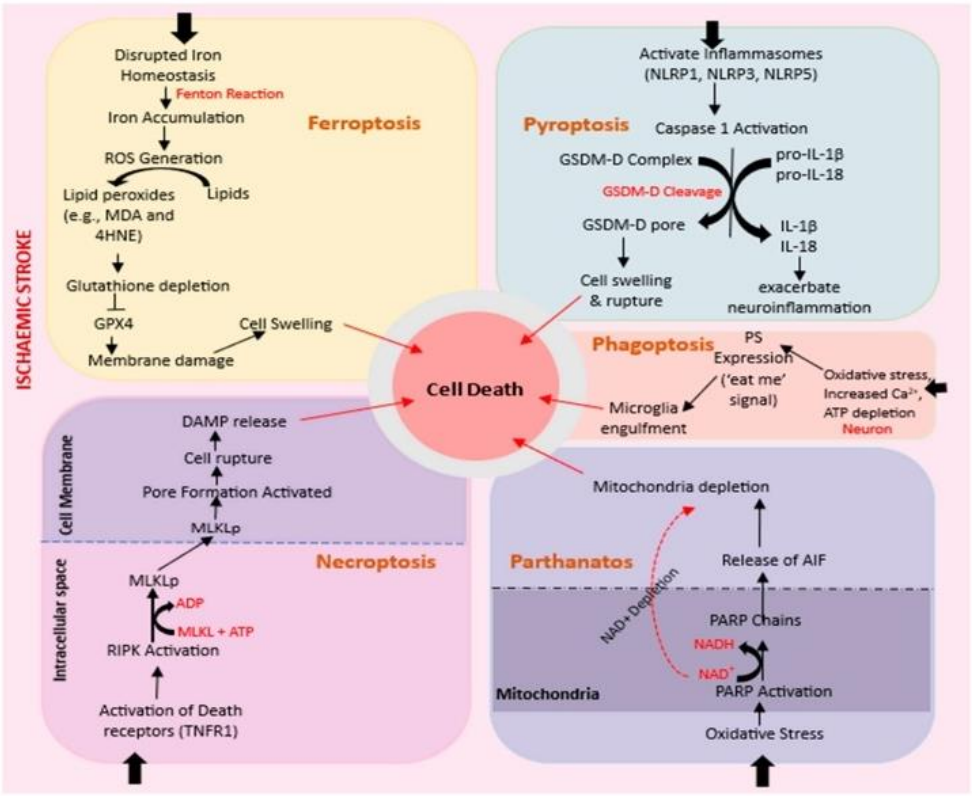
Apoptosis is associated with a range of intrinsic and extrinsic events, which lead to cytoplasmic condensation, nuclear membrane rupture and the formation of apoptotic antibodies.

Intrinsic pathway, ATP supplementation is done by glycolytic oxidative phosphorylation. This pathway predominates and ATP production is insufficient to maintain cellular activity.

The results of the ionic balance Na/Ca influx and K+ efflux and Ca accumulated in the cells lead to the excess accumulation of neurotransmitter amino acids, especially glutamate, in the extracellular space.

This process is followed by a series of cytotoxic events in the nucleus and cytoplasm, generating ROS, which cause the activation of inflammatory factors.

Cell death following ischemia is due to five mechanisms: *Feroptosis; Necroptosis; Pyroptosis; Parthanatos; Phagoptosis.*



Different Forms of Cell Death Associated with Ischemic Stroke.

Iron accumulation and lipid peroxidase are key to the development of ROS, which lead to cell death. In ischemia, the level of soluble protein Tau, which mediates iron transport, decreases in the ischemic region after stroke, leading to iron accumulation. Iron accumulation and decreased antioxidant mechanisms, reduced glutathione peroxidase-4 (GP x 4) may promote lipid peroxidation and ferroptotic cell death. The lipid peroxidase pathway may represent a therapeutic strategy.

Necroptosis is a form of necrosis that involves the response to various stimuli, including inflammation and ischemia. It is cell death induced by various signals. It is mediated by activation of receptor-interacting protein kinase-1 and RIPK-1 and RIPK-S leading to the activation and phosphorylation of kinases (TLKL). This kinase leads to plasma membrane rupture and cell death. Protein kinase inhibitors decrease necroptosis.

Pyroptosis is a form of cell death that is determined by the activation of caspasses-1, which causes the formation of the inflammasome. It is a form of high inflammation, which programs cell death, leading to the increase of proinflammatory cytokines and the activation of

the inflammasome. The inflammasome is a multiprotein complex, which is built of proteins, which intervene in the proinflammatory process of cytokines. During ischemia, the activation of the inflammasome leads to the activation of caspasses-1, which forcefully causes prointerleukin-1B and prointerleukin-17 to produce interleukin-1B and interleukin-17, both of which are key cytokines of inflammation, cytokines that cause neuronal death along with other inflammatory factors during pyroptosis.

Parthanatos is another form of neuronal death, dependent on polyADP-ribose polymerase.

PolyADP-ribose polymerase is an enzyme that is activated by oxidative stress and damages DNA and produces chromatolysis. Parthanatosis does not lead to the formation of apoptotic antibodies, but causes plasma membrane rupture. PolyADP-ribose polymerase plays an important role in the recognition and repair of broken DNA, a process that uses NADH. Parthanatosis is characterized by the loss of NADH and the inhibition of glycolytic hexokinase, leading to necrosis, while excess PolyADP-ribose polymerase-1 and the loss of NAD influence the cellular metabolic process.

5. *Phagocytosis*

Phagocytosis is the mechanism of recognition and digestion by microglia. Microglia is a monitor of the neuronal surface and recognizes the "eat me" signal from neurons. Typical for the “eat me” signal is the presence of phosphatidylserine (PS) on the cell surface. This phosphatidylserine is the expression of oxidative stress of increased cellular calcium levels and ATP depletion. Cell death following AIT has 5 mechanisms: ferroptosis, phagocytosis, parthanatos, pyroptosis and necroptosis. Iron accumulation by lipid peroxidases leads to membrane rupture. Disruption of cellular homeostasis leads to accumulation of ROS and iron. In phagocytosis, cells are eliminated due to changes, not being influenced by typical morphological changes. Phagocytosis is part of the neuroinflammatory response. The neuropsychiatric consequences of stroke depend on the extent of the brain injury, the existence of other brain injuries, as well as the patient's premorbid intellectual and emotional functionality.

After stroke, emotional and affective abnormalities appear. Neuropsychiatric disorders may be accompanied by motor, sensory abnormalities or may be only psychological

manifestations. Cognitive, emotional and behavioral disorders may coexist or be independent. Depression, mania, anxiety and apathy are the most common neuropsychiatric disorders that appear after stroke.

By understanding *these etiopathological mechanisms* that occur post-stroke, we also understand the psychological disorders that can occur post-stroke.

Currently, it is important to identify new etiopathogenic factors involved in strokes, in order to find new therapeutic solutions capable of influencing the prognosis and quality of life of patients.

After stroke, Scackley showed that complications occur that affect the ability to perform high-performance activities. These complications are contractures (60%), pain (55%), hip pain (52%), emotional disturbances (50%), as well as mild cognitive impairment (MCI) and vascular dementia.

To better understand how these mental disorders arise, we need to understand the etiopathogenesis that leads to cognitive dysfunction and vascular dementia.

Clinical study

Materials and methods

In this regard, we undertook a retrospective study for the year 2024, on a number of 221 patients hospitalized with Daily Sheet in the Acute Psychiatric Department of SJU Targu-Jiu, who suffered from various mental disorders: from anxiety, depression, cognitive deficits to the appearance of the most disabling disorder for both the patient and the social environment, Vascular Dementia – being the determining cause in the decrease in the quality of life and the increase in the degree of disability.

Of the patients included in the study, 124 patients were female and 97 patients were male. The age groups were:

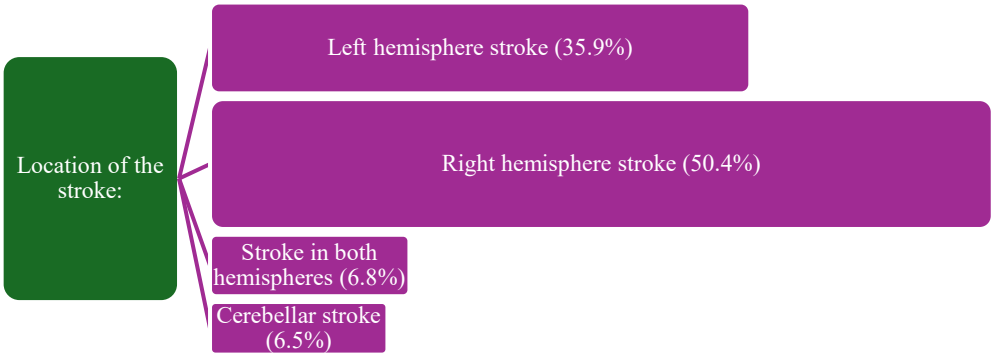
- For women: minimum 56 years – maximum 98 years;
- For men: minimum 55 years - maximum 93 years.

Inclusion criteria were: history of ischemic or hemorrhagic stroke and confirmation of strokes by CT or MRI.

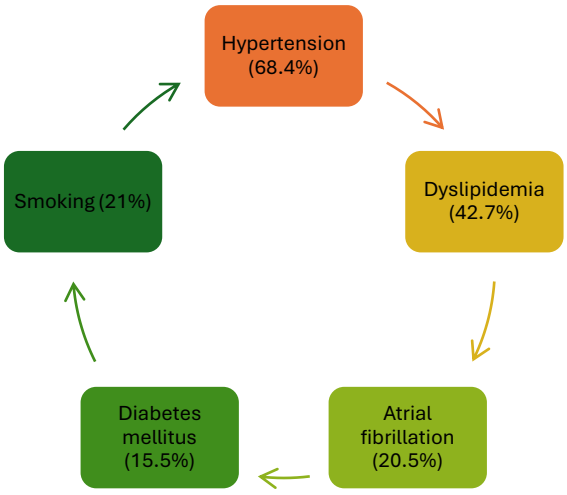
Exclusion criteria were: patients with transient ischemic attack (TIA) and patients who had neuropsychiatric disorders (such as anxiety disorders, depressive disorders, neurocognitive disorders) prior to the onset of the stroke.

Patients were followed for one year, with periodic evaluation, for at least 3 months, in order to adopt the most reliable therapeutic conduct.

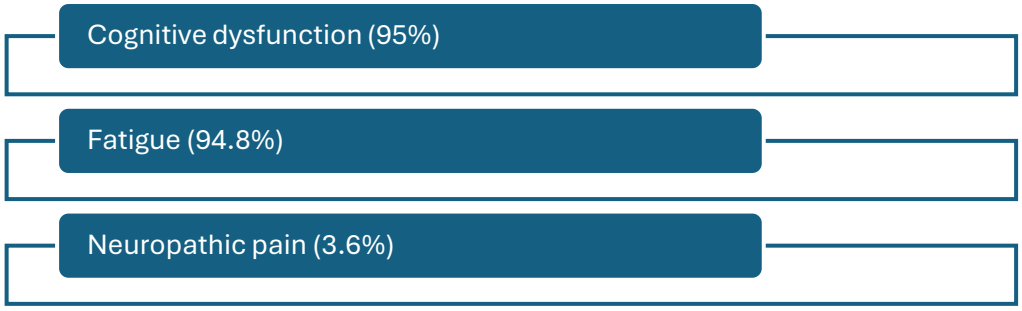
Of the group of patients included in the study, 95.7% were diagnosed with ischemic stroke and 4.3% with hemorrhagic stroke.



Risk factors for stroke at patients included in the study:



After 3 months post-stroke, the following manifestations appear:



Patients were followed for 1 year, with periodic evaluation at least every 3 months, in order to adopt the most reliable therapeutic behavior.

Among the mental disorders present, the most common were anxiety, depressive disorders and cognitive impairments.

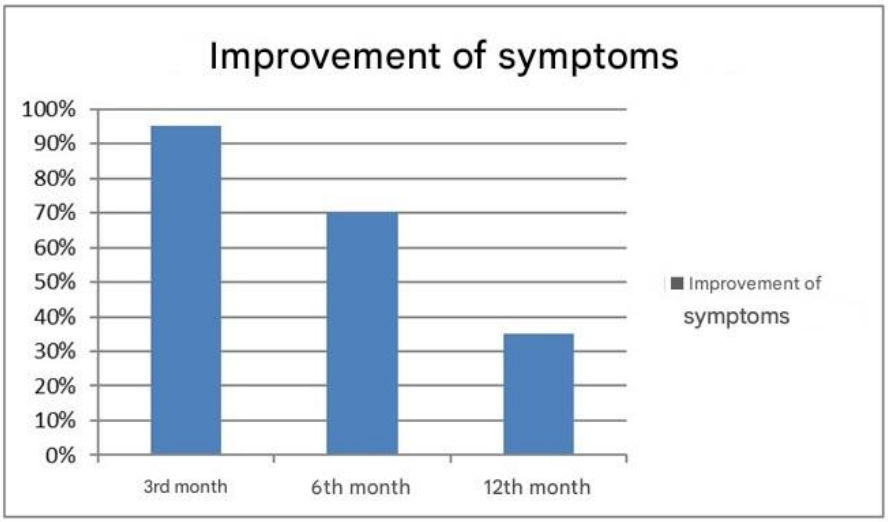
Anxiety was present in 35% of patients. This would be due to prolonged immobilization, neuropathic pain, emotional stress. Anxiety accompanies cortical lesions, not subcortical ones (which cause depression). Anxiety present in the studied patients was associated with comorbidities such as depression, fatigue, low social support. 20% of patients developed anxiety in the first days post-stroke, which manifested itself through excessive fear, difficulty controlling their fear, insomnia, fatigue, nervous tension, inability to relax. Anxiety was also determined by the risk of stroke recurrence in survivors and decreased independence.

In addition to clinical symptomatology, the Hamilton Anxiety Scale was applied for diagnosis.

Treatment with sertraline (SSRI) 50-100 mg/day was applied, and for the treatment of insomnia Trazodone 25-75 mg/day. Considering the effect of trazodone, both increasing the inhibition of the serotonin transporter (SER-T) and antagonizing both 5HT2A and 5HT2C receptors, having an antagonistic effect on both ʃ-1 and ʃ-2 adrenergic receptors and histamine receptors, it has a minimal anticholinergic effect. Small doses of anxiolytics (and without a long half-life, such as Anxiar, Xanax) were used in order not to increase the confusional state and not to cause addiction phenomena.

Counseling and cognitive-behavioral psychotherapy were applied to biological methods.

Following the treatment applied, it was found that after 3 months the symptoms improved by 35%, at 6 months by 70%, and at 12 months by 95%.



The high level of anxiety disorders is also due to the existence of insufficient rehabilitation services after stroke, reduced social and psychological support for survivors. Teychenne showed the link between anxiety and the duration of sedentarism, sedentary behavior being reflected both at the psychosocial and biological levels. Sedentary behavior leads to changes in the CNS, sleep and metabolic changes, as well as to social loneliness and a decrease in interpersonal relationships, which leads to a worsening of social anxiety (this explains why patients with anxiety have pain attacks and attract attention with increased levels of anxiety when performing any kind of work).

Another psychiatric complication diagnosed in patients in the study group was ***Depressive Disorder.***

The Hamilton scale was used in the diagnosis of depression, as well as the MADRS scale (Montgomery-Asberg).

45% of patients presented with depressive disorders, which appeared in the first 3 months after the onset of the stroke, generally in right hemisphere lesions.

Depression occurred in patients with stroke, which affected the brain structures of the frontal cortex, anterior cingulate cortex, amygdala, thalamus, and hippocampus.

The diagnosis of depression is based on clinical symptoms:

- A significant and persistent period characterized by depressed mood or marked loss of interest and pleasure in all or almost all activities and which dominates the clinical picture.

- History, physical examination, or laboratory data identify a prior stroke. A first consideration is the presence of a temporal association between the onset, exacerbation, or

remission of the neurological condition and the onset, exacerbation, or remission of the affective disturbance.

- A second consideration is the presence of elements that are atypical for depressive disorder (age at onset and atypical course or absence of family history).

- The disturbance cannot be better explained by another mental disorder (such as Adjustment Disorder)

- The disturbance does not occur exclusively in the case of delirium

- The disturbance causes significant distress or impairment in social, occupational, or other areas of functioning.

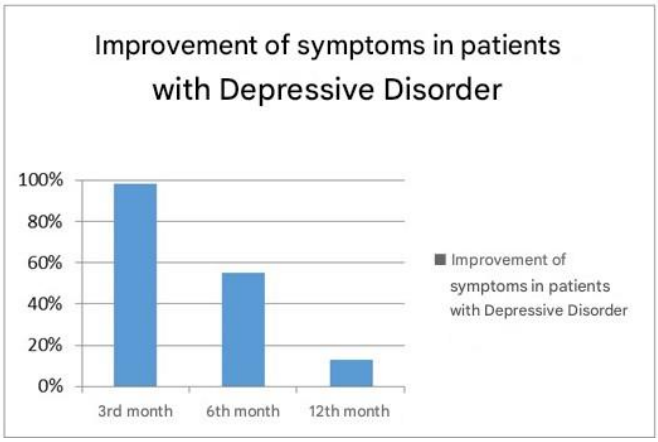
- The severity of depressive manifestations depends on family and social support and predisposing genetic factors that can lead to the onset of depression.

Depression represents a significant burden in effective rehabilitation, leading to limited activity decline.

As first-line treatment, we used serotonin reuptake inhibitors, among them – although the literature cites fluoxetine in the USA, we used as an antidepressant Citalopram in doses of 20-40 mg/day, Sertraline 50-100 mg/day, Fluvoxamine 50-100 mg/day. If we add to the depressive pathology the emotional pathology (easy crying, laughter, emotional lability, irritability or apathy) we will use methylphenidate, levodopa, amantadine and we used affective stabilizers (lamotrigine, valproate, carbamazepine), as an antidepressant and buspirone as an anxiolytic. For sleep disorders, trazodone hydrochloride was used in doses of 25-75 mg/evening.

Depression and fatigue are comorbidities that occur in a third of patients.

An improvement in depressive disorders was observed under treatment.



Apathy can occur without concomitant depression. Apathy can be defined as a decrease in motivation and can be diagnosed using the Apathy in Psychopathology Scale. In psychopathology, this disorder is due to abnormalities involving the orbitofrontal lobe and anterior cingulate gyrus. Treatment includes acetylcholinesterase inhibitors and stimulants such as methylphenidate.

93% of stroke patients have ***neurocognitive disorders***. In DSM IV, neurocognitive disorders include dementia, delirium, amnestic disorder, and other cognitive disorders. According to DSM, neurocognitive disorders can be major or minor, depending on the degree of cognitive impairment. Diagnosis is based on clinical symptomatology and psychological tests MMSE (Mini Mental State Examination).

Cognitive disorders are characterized by a significant cognitive deficit of the individual compared to the previous level of functioning in one or more cognitive domains (complex attention, executive function, learning and memory, language, perceptual-motor function or social cognition).

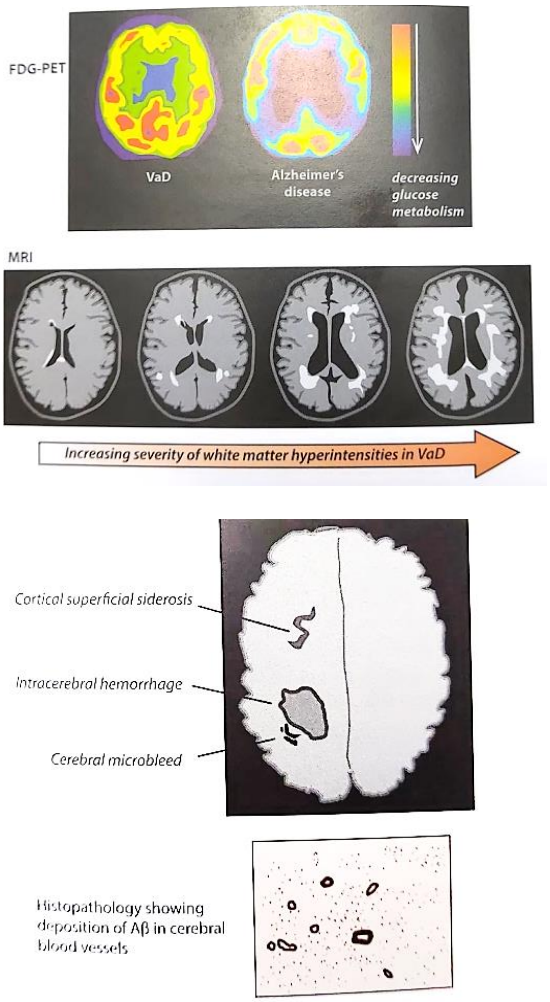
This cognitive deficit is based on:

- Accusations by the individual, a known person, or a physician's concern regarding significant deterioration in cognitive function.
- Severe impairment of cognitive functions, determined by standardized neuropsychological evaluation.

The diagnosis is supplemented by the MMSE psychological test and imaging exams, which justify the cognitive deficit.

Cognitive deficits affect independence in daily functioning, requiring assistance in carrying out complex, indispensable activities of life. The deficits do not occur exclusively in the case of an episode of delirium and are not explained by another mental disorder. The clinical features are consistent with a vascular etiology (the onset of cognitive deficits is temporally linked to one or more cerebrovascular events).

There is clear evidence of decline in attention (processing speed) and frontal executive function, as well as evidence of cerebrovascular disease.



As a treatment, donepezilium, a selective inhibitor of acetylcholinesterase, without inhibition of butyrylcholinesterase (BuchE), was used in doses of 5-10 mg. It acts on cholinergic neurons, inhibiting pre- and post -synaptic acetylcholinesterase.

In addition to donepezil, rivastigmine was used in some patients, which inhibits acetylcholinesterase and butyrylcholinesterase, which are present both in the central nervous system and in the periphery. To remove the gastrointestinal effects, we used exelon patches. To the treatment with donepezilium or rivastigmine, we associated the treatment with memantine, which acts as a glutamate inhibitor, acting as an NMDA (n-methyl-D-aspartate) antagonist that reduces the neuronal activation of glutamate, with an excitotoxic role. As neuroprotectors to stimulate neuroplasticity, neuroregeneration and neuroprotection, we used Cerebrolysin 10 ampoules/month (porcine brain hydrolysate) or Pramistar (pramiviracetam).

Conclusions

Post-stroke neuropsychological disorders are debilitating for the patient, representing a burden both for him and for his family.

The study shows the consequences that occur 1-3 months after stroke, consequences that affect remission.

These psychiatric events represent a complication in the path of rehabilitation, leading to low medication compliance, high levels of fatigue, and low performance.

This study leads us to pay more attention to post-stroke complications and an urgent need for investigations into the pathogenesis, prevention and treatment of stroke.

Protocols are needed to establish stroke management for both the acute phase and to evaluate and organize rehabilitation services that will reduce the consequences of stroke.

Factors such as the complexity of the ischemic lesion, the heterogeneity of the patient population, the limited therapeutic window for effective neuroprotection, and unforeseen side effects make the translation of experimental findings into clinical therapies a challenge.

Given the multifactorial nature of ischemic injury, exploring combination therapies that target multiple pathways simultaneously may increase the likelihood of success in clinical manifestation.

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PRACTICAL ASPECTS IN PERIPHERAL PARENTERAL NUTRITION

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Abstract

Peripheral parenteral nutrition (PPN) is an alternative to total parenteral nutrition and is an adjunct method of supplementing enteral or oral nutrition for a limited time. Important advances in the design of peripheral catheters, of optimal nutrition solutions, have made peripheral parenteral nutrition an effective and safe therapeutic option to provide nutritional support for a limited period of time for patients. Peripheral venous thrombophlebitis is the most serious complication of PPN, to which a multitude of factors contribute that can be influenced by an adequate installation and maintenance technique.

Keywords: peripheral parenteral nutrition, malnutrition, nutritional requirement, thrombophlebitis

Introduction

Malnutrition, frequently found in hospitalized patients, is associated with increased morbidity and mortality, hospitalization and costs. Therefore, the initiation of nutritional support is beneficial in this category of patients, leading to an improvement in nutritional status. Preferably and when possible, the initiation of artificial nutrition should be done via the physiological enteral route, with minimal risks and being cheaper.

The presence of a central venous catheter necessary for the administration of total parenteral nutrition is often associated with serious complications of septic type or mechanical obstruction.

Thus, peripheral parenteral nutrition (PPN) has emerged as an effective nutrition alternative that avoids the risks associated with the placement of a central venous catheter, simplifies medical care, reduces costs and can prevent delays in initiating nutritional support.

However, the increased osmolarity of nutrition solutions limits the patient's tolerance to peripheral intravenous administration, and the large volume of solutions necessary to decrease osmolarity limits the amount of nutrients that can be administered. Important advances in the design of peripheral catheters and optimal nutrition solutions have made peripheral parenteral nutrition an effective and safe therapeutic alternative to provide nutritional support for a limited period of time for patients.

There is more and more evidence of the increasing use of NPP. A study carried out in Spain on 1261 patients with artificial nutrition showed that 18.2% of patients received NPP, 38.5% total parenteral nutrition, and the remaining 53.3% enteral nutrition.

Definition

Nutriţia parenterală peripheral is a type of artificial nutrition that is administered through a subcutaneous vein. The administration of nutrition via a peripherally inserted catheter whose tip is located in a central vein is not considered NPP. The concept of PPN generally involves the administration of low-calorie nutrition, especially due to the fact that the administered solutions have limited osmolarity with low calorie content. However, there are patients with good tolerance or who require a large amount of fluids, so NPP can provide the entire caloric and nutrient requirement.

Indications and objectives

NPP should be considered as a temporary method of patient nutrition until oral or enteral feeding is reintroduced. It is also a therapeutic option to minimize the negative nitrogen balance secondary to an acute pathology in the hospitalized patient, in addition, it is an additional measure to supplement the caloric requirement when patients do not tolerate sufficient amounts of oral or enteral nutrition NPP should be considered when artificial nutrition is estimated for no more than 7 days, Although there are now more and more recommendations to extend the duration to 14 days, provided that the entire caloric requirement is ensured, the 2003 guidelines of the American Society of Enteral and Parenteral Nutrition (ASPEN) do not recommend

peripheral parenteral nutrition in patients with significant malnutrition, especially due to increased metabolic stress and increased need for nutrients and electrolytes, fluid restriction, prolonged duration of intravenous nutrition, these patients requiring the administration of nutritional support via a central venous catheter. It was observed that some of them could benefit from NPP for a short period of time and partially.

Nutritional needs

The need for vitamins and trace minerals is easy to achieve with a small volume of solution Providing the necessary electrolytes (sodium, potassium, calcium, magnesium, phosphorus) requires a much larger volume of solution, approx. 2000 ml, a therapeutic objective that is also relatively easy to achieve in most cases. The attempt to ensure the entire caloric and protein requirement by administering large amounts of glucose, amino acids and lipid emulsions in order to positive the nitrogen balance is difficult to achieve, especially in intensely catabolic patients and frequently leads to complications (e.g. hyperglycemia). Almost half of the hospitalized patients have a relatively good nutritional status (body mass index > 20), being able to withstand even a few days of a period of lack of food intake, without severe metabolic alterations. Ensuring energy intake during the lack of food intake is done in the first phase by consuming hepatic glycogen deposits and then muscle protein is used as an energy substrate through gluconeogenesis. Adipose tissue provides a limited amount of energy support during an acute illness. The average caloric requirement of the hospitalized patient is 25-35 kcal/kg/day, of which amino acids are at least 0.8 g/kg/day to 1-1.2 g/kg/day in the context of increased catabolic stress, glucose approx. 150g/day, lipids 1-2 g/kg/day. If all this caloric requirement must be administered exclusively parenterally, the peripheral route can only achieve this for a limited number of days.

Venous access

There are numerous studies that try to identify the profile of the patient who could benefit best from NPP. Not infrequently, the hospitalized patient is subjected to venipunctures for the collection of analyzes or for the administration of various infusions and presents significant peripheral edema which makes peripheral venous cannulation very difficult. However, the results of many studies have shown that up to 70% of patients can receive NPP, and 50% manage to complete this type of nutritional therapy. Another aspect to be taken into account is

the anticipation of the duration of the NPP, because the peripheral path can no longer be used for more than 10-14 days.

Peripheral venous thrombophlebitis

Its occurrence is the most serious complication of PPN, to which a multitude of factors contribute. There is no absolute consensus on the optimal type of nutrition solution, venous cannula type, infusion technique or pharmacological adjuvants.

Composition of NPP solution

The incidence of thrombophlebitis is mainly related to the osmotic content of the solution as well as to the so-called osmolality rate (the product between osmolality and infusion rate) [8,9,10]. The main active osmotic components in most solutions are glucose, amino acids and electrolytes. In older studies, it has been observed that the use of solutions with an osmolarity of more than 600 mosm/1 containing amino acids and glucose resulted in a thrombophlebitis rate of 100%. Most authors recommend that osmolarity should not exceed 800-1000 mosm/1. This correlation between hyperosmolarity and the rate of occurrence of phlebitis is not maintained when lipids are introduced into solutions. In the study by Kane et al, in which patients received solutions with lipids and 1700 mosm/l, compared with the 1200 mosm/1 solution with osmolarity, no difference was observed between the two groups in the incidence of thrombophlebitis. In other studies led by McMahon et al., a relatively low incidence of phlebitis has been reported, between 7-26%, when the solution used contains lipids and with osmolarity of approx. 1100 mosm/l . In conclusion, lipid-containing NPP solutions allow the safe administration of solutions with high osmotic content.

Type of venous cannula

The most important characteristics of the cannula that contribute to the appearance of phlebitis are the diameter, length and material from which it is made. Short slugs used mainly for volume replenishment are associated with an increased phlebitis rate of up to 100%. In studies using fine cannulas (22-23G), a low rate of thrombolphlebitis (approx. 15%) was noted. The main reasons why there is a good tolerance to this type of fine cannulas are the small size and increased flexibility that minimally damages the venous wall, small diameter that allows a good dilution of nutrients inside a large vein, the longer length that implies less bacterial colonization by increasing the distance between the puncture site and the tip of the cannula. In

conclusion, in order to minimize complications in NPP, it is recommended to use fine, small-diameter cannulas made of inert material such as polyurethane or silicone rubber.

Intermittent versus continuous administration

Basically, phlebitis appears sooner or later in any vein that contains a cannula. In addition, the type of solution influences the occurrence of this complication by simple chemical irritation. Thus, the decrease in the rate of thrombophlebitis was demonstrated by electively changing the venous cannula and reducing the time of administration of NPP.

Heparin and corticosteroids

There are numerous studies that have suggested the effectiveness of the combination of the two substances in decreasing the incidence of thrombophlebitis. Their mechanism of action is still unclear, even though it is observed that the addition of heparin to lipid solutions results in the formation of microaggregates. However, it cannot be routinely recommended to introduce these substances into nutrition solutions, at least until clear studies are done demonstrating the chemical and physical stability of these substances.

Topical agents

The use of topical nitroglycerin-containing solutions or non-steroidal anti-inflammatory drugs has been shown to result in a decrease in phlebitis rates in healthy volunteers and in patients receiving crystalloid infusions. There is only one randomized controlled trial that compared the effectiveness of the topical solution with nitroglycerin, but its results did not show any decrease in phlebitis rate, only an increase in the duration of cannula use. In conclusion, there is insufficient evidence for the routine use of topical agents.

Conclusions

NPP is an alternative to total parenteral nutrition for the administration of nutrients, for a short period of approx. 10-14 days and reduced complications. The use of solutions containing lipid emulsions led to an increase in caloric intake with a decrease in osmolarity and the risk of phlebitis. The technique of administering NPP requires strict rules aimed at reducing the thrombophlebitis-type complication: correct fitting of the cannula, preferably made of polyurethane and small diameter, periodic control of the puncture site for early identification

of signs of phlebitis, encouraging the use of industrialized 'all-in-one' solutions or solutions with limited osmolarity.

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Personalized Pharmacology in Palliative Care: Opportunities, Limitations, Emerging Realities, and Future Directions

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Abstract

Personalized pharmacology represents a key direction in contemporary medicine, offering the potential to optimize treatments based on individual genetic, biological, and clinical characteristics. In palliative care, this approach becomes particularly relevant, with the potential to improve symptom control, reduce medication-related toxicity, and enhance the quality of life for patients with advanced disease. Nevertheless, the implementation of personalized pharmacology in palliative practice remains incomplete. In this paper, we propose the concept of "partial therapeutic reality" to describe situations where a scientifically validated innovation is only partially translated into clinical practice due to practical, financial, or organizational barriers. We analyze the potential benefits of personalized pharmacology in palliative care and identify major obstacles to its implementation: limited accessibility of pharmacogenetic testing, the absence of guidelines adapted to palliative care, time constraints, high costs, and insufficient training of clinical teams. Emerging opportunities are also discussed, including the integration of clinical pharmacologists into interdisciplinary teams, the development of personalized therapeutic protocols, and the strengthening of continuous medical education programs. Technological advances in genetic sequencing and the application of artificial intelligence to the interpretation of clinico-genetic data will represent major pillars in accelerating the adoption of personalized pharmacology in palliative care. Overall, the systematic integration of these advances has the potential to enhance symptom control, minimize treatment-related risks, and improve the overall quality of life of palliative care patients.

Keywords: palliative care, clinical pharmacology, pharmacogenomics, fine-tuned therapy **JEL Code:** I10 – Health: General

1. Introduction

Personalized pharmacology represents a modern therapeutic approach aimed at optimizing medical treatments based on the individual genetic, biological, and clinical characteristics of the patient (Ashley, 2015). This strategy enables the adjustment of drug dosage, the selection of appropriate therapeutic molecules, and the anticipation of adverse drug reactions, with the goal of improving both the efficacy and safety of treatment (Hamburg & Collins, 2010). In the field of palliative care, personalized pharmacology gains particular significance due to the complexity of symptomatology and the vulnerability of patients. Palliative care is defined by the World Health Organization as "an approach that improves the quality of life of patients and their families facing the problems associated with life-threatening illness, through the prevention and relief of suffering by means of early identification and impeccable assessment and treatment of pain and other problems, physical, psychosocial and spiritual" (World Health Organization, 2020).

Patients receiving palliative care often present with multiple comorbidities, conditions associated with the primary disease, and, in many cases, complex multimorbidity, characterized by the simultaneous presence of several chronic diseases without a clear dominance, which significantly influences the response to administered treatments. These conditions contribute to extreme frailty and substantial alterations in pharmacokinetics, including reduced hepatic and renal function, which affect the absorption, distribution, metabolism, and excretion of medications (Currow, Phillips, & Agar, 2017). The management of symptoms such as pain, anxiety, nausea, or dyspnea often requires the use of opioids, benzodiazepines, antiemetics, and corticosteroids (Davies et al., 2009). The careful selection of the appropriate therapeutic agent, precise dose adjustment, and rigorous monitoring of side effects become essential in this context to optimize symptom control and minimize the risks associated with standardized pharmacotherapy.

In this context, the concept of "fine-tuned" therapy, precise therapeutic adjustments personalized according to the patient's individual profile, becomes essential for achieving an optimal balance between efficacy and safety (Phillips et al., 2001). Therapeutic fine-tuning involves the continuous adaptation of treatments based on the patient's response, clinical changes, and, when available, genetic testing results (Johnson, 2003).

Nevertheless, the application of personalized pharmacology in palliative care currently remains a partial reality. Technological limitations, the high costs of genetic testing, the lack of standardized protocols, and the limited time available for interventions represent significant barriers to the widespread implementation of this approach (Schleidgen et al., 2013). This paper aims to explore the foundations of personalized pharmacology applicable to palliative care, its potential benefits, current obstacles, and future perspectives for this emerging field.

2. Principles of personalized pharmacology applicable to palliative care

Personalized pharmacology is primarily based on identifying genetic, metabolic, and clinical factors that influence the individual response to medications. In palliative care, these principles are crucial given the complexity of coexisting pathologies and the metabolic fragility of patients. One key domain is pharmacogenetics, which investigates how genetic variations impact drug responses. For example, polymorphisms in the CYP2D6 gene affect the metabolism of many opioids, such as codeine, tramadol, and oxycodone (Crews et al., 2014). Patients who are ultra-rapid metabolizers may experience toxic effects even at standard doses, whereas poor metabolizers may have insufficient pain control (Dean & Kane, 2012).

In addition to opioids, other classes of medications commonly used in palliative care are also influenced by genetic variability. Benzodiazepines, used for the management of anxiety and dyspnea, are metabolized by the CYP3A4 and CYP2C19 enzymes, with genetic variations in these enzymes potentially altering the half-life and efficacy of these drugs (Zanger & Schwab, 2013). In the case of antiemetics, polymorphisms in the HTR3A gene may influence the response to 5-HT3 receptor antagonists such as ondansetron (Padmanabhan, Caulfield, & Dominiczak, 2015). Applying the principles of personalized pharmacology involves identifying these relevant genetic variations and adjusting the therapeutic strategy accordingly. In many cases, even in the absence of formal genetic testing, clinicians can achieve fine-tuning of therapy based on the patient's clinical response, rapidly adjusting doses or switching medications depending on tolerability and efficacy (Currow et al., 2017).

A representative clinical example is the use of morphine in pain management. Variability in the efficacy and toxicity of morphine is associated with both genetic factors (such as CYP2D6 and UGT2B7 polymorphisms) and clinical factors, including renal or hepatic impairment, which are frequently encountered in advanced stages of disease (Mercadante & Portenoy, 2001). In such cases, careful opioid selection and progressive dose titration are

essential to optimize therapeutic benefits while minimizing associated risks. Therefore, the principles of personalized pharmacology applicable to palliative care incorporate both genetic and clinical components, and integrating these factors into daily therapeutic decision-making can significantly enhance symptom control and improve patients' quality of life.

3. Potential benefits of personalized pharmacology in palliative care

The integration of personalized pharmacology principles into palliative care can offer substantial benefits, impacting both therapeutic efficacy and treatment safety, as well as the patient's quality of life. This approach becomes particularly relevant in a context characterized by biological fragility, low tolerance to standardized treatments, and an increased risk of severe adverse effects.

One fundamental advantage is the improvement of therapeutic efficacy. Tailoring treatments according to the patient's pharmacogenetic and clinical profile can optimize the response to analgesics, anxiolytics, and antiemetics. For instance, in patients who are poor or ultra-rapid CYP2D6 metabolizers, adjusting the doses of opioids such as morphine or codeine, or selecting alternatives metabolized through CYP2D6-independent pathways (e.g., hydromorphone), can ensure superior symptom control (Crews et al., 2014; Bruehl, 2015). Recent studies have emphasized that pre-therapeutic genotyping can significantly reduce the rate of analgesic failures and decrease the need for reactive treatment adjustments (van Driest et al., 2014). Furthermore, it has been demonstrated that treatment personalization shortens the time required to achieve effective pain control (Barry & Patel, 2025).

A second major advantage is the reduction in the incidence and severity of adverse effects. Identifying patients with genetic polymorphisms associated with deficient or exaggerated drug metabolism enables the prevention of common complications encountered in palliative care, such as opioid-induced respiratory depression, benzodiazepine-associated delirium, or extrapyramidal reactions to antiemetics (Ji et al., 2016). Furthermore, the application of personalized pharmacology has been correlated with shorter hospital stays and reduced costs associated with adverse drug events (Luzum et al., 2017).

Fundamentally, improving quality of life represents the central objective of palliative care. The use of fine-tuned treatments, calibrated to the patient's biological and clinical particularities, not only enables more effective symptom control but also reduces the treatment burden on the patient (Caraceni & Shkodra, 2019). Personalized pharmacotherapy supports the

maintenance of functionality, facilitates effective communication, and contributes to preserving patient autonomy, all of which are essential elements of the ethical approach to palliative care (Klepstad et al., 2005). Recent studies indicate that patients enrolled in personalized pharmacogenomics programs report higher levels of satisfaction and a more positive perception of quality of life (Peterson et al., 2013).

In the context of palliative care, the application of the "fine-tuned therapy" concept involves the dynamic and continuous adjustment of pharmacological treatments according to the clinical response, pathophysiological changes, and, where available, the patient's pharmacogenetic profile (Caraceni & Shkodra, 2019; Klepstad et al., 2005). Therapeutic fine-tuning entails not only the initial selection of the appropriate molecule but also the careful titration of doses, modification of drug formulations (e.g., switching from oral to transdermal or subcutaneous administration), and the adaptation of administration schedules based on the progression of symptoms and the patient's overall clinical status.

A practical example of fine-tuning is the adjustment of opioid treatment in patients with severe renal impairment, where the active metabolite of morphine (M6G) may lead to cumulative toxicity. In such cases, molecules like fentanyl or methadone, which undergo predominant hepatic metabolism and do not generate renotoxic active metabolites, are preferred (Dean, 2004). Regarding the management of anxiety and dyspnea, the selection of benzodiazepines metabolized via glucuronidation (such as lorazepam) is favored in patients with hepatic dysfunction to avoid the accumulation of active compounds (Klepstad et al., 2005).

Fine-tuning is, therefore, a continuous process based on the careful monitoring of symptomatic response, toxicity profile, and pharmacokinetic changes, aiming to maintain an optimal balance between therapeutic efficacy and treatment safety. Implementing this process requires close collaboration between the palliative care physician, the clinical pharmacologist, and, ideally, access to relevant pharmacogenetic data for each patient.

In clinical practice, the implementation of the fine-tuned therapy concept primarily requires a rigorous evaluation of hepatic and renal function, as pharmacokinetic alterations secondary to hepatic or renal insufficiency can invalidate the relevance of adjustments based solely on genomic profiling. In palliative care, the functional status of the liver and kidneys dramatically influences the pharmacokinetics of drugs: hepatic dysfunction alters the metabolism of medications dependent on CYP450 enzymes, including fentanyl, morphine, and

benzodiazepines, while renal insufficiency affects the elimination of active or toxic metabolites, such as the M6G metabolite derived from morphine (Verbeeck, 2008; Odoma et al., 2023).

A perfect genomic profile, such as a normal or rapid CYP2D6 metabolizer status, becomes irrelevant in the presence of severe hepatic cirrhosis, advanced renal failure, or marked hypoproteinemia. Thus, therapeutic fine-tuning in palliative care must prioritize the evaluation of the patient's overall clinical status (including frailty and comorbidities), hepatic and renal function (objectified by specific laboratory analyses), and only subsequently integrate available pharmacogenetic information (Verbeeck, 2008; Odoma et al., 2023). Therefore, the integration of personalized pharmacology into palliative care has the potential to optimize symptomatic treatments, reduce therapeutic risks, and improve the quality of life of patients in advanced stages of disease.

4. Partial therapeutic reality in palliative care: limitations and barriers in the implementation of personalized pharmacology

Although numerous scientific discoveries have demonstrated the efficacy of personalized treatments under controlled clinical trial conditions, their translation into routine medical practice often remains challenging. This discrepancy between experimentally demonstrated efficacy and the effectiveness observed in real-world clinical settings, known as the "efficacy-effectiveness gap," is widely documented in the specialized literature (Eichler et al., 2011). The barriers that exacerbate this gap include difficulties in the implementation of innovations, technological and financial limitations, the lack of adequate educational or organizational infrastructures, and logistical obstacles in translating research into clinical practice (Dunnenberger et al., 2015; Swen et al., 2011).

Moreover, the limited clinical applicability of certain pharmacogenomic discoveries remains a recurrent issue in fields such as oncology, psychiatry, cardiology, and hematology (Relling & Evans, 2015), including among vulnerable populations in palliative care, where implementation remains fragmented and dependent on multiple factors (Barry & Patel, 2025).

In this paper, we propose the use of the term "partial therapeutic reality" to describe situations in which a scientific innovation, although theoretically validated and supported by solid experimental data, is only partially implemented in current medical practice due to practical, financial, or organizational barriers. When applied to the field of palliative care, this notion reflects the situation of personalized pharmacology: although the optimization of

treatments based on the patient's individual profile is firmly grounded in scientific evidence, its integration into daily clinical practice remains limited by numerous structural, operational, and educational obstacles. This reality does not indicate a lack of scientific validation but rather highlights the real-world constraints affecting therapeutic application in a vulnerable clinical setting, impacted by economic limitations, the absence of standardized protocols, and the need for specialized pharmacogenomic expertise.

Thus, the proposed concept of partial therapeutic reality captures the existence of a solid scientific foundation, in this case personalized pharmacology, alongside its incomplete implementation in palliative care. Factors such as the high costs of genetic testing, the absence of adapted guidelines, and insufficient training of clinical teams impede the full translation of this innovation. The notion of partial therapeutic reality specifically refers to the real-world clinical applicability of a scientifically validated intervention, distinguishing it from theoretical or philosophical realities.

To date, in the medical literature, including pharmacology, pharmacogenomics, and palliative care, no established concept under the designation "partial reality" exists. Conversely, in fields such as philosophy, sociology, or economics, the term is employed in different contexts, referring to discrepancies between perceived and objective reality. In the specialty literature concerning the translation of innovations into clinical practice, similar phenomena are described by concepts such as "efficacy-effectiveness gap," "implementation barriers," "translational challenges," and "limited clinical applicability." Therefore, our proposal aligns with these perspectives while offering an additional nuance specific to the context of personalized pharmacology in palliative care.

A major obstacle to the implementation of personalized pharmacology in palliative care is the limited accessibility to rapid and reliable pharmacogenetic testing. In many palliative care centers, resources for preemptive or reactive genetic testing are restricted either due to the lack of specialized infrastructure or the high costs associated with sequencing technologies and the analysis of relevant gene polymorphisms (Dunnenberger et al., 2015). Even within well-developed healthcare systems, the integration of pharmacogenetics into palliative practice remains fragmented, with unequal distribution between university hospitals and community-based facilities (Swen et al., 2011).

Another significant challenge is the absence of standardized clinical guidelines specifically tailored for palliative care. Most existing pharmacogenomic recommendations have

been developed for fields such as curative oncology, cardiology, or psychiatry, and their extrapolation to terminally ill patients may be risky and imprecise (Relling & Evans, 2015). The pharmacokinetic and pharmacodynamic particularities of palliative patients, influenced by multimorbidity, frailty, and organ failure, require the development of dedicated protocols based on empirical data derived from this vulnerable population.

The limited time available for therapeutic decision-making represents another major restrictive factor. In palliative care, the rapid progression of symptoms and the general clinical deterioration often require immediate interventions, reducing the feasibility of obtaining and applying pharmacogenetic results within a clinically useful timeframe (Caudle et al., 2018). Under these conditions, physicians frequently rely on clinical experience and empirical methods to adjust treatments, without the possibility of real-time integration of pharmacogenetic data.

The high costs associated with the implementation of personalized pharmacology constitute an additional barrier. Besides the direct expenses of genetic testing, indirect costs must also be considered, such as the development of IT infrastructure to integrate genetic data into electronic health records, training of clinical teams, and the adaptation of clinical workflows (Abul-Husn & Kenny, 2019). In many healthcare systems, financial priorities are focused on acute care and curative therapies, leaving few resources available for innovations in palliative care.

Moreover, the lack of adequate training of clinical teams in pharmacogenomics further limits the implementation of this approach. Many palliative care specialists lack in-depth education in personalized pharmacology or in the interpretation of genetic tests, leading to hesitations or suboptimal use of these data (Demmer & Waggoner, 2014; Nisselle et al., 2023). Integrating pharmacogenomics into medical education curricula and developing continuous professional education programs dedicated to palliative care teams are essential steps to overcome this barrier. Thus, although personalized pharmacology offers real opportunities to optimize symptom management in palliative care, its current implementation remains constrained by a series of practical, financial, and educational obstacles, defining a partial therapeutic reality with the potential for future evolution.

5. Opportunities and future directions for the implementation of personalized pharmacology in palliative care

Although the implementation of personalized pharmacology in palliative care currently faces numerous obstacles, several emerging opportunities outline promising perspectives for the progressive integration of this approach into clinical practice. One essential area is the development of emerging technologies that facilitate rapid access to relevant pharmacogenetic data. Next-generation sequencing techniques are becoming increasingly faster and more accessible, while new point-of-care testing platforms allow for obtaining genetic results within timeframes compatible with immediate clinical decision-making (Manolio et al., 2013). In parallel, artificial intelligence and machine learning algorithms are being increasingly utilized to integrate genetic, clinical, and pharmacological data, supporting personalized prediction of treatment response (Beam & Kohane, 2018).

Another strategic direction is the integration of clinical pharmacologists into palliative care teams. Clinical pharmacologists can interpret pharmacogenetic data, adjust treatments according to the patient's pharmacokinetic particularities, and optimize complex therapeutic regimens (McLeod & Evans, 2001; Peterson et al., 2016). Interdisciplinary collaboration models that include clinical pharmacologists have already demonstrated effectiveness in fields such as oncology and transplantology and can be specifically adapted to palliative care.

The development of standardized clinical guidelines for palliative care represents another important objective. Existing pharmacogenomic guidelines are generally oriented toward curative domains and do not adequately consider the pharmacokinetic particularities of fragile patients with multiple organ dysfunctions (Dunnenberger et al., 2015; O'Donnell et al., 2017). Creating specific recommendations for palliative care, based on clinical studies dedicated to this patient population, would enable the safer and more effective application of personalized pharmacology in this context.

Moreover, strengthening applied research in palliative pharmacogenetics is essential. Prospective multicenter studies and the use of specialized biobanks can provide robust data regarding the clinical-genetic relevance of personalized treatment adjustments in palliative care (Williams et al., 2018; O'Donnell et al., 2014). In the absence of specific evidence, the applicability of pharmacogenomics in this field remains limited and heavily reliant on extrapolations from other therapeutic areas.

The education of clinical teams represents a fundamental component for the future of personalized pharmacology in palliative care. Integrating pharmacogenomics into continuing medical education programs and developing specialized courses for palliative care physicians, clinical pharmacologists, and nurses are essential measures to overcome current reluctance and to encourage the informed use of genetic testing (Stanek et al., 2012).

In the near future, the personalization of symptomatic treatment could become a standard in palliative care. Expanding genetic testing as routine practice, supported by efficient infrastructures, dedicated guidelines, and ongoing professional education, holds the potential to significantly transform the management of complex symptoms in patients with advanced-stage diseases.

6. Conclusions

Personalized pharmacology represents an emerging paradigm with significant potential to transform the management of symptoms in palliative care patients. By integrating genetic, clinical, and biological data, this approach enables fine-tuned therapeutic adjustments aimed at maximizing efficacy while minimizing adverse effects. In the context of patients characterized by biological frailty, multiple comorbidities, and major pharmacokinetic alterations, pharmacological personalization is not merely an option but an ethical necessity for optimizing quality of life. The application of the "fine-tuned therapy" concept demonstrates that continuous adaptation of treatment based on symptomatic response and dynamic clinico-biological parameters is essential for achieving an optimal therapeutic balance.

Nevertheless, the implementation of personalized pharmacology in palliative care remains a partial reality, hindered by technological, financial, educational, and organizational barriers. Limited access to rapid pharmacogenetic testing, the absence of palliative-specific clinical guidelines, time constraints, and the insufficient training of clinical teams are major factors restricting broad integration. Advances in rapid sequencing technologies, the integration of artificial intelligence into therapeutic decision-making, strengthening interdisciplinary teams through clinical pharmacologist involvement, the development of tailored guidelines, and the expansion of pharmacogenomic education represent critical directions for overcoming current limitations. Strengthening these emerging pathways could transform a partial reality into fully integrated clinical practice, ultimately benefiting patients with advanced illnesses and the multidisciplinary teams who care for them.

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Emetic syndrome in oncology: clinical intricacies and management approaches

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Abstract

Cancer is currently one of the most common diseases and is often associated with multiple systemic complications as well as complex adverse reactions. Among these, nausea and vomiting represent two of the most distressing and debilitating symptoms, occurring either because of the tumor itself or as adverse effects of oncologic treatments such as chemotherapy and radiotherapy. Chemotherapy-induced nausea and vomiting (CINV) and radiotherapy-induced nausea and vomiting (RINV) occur in 40–70% of patients and significantly affect quality of life, nutritional status, hydration, and treatment adherence. The pathophysiology of emesis involves complex neurochemical mechanisms mediated by serotonin (5-HT_3), dopamine (D_2), and neurokinin-1 (NK_1) receptors, among others. Advances in prophylactic and therapeutic antiemetic regimens, including the combined use of 5-HT_3 receptor antagonists, NK_1 receptor antagonists, corticosteroids, and atypical antipsychotics such as olanzapine, have significantly reduced symptom intensity. However, delayed, anticipatory, and refractory forms of emesis remain major challenges despite adherence to evidence-based antiemetic guidelines. This article reviews the mechanisms, classifications, and management strategies of emetic syndromes associated with cancer therapy, highlighting the importance of integrating pharmacological and supportive approaches to improve clinical outcomes in oncology patients.

Keywords: emetic syndrome; cancer; chemotherapy-induced nausea and vomiting (CINV); radiotherapy-induced nausea and vomiting (RINV); supportive care; quality of life

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1. Introduction

Cancer remains one of the most frequent and life-threatening diseases worldwide, and both its biological progression and treatment-related adverse effects significantly influence patient prognosis and quality of life. Despite major advances in early diagnosis, targeted therapy, and supportive care, oncologic treatments continue to be associated with a wide spectrum of complications that profoundly affect the physical and psychological well-being of patients (Hesketh et al., 2020; Herrstedt et al., 2024). Among these adverse effects, nausea and vomiting, collectively referred to as the emetic syndrome, are among the most distressing and debilitating manifestations (Basch et al., 2011).

Emetic syndrome in cancer refers to the occurrence of nausea and vomiting either as a direct consequence of the neoplastic process or, more commonly, as adverse effects of antineoplastic treatments such as chemotherapy, radiotherapy, immunotherapy, or targeted molecular therapies. The most frequent forms are chemotherapy-induced nausea and vomiting (CINV) and radiotherapy-induced nausea and vomiting (RINV), both of which have a major impact on quality of life, nutritional status, hydration, and adherence to therapy (Hesketh, 2008; Jordan et al., 2023).

The prevalence of these complications remains high, with studies reporting that between 40% and 70% of cancer patients experience treatment-related nausea and vomiting despite the use of modern antiemetic medications (Navari et al., 2016; Chow et al., 2021). Inadequate control of these symptoms not only diminishes patient comfort but may also lead to dehydration, electrolyte imbalance, and discontinuation of potentially curative therapy (Basch et al., 2011).

The pathophysiology of emesis is complex and involves activation of multiple neurochemical pathways mediated by neurotransmitters such as serotonin (5-hydroxytryptamine, 5-HT_3), dopamine (D_2), and substance P, which acts on neurokinin-1 (NK_1) receptors. These receptors are located in the chemoreceptor trigger zone (CTZ) and the vomiting center in the medulla, as well as on vagal afferents of the gastrointestinal tract (Roila et al., 2016). Stimulation of these pathways by chemotherapeutic or radiotherapeutic agents activates a central reflex arc that results in nausea and vomiting.

Advances in pharmacologic and non-pharmacologic strategies have greatly improved control of emetic syndromes in oncology. The most recent evidence-based international guidelines, issued jointly by the Multinational Association of Supportive Care in Cancer

(MASCC) and the European Society for Medical Oncology (ESMO), as well as by the American Society of Clinical Oncology (ASCO), recommend a multimodal prophylactic approach combining 5-HT_3 receptor antagonists (e.g., ondansetron, palonosetron), NK_1 receptor antagonists (e.g., aprepitant, fosaprepitant, rolapitant), corticosteroids (e.g., dexamethasone), and atypical antipsychotics such as olanzapine, which acts on multiple receptor types (Herrstedt et al., 2024; Jordan et al., 2015; Hesketh et al., 2020).

Nevertheless, delayed, anticipatory, and refractory emesis continue to present significant clinical challenges, underscoring the need for personalized, evidence-based approaches and ongoing research into novel pharmacologic agents and individualized antiemetic regimens (Ruhlmann et al., 2023; Sutherland et al., 2018).

2. Pathophysiology of emesis in cancer

The pathophysiology of emesis in cancer represents a multifactorial and intricately regulated process that involves both central and peripheral nervous system pathways. Under normal physiological conditions, the vomiting reflex functions as a protective mechanism to eliminate ingested toxins. In oncologic settings, however, this reflex is pathologically activated by the tumor itself, by antineoplastic therapies such as chemotherapy and radiotherapy, or by a combination of treatment-related and metabolic factors (Hesketh, 2008; Herrstedt et al., 2024). The emetic response is coordinated by a neural network centered in the medulla oblongata, known as the vomiting center, which integrates afferent signals from multiple regions: the chemoreceptor trigger zone (CTZ) located in the area postrema, the gastrointestinal tract through vagal and splanchnic afferents, the vestibular system, and higher cortical centers involved in emotional and anticipatory conditioning (MacDougall & Sharma, 2023). The CTZ plays a critical role in cancer therapy–related emesis because it lies outside the blood–brain barrier, allowing direct detection of circulating chemotherapeutic agents and their metabolites (Roila et al., 2016).

Chemotherapy and radiotherapy can both activate the emetic reflex via neurochemical mediators released in response to tissue injury or cytotoxic stress. The most relevant neurotransmitters involved in this process include serotonin (5-hydroxytryptamine, 5-HT), dopamine, and substance P. The serotoninergic pathway, mediated by 5-HT_3 receptors, is the predominant mechanism in acute chemotherapy-induced nausea and vomiting (CINV). Cytotoxic drugs such as cisplatin stimulate enterochromaffin cells in the intestinal mucosa to

release serotonin, which binds to 5-HT_3 receptors on vagal afferent fibers, transmitting signals to the vomiting center and initiating the emetic reflex (Hesketh, 2008; Roila et al., 2016).

The dopaminergic system, through activation of D_2 receptors primarily located in the CTZ, also contributes to emesis. This pathway has historically been targeted by dopamine antagonists such as metoclopramide and haloperidol, although their use has been largely replaced by newer agents with more favorable safety profiles (Ruhlmann et al., 2023). In contrast, the neurokinin-1 (NK_1) receptor, activated by substance P, plays a major role in delayed emesis, which typically develops between 24 and 120 hours after chemotherapy. NK_1 receptor antagonists, such as aprepitant, fosaprepitant, rolapitant, and netupitant, have substantially improved control of delayed nausea and vomiting and are now essential components of modern antiemetic prophylaxis (Herrstedt et al., 2024; Jordan et al., 2023). Other receptor systems, including histaminergic (H_1), muscarinic (M_1), and cannabinoid (CB_1) receptors, contribute to emetic modulation, particularly in motion-induced, vestibular, or anticipatory nausea (Chow et al., 2021). In the context of radiotherapy-induced nausea and vomiting (RINV), similar mechanisms are implicated. Radiation exposure, especially to the abdomen, pelvis, or cranium, can induce mucosal inflammation, trigger serotonin release, or directly stimulate the CTZ and brainstem centers responsible for vomiting (Ruhlmann et al., 2023).

The emetic response in cancer can thus be divided into acute, delayed, and anticipatory phases. The acute phase, occurring within the first 24 hours following exposure to an emetogenic agent, is primarily mediated by peripheral 5-HT_3 receptor activation. The delayed phase, developing over subsequent days, involves central activation of NK_1 receptors by substance P. The anticipatory phase, seen in patients who have previously experienced severe emesis, represents a conditioned response involving higher cortical centers, anxiety, and memory (MacDougall & Sharma, 2023). Because multiple neurochemical pathways converge to produce emesis, no single therapeutic agent can achieve complete control. This understanding provides the rationale for combination antiemetic therapy, which simultaneously targets different receptor systems. Modern guideline-based regimens combine 5-HT_3 and NK_1 receptor antagonists, corticosteroids such as dexamethasone, and the atypical antipsychotic olanzapine, which acts on a broad spectrum of receptor subtypes including dopaminergic, serotonergic, histaminergic, and muscarinic systems (Navari et al., 2016; Chow et al., 2021).

Emesis in cancer is a multifaceted neurophysiological phenomenon arising from the interplay between peripheral sensory inputs, central integrative circuits, and diverse neurotransmitter pathways. A detailed understanding of these mechanisms has driven the evolution of multimodal antiemetic strategies, substantially improving both symptom control and quality of life for oncology patients.

3. Causes and classification of emetic syndrome in cancer

Emetic syndromes in cancer arise from multiple interacting factors that include the underlying malignancy, antineoplastic therapy, concomitant medications, and individual patient characteristics. Understanding these causal mechanisms has led to the modern classification of emesis based on both etiology and chronobiological pattern, which is central to accurate prevention and management (Hesketh, 2008; Jordan et al., 2023).

The most prevalent and clinically significant form is chemotherapy-induced nausea and vomiting (CINV). The emetogenic potential of antineoplastic drugs varies substantially according to their mechanism of action, dosage, and route of administration. According to the most recent MASCC/ESMO and ASCO guidelines, chemotherapeutic agents are stratified into four risk categories: high (>90%), moderate (30–90%), low (10–30%), and minimal (<10%) risk of acute emesis (Herrstedt et al., 2024; Jordan et al., 2023). Cisplatin remains the prototypical high-risk agent, whereas carboplatin, cyclophosphamide, and doxorubicin combinations exhibit moderate-to-high risk profiles. Drugs such as methotrexate and paclitaxel are classified as low or minimal risk. This stratification is essential for designing appropriate prophylactic regimens (Hesketh et al., 2020).

CINV is further subdivided based on the timing of symptom onset. Acute emesis occurs within the first 24 hours following chemotherapy, primarily triggered by serotonin release from enterochromaffin cells. Delayed emesis arises between 24 and 120 hours and is mediated predominantly by substance P and activation of NK_1 receptors. Anticipatory emesis represents a conditioned psychological response to previous emetic experiences and is associated with anxiety and activation of higher cortical centers. Finally, refractory emesis refers to nausea and vomiting that persist despite optimal antiemetic prophylaxis during previous treatment cycles (Navari, 2015; Roila et al., 2016).

Radiotherapy-induced nausea and vomiting (RINV) is another common cause of emetic syndrome. Its pathophysiology largely overlaps with that of CINV but is initiated by radiation-

induced mucosal injury and local serotonin release. The risk of RINV depends on the irradiated site and volume: total body, cranial, abdominal, or pelvic irradiation are classified as high-risk, thoracic irradiation as moderate-risk, and extremity or breast irradiation as low-risk (Ruhlmann et al., 2023). This anatomical risk stratification reflects the density of serotonergic nerve endings and the proximity of irradiated tissues to the gastrointestinal tract and central emetic centers.

In addition to treatment-related causes, the tumor itself can directly induce nausea and vomiting. Brain tumors or metastases may elevate intracranial pressure, triggering the CTZ and vomiting center. Gastrointestinal malignancies can cause mechanical obstruction, impaired motility, or inflammation, while metabolic alterations such as hypercalcemia, hyponatremia, or uremia contribute to central nausea through humoral mechanisms (Basch et al., 2011; Gupta, Walton & Kataria, 2021).

Finally, supportive medications, including opioids, antibiotics, and certain anesthetics, are well-known contributors to secondary emesis through dopaminergic or cholinergic receptor stimulation in the CTZ. Psychological and anticipatory factors further amplify these effects; anxiety and learned associations between treatment and discomfort often precipitate nausea even before therapy begins, highlighting the interplay between neurochemical and psychological pathways (Ning et al., 2024). These findings support a multidimensional view of emesis in cancer that integrates pharmacologic, physiological, and psychological causation. The classification into acute, delayed, anticipatory, and refractory forms, alongside the etiologic distinction between CINV, RINV, and disease-induced or drug-induced emesis, provides a clinically relevant framework for tailored prophylaxis and management.

4. Factors influencing the occurrence of emetic syndrome in cancer

The occurrence and severity of emetic syndrome in oncology result from a complex interplay between treatment-related emetogenicity, patient-specific susceptibility, and disease- or metabolism-related contributors. Although modern antiemetic prophylaxis has improved outcomes, considerable interindividual variability persists, necessitating risk-adapted strategies grounded in validated determinants (PDQ Supportive and Palliative Care Editorial Board, 2025).

From a treatment standpoint, the emetogenic potential of chemotherapy remains the most critical factor. Antineoplastic agents are classified as having high, moderate, low, or minimal

emetogenic risk. This categorization consistently places cisplatin and anthracycline–cyclophosphamide combinations at the highest risk level, while agents such as paclitaxel, docetaxel, and methotrexate carry minimal risk (Berger et al., 2017; Dranitsaris et al., 2017). These classifications, reflected in NCCN and MASCC/ESMO guidelines, guide the intensity and duration of prophylaxis. Dose, administration route, infusion rate, and multi-drug regimens also influence the emetic response (Hu et al., 2016).

Regarding radiotherapy, emetic risk correlates closely with the irradiated field and volume. High-risk situations include total-body irradiation, cranial fields, and upper abdominal/pelvic exposures, whereas thoracic and breast/extremity sites confer moderate and low risk, respectively (Urba, 2007; Feyer, Jahn & Jordan, 2015; Ruhlmann et al., 2023). Mechanistically, RINV overlaps with CINV through peripheral serotonin release, mucosal injury, and potential direct activation of the chemoreceptor trigger zone during cranial irradiation (Salvo et al., 2012). Combined chemoradiotherapy further increases risk and requires intensified prophylactic regimens (Ruhlmann et al., 2023).

Patient-related factors significantly modulate emetic susceptibility. Female sex, younger age, low habitual alcohol intake, and a prior history of motion sickness or pregnancy-related vomiting have consistently been associated with higher risk (Mosa et al., 2020). These predictors are supported by multivariate analyses and validated through clinical prediction tools that integrate patient and treatment characteristics to estimate individualized risk (Dranitsaris et al., 2017; Hu et al., 2016). Psychological and anticipatory components, such as anxiety or previous uncontrolled nausea, also play a crucial role, especially in recurrent treatment cycles (PDQ Supportive and Palliative Care Editorial Board, 2025).

Disease and metabolism related factors can precipitate or exacerbate emesis independent of anticancer therapy. Intracranial metastases, primary brain tumors, and increased intracranial pressure activate the vomiting center directly. Gastrointestinal obstruction, hepatic failure, or metabolic abnormalities, notably hypercalcemia, uremia, and electrolyte imbalances, are frequent contributors (PDQ Supportive and Palliative Care Editorial Board, 2025). Identifying and correcting these reversible causes remain essential to optimize antiemetic control.

Concomitant medications may also trigger nausea and vomiting. Opioids, for instance, can induce emesis through μ-opioid receptor stimulation in the chemoreceptor trigger zone and the area postrema, leading to a dose-dependent activation of the vomiting reflex (MacDougall

& Sharma, 2023; Smith et al., 2012). Constipation and delayed gastric emptying secondary to opioid therapy can further amplify symptoms.

Emesis in oncology reflects the convergence of treatment, patient, and disease related determinants. Comprehensive classification therefore spans both etiology, chemotherapy-induced (CINV), radiotherapy-induced (RINV), disease-related or drug-related and chronobiology, acute, delayed, anticipatory, and refractory. Applying validated risk models and stratification systems allows clinicians to tailor antiemetic strategies to individual patient profiles, preserving adherence, hydration, and quality of life (Berger et al., 2017; Ruhlmann et al., 2023).

5. Prevention and management of emetic syndrome in cancer

Effective prevention and management of emetic syndromes in cancer require an evidence-based, multidisciplinary approach that integrates pharmacologic prophylaxis with supportive, behavioral, and psychosocial interventions. The aim is not only to suppress nausea and vomiting but also to preserve treatment adherence, nutritional status, and psychological well-being, thereby improving patients' overall quality of life (Herrstedt et al., 2024; Hesketh et al., 2020). Current antiemetic strategies are designed according to the emetogenic potential of cancer therapies. Guideline-based prophylaxis employs a multireceptor blockade combining a 5-hydroxytryptamine-3 (5-HT_3) receptor antagonist, a neurokinin-1 (NK_1) receptor antagonist, and a corticosteroid, most commonly dexamethasone, for highly emetogenic chemotherapy (HEC). This regimen offers optimal control of both acute and delayed emesis (Herrstedt et al., 2024; Jordan et al., 2023).

For moderately emetogenic chemotherapy, dual therapy with a 5-HT_3 antagonist and dexamethasone is usually sufficient, while low or minimal-risk regimens may only require on-demand antiemetics. Olanzapine, an atypical antipsychotic that acts on dopaminergic, serotonergic, histaminergic, and muscarinic receptors, is increasingly included in prophylactic regimens for its efficacy against both nausea and vomiting in the acute, delayed, and refractory phases (Navari et al., 2016; Chow et al., 2021).

Radiotherapy-induced nausea and vomiting (RINV) should be managed based on the irradiated field and volume. Prophylaxis with a 5-HT_3 receptor antagonist and dexamethasone is recommended for high-risk fields such as total-body, abdominal, or cranial irradiation. When chemoradiation is used, combined antiemetic coverage is essential (Ruhlmann et al., 2023).

Refractory emesis, defined as nausea and vomiting that persist despite optimal, guideline-concordant prophylaxis in previous treatment cycles, represents one of the most challenging clinical scenarios. Its pathogenesis is multifactorial, involving neurochemical adaptation, cumulative anxiety, metabolic alterations, and inadequate receptor coverage (Basch et al., 2011; Navari, 2013).

Preventive measures focus on early identification of high-risk patients and optimization of prophylactic regimens before subsequent cycles. Switching to or adding alternative agents targeting different receptor pathways can improve outcomes. For instance, adding olanzapine or levosulpiride to standard 5-HT_3/NK_1/corticosteroid therapy has been shown to enhance control in refractory cases (Navari et al., 2016; Chiu et al., 2016). In situations of prolonged delayed emesis, prolonged NK_1 blockade with rolapitant or netupitant-palonosetron combinations (NEPA) can provide sustained protection.

Non-pharmacologic approaches are also crucial. Hydration, electrolyte correction, and nutritional support should be promptly initiated to prevent complications such as dehydration, renal impairment, or malnutrition. Continuous reassessment of contributing factors, including medication-induced nausea (opioids, antibiotics), metabolic derangements, or disease progression, is essential. For patients with psychological conditioning or anticipatory components, psycho-oncological intervention is strongly recommended (Samami et al., 2022; Anghel et al., 2025).

When standard strategies fail, palliative antiemetic approaches, including benzodiazepines for anxiety-related nausea, cannabinoids (e.g., nabilone) for appetite and emesis control, and continuous subcutaneous infusions of antiemetics in advanced disease, may be employed, always tailored to the patient's clinical status and goals of care (Gurgenci et al., 2024; Leach, 2019).

Complementary interventions can enhance pharmacologic treatment, particularly for nausea control. Evidence supports the use of acupuncture, acupressure, aromatherapy, relaxation training, and ginger extract as adjunctive measures to alleviate symptoms and improve comfort (Molassiotis et al., 2005; Klein & Griffiths, 2004). Nutritional counseling, focused on small, frequent meals and adequate hydration, helps maintain physiological stability and tolerance to treatment.

Psychological mechanisms significantly influence both the development and control of emetic syndromes. Anticipatory nausea and vomiting (ANV), a conditioned response triggered

by prior negative treatment experiences, can precede therapy in up to 25% of patients (Roscoe et al., 2011). Cognitive-behavioral therapy (CBT), guided imagery, relaxation techniques, and desensitization protocols have all been shown to reduce ANV severity and improve coping (Samami et al., 2022; Anghel et al., 2025; Newell et al., 2002). Integration of psycho-oncological care within supportive oncology teams contributes to reduced anxiety, enhanced treatment adherence, and improved patient outcomes (Redd et al., 2001).

Optimal management of emesis in cancer should be personalized and multimodal. Prophylaxis must begin before exposure to emetogenic therapy, continue throughout treatment cycles, and include ongoing reassessment of efficacy. Combining pharmacologic agents, supportive interventions, and psycho-oncological support provides the best protection against both acute and refractory symptoms, maximizing quality of life and adherence to cancer therapy.

6. Conclusion

Emetic syndrome remains a multifactorial and clinically relevant complication in oncology, reflecting the intricate interplay between therapeutic toxicity, neurochemical signaling, and patient-specific vulnerability. Despite the substantial progress achieved through multireceptor pharmacologic strategies, complete prevention of nausea and vomiting remains elusive. An evidence-based and multidimensional approach to emesis control requires precise risk stratification, early prophylaxis, and integration of pharmacologic, nutritional, and psychological interventions. Optimized use of 5-HT_3 and NK_1 receptor antagonists, corticosteroids, and atypical antipsychotics, combined with psycho-oncological support, has markedly improved patient comfort and treatment adherence. Future directions in oncology should emphasize personalized prophylactic algorithms, pharmacogenomic profiling, and broader access to supportive care services. Addressing emetic syndromes comprehensively not only mitigates symptom burden but also enhances the overall therapeutic experience and quality of life of patients undergoing cancer treatment.

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Romanian medical terminology under the determining influence of the French language

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Abstract

The Romanian medical terminology has been influenced a lot by the French language especially in the 19th and 20th centuries when Romanian medicine was also at its peak. This process was greatly enhanced by the French model of medical education and the French medical literature and dictionaries. The lexical examples, as well as phonetic and semantic changes, reflect the extent of this impact. These examples confirm that over 60% of Romanian medical terminology originates from the French language, a phenomenon driven by historical, cultural, and academic influences exerted during the 19th–20th centuries.

Keywords: medical terminology, linguistic influence, medical lexicon, French language, semantic changes

The French medical language has significantly influenced the Romanian medical terminology, this influence being deeply rooted in the history of Romanian medicine and the need to adopt the European scientific terminology. France, especially in the 19th and early 20th centuries, was one of the leading countries in terms of medical education and clinical research.

In the 19th century the Romanian elites were strongly inclined towards the French cultural pattern including in the field of medical sciences. A number of Romanian doctors went to Paris, Montpellier or Lyon to study and returned home with French medical terms. This development was even more pronounced in the inter war period thus making the French terminology to become the official terminology in the Romanian medical practice.

These doctors used the French medical language that naturally became the professional language of the newly formed Romanian medical elite. It should be mentioned that at that time the French medical language had already been standardized in major dictionaries and medical treatises which made it easier for the terminology to be translated into Romanian in a consistent and organized manner. The dictionaries such as Dictionnaire des termes de médecine by

Garnier-Delamare and encyclopedic works like Larousse Médical(Larousse Médical. (2008). Le grand Larousse médical) were widely used in Romania either in translation or in the original French language.

Romanian medicine adopted professionalization through numerous lexical borrowings from French since the Organic Regulations period and especially in the second half of the 19th century. This terminology was soon adopted from the academic to the practical side of medicine and healthcare laws and the training of new medical professionals.

The first Romanian medical journals contained bilingual texts or glossaries in French, and the authors developed their medical discourse in accordance with the stylistic features of French publications. The doctoral theses defended in France by Romanian physicians were translated or adapted for Romanian audiences to introduce and reinforce the French-origin medical terminology.

The medical literature of Romania during this period: textbooks, treatises, specialized journals, this linguistic influence is accurately portrayed. Many works adopted not only French-origin terms but also the methods of organizing medical knowledge, the structure of chapters, descriptive style, and nosological classifications.

For instance, the internal pathology compendium by Professor Ion Nanu-Muscel written in the 1930s (Goldstein, L. 1999, p.47) contains terms such as bronchopneumonie, hémorragie digestive, colique hépatique, or syndrome néphrotique that are not translated into Romanian since they were already considered as part of the standard medical terminology. Other notable works include the treatises of Professors Daniel Danielopolu and Thoma Ionescu, which combine French terminology with efforts to establish a coherent Romanian medical style.

During the interwar period, medical journals such as Revista Științelor Medicale and Spitalul published scientific papers that used vocabulary which was heavily influenced by French. Another practice that was adopted was writing the summaries in French, this was to show international recognition and the desire to be part of the Francophone medical community.

In the educational domain, the University of Medicine and Pharmacy in Bucharest, as well as the faculties in Cluj and Iași, preserved the tradition of using textbooks that were either translated from French or written under the influence of French for a long time. French terms

were the norm in the specialized terminology in the main subjects: anatomy, physiology, pathology, and pharmacology.

According to Rodica Zafiu in Limba română actuală. Vocabularul (Humanitas, 2001, p.89), the author states that in the medical field, 60% of the basic terminology is of French origin.

According to Sorin Stati's study (Limba română contemporană, Ed. Didactică și Pedagogică, 1981, p. 254), more than 60% of the medical terminology that is used in everyday practice is of French origin, most of which was adopted during the 19th and 20th centuries together with the influence of French medical schools on the training of Romanian specialists. This finding is also supported by the analysis of the vocabulary in Dicționarul medical (V. Rusu, 2010, p.38), where 7 out of 10 terms have French etymology or entered Romanian through the French linguistic pathway.

The French terms borrowed into Romanian in the field of medicine can be grouped into two major categories depending on the degree of correspondence between the French term and its Romanian form.

Terms with the Same or Similar Spelling

These terms were adopted directly from French without much modification (for example, accent removal or slight phonetic change).

The root and morphological structure of the word were preserved.

Below are examples of such terms:

French Term	Romanian Term	English Term	Observations	Source
diagnostic	diagnostic	diagnosis	Identical	DEX 2022, Larousse Médical, p. 213
pneumonie	pneumonie	pneumonia	Identical	Larousse Médical, p. 634
chirurgie	chirurgie	surgery	Identical	Ciobanu, Illustrated Medical Dictionary, p. 133
fracture	fractură	fracture	Almost identical – suffix adaptation -ure → -ură	DEX 2022
cancer	cancer	cancer	Identical	Rusu, Medical Dictionary, p. 174
virus	virus	virus	Identical	DEX 2022
injection	injecție	injection	Almost identical – suffix -tion → -ție	Rusu, p. 378

antibiotique	antibiotic	antibiotic	Identical root, suffix -ique → -ic	Romanian Pharmacopoeia, 10th Ed., p. 112
stéthoscope	stetoscop	stethoscope	Almost identical – no accent	Larousse Médical, p. 951
clinique	clinic	clinic	Shortened and adapted form	DEX 2022
diabète	diabet	diabetes	Identical without accent	Larousse Médical, p. 314
psychose	psihoză	psychosis	Minor phonetic adaptation	DEX 2022
hémorragie	hemoragie	hemorrhage	Identical without accent	Goldstein, p. 109
médecine	medicină	medicine	Phonological adaptation: -cine → -cină	DEX 2022
pathologie	patologie	pathology	Minor adaptation – th → t	Larousse Médical, p. 712
fièvre	febră	fever	Common etymology, similar form	Ciobanu, p. 154
toxicologie	toxicologie	toxicology	Identical	DEX 2022
infection	infecție	infection	Adapted suffix	Rusu, p. 379

nutrition	nutriție	nutrition	Regular adaptation	DEX 2022
respiration	respirație	respiration	Almost identical	DEX 2022
cardiologie	cardiologie	cardiology	Identical	Larousse Médical, p. 117
neurologie	neurologie	neurology	Identical	DEX 2022
dermatologie	dermatologie	dermatology	Identical	Ciobanu, p. 178
radiologie	radiologie	radiology	Identical	DEX 2022
pharmacologie	farmacologie	pharmacology	Minor phonetic shift: ph → f	Romanian Pharmacopoeia, p. 205

Terms with Different Spellings (but Clear French Origin)

The differences in French and Romanian medical terms in terms of spelling are due to phonetic, morphological, and orthographic changes to fit the Romanian language structure.

Most of the changes were determined by the Romanian language rules concerning the formation of derivatives, suffixation or the deletion of diacritical signs which are typical of the French language.

Exemples of changes:

- **Orthographic changes**: French suffixes -tion, -ique, -ème are replaced in Romanian with -ție, -ic, -em.

• ex. injection → injecție, clinique → clinic, système → sistem

• **Dropping diacritical marks**: Romanian does not use French accents (é, è, ê).

• ex. hémorragie → hemoragie, stéthoscope → stetoscop

• **Preference for the Latin form**: There were cases when Romanian adopted the Latin term or a combination of the Latin and French terms.

• ex. muscle (fr.) ← musculus (lat.) → mușchi (rom.)

French Term	Romanian Term	English Term	Notes	Source
muscle	mușchi	muscle	Deep adaptation – common etymon, French influence	Ciobanu, p. 220
hôpital	spital	hospital	Complete initial letter change – French root	Goldstein, p. 88
maladie	boală	illness	Conceptual synonym, French influence	Larousse Médical, p. 303
médecin	medic	doctor	Adapted to Romanian form	Rusu, p. 467
contagieux	contagios	contagious	Suffix -eux → -os	DEX 2022
antiseptique	antiseptic	antiseptic	Suffix -ique → -ic	Farmacopeea, p. 89

analgésique	analgezic	analgesic	Graphic adaptation: -ique → -ic	Rusu, p. 57
accouchement	naștere	childbirth	Semantic translation, not phonetic	Larousse Médical, p. 44
plaie	rană	wound	Different lexical translation	DEX 2022
tumeur	tumor	tumor	Phonetic adaptation	DEX 2022
médicament	medicament	medication	Almost identical	DEX 2022
fièvre	febră	fever	Distinct form, shared Latin etymology	Ciobanu, p. 154
saignement	sângerare	bleeding	Semantic translation, French origin	DEX 2022
brûlure	arsură	burn	Semantic translation	Larousse Médical, p. 127
douleur	durere	pain	Conceptual synonym	DEX 2022
traitement	tratament	treatment	Almost identical	Rusu, p. 485

salle d'opération	sală de operație	operating room	Expression translation	Ciobanu, p. 377
vertige	amețeală	dizziness	Equivalent meaning, different form	DEX 2022
convalescence	convalescență	convalescence	Adapted suffix: -ce → -ță	DEX 2022
ordonnance	rețetă	prescription	Semantic, not phonetic translation	Larousse Médical, p. 536
guérison	vindecare	healing	Complete translation	DEX 2022
salle d'attente	sală de așteptare	waiting room	Expression translation	Ciobanu, p. 377
tension	tensiune	tension	Phonetic adaptation	DEX 2022
consultation	consultație	consultation	Adapted suffix	DEX 2022
intervention	intervenție	intervention	Adapted suffix	DEX 2022

These examples confirm that over 60% of Romanian medical terminology originates from the French language, a phenomenon driven by historical, cultural, and academic influences exerted during the 19th–20th centuries. The adoption of French terms was often accompanied by graphic, phonetic, and morphological adaptations to comply with the rules of the Romanian language. Identical terms such as "clinic" or "bronchite" coexist with adapted forms like "injecție" (fr. injection) or "farmacologie" (fr. pharmacologie), reflecting a process of linguistic naturalization.

According to Alexandru Graur, in Introducere în studiul limbii române moderne (Scientific Publishing House, 1965, p. 211), these adaptations followed coherent patterns dictated by oral usage and the phonetic norms of the Romanian language.

This massive influence contributed to the modernization of Romanian medical vocabulary, facilitating access to Western specialist literature and alignment with international terminology. At the same time, the specific adaptations to the Romanian language demonstrate a capacity for creative integration, which led to a coherent and functional terminological system.

In conclusion, French medical language was not only a source of terms for Romanian but also a model for the professionalization, rationalization, and modernization of Romanian medicine. Therefore, understanding the French influence in this field is not merely a linguistic exercise, but an exploration of the intellectual and institutional history of modern Romanian medicine.

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Obstetrical prognosis of pregnancy with previous uterine surgery

Daiana Elena Angheloiu[9], George Adam[10]

Abstract

Surgical intervention at the level of the uterus can lead to myometrial or endometrial scar defect that can lead to infertility, the consequence of endometrium or myometrial cicatrization and the qualitative modification of the endometrial cells and also endometrial cavity. The most common risks of obstetric complications reported in pregnancy who have undergone myomectomy or fibroid surgery were spontaneous loss of pregnancy, uterine rupture with increased neonatal morbidity and mortality due to prematurity, premature ruptures of membranes. The obstetric prognosis it can be affected after a single intervention on uterus, but with associated diseases such as obesity type 2 or type 3 or an anterior caesarean section can highly increase the risk of maternal mortality and morbidity.

Of all the techniques used for uterine surgery, the endometrial surgery affects the obstetric prognosis the most, while myomectomy surgery the least.Regardless all the new improve techniques severe complications like uterine rupture and abnormal placentation can occur but in the same time uterine surgery can improve reproductive outcomes of women with uterine pathology like fibroids, endometrial polyps, adenomyosis.

The administration of obstetric supportive treatment like progesterone does not improve the obstetric prognosis significantly but with such a wide range of new and emerging treatment options, it is important to understand which pregnancy are likely to respond optimally to a specific treatment, in order to individualize appropriate and effective management for patients.

Key words: uterine surgery, obstetric, pregnancy, myomectomy

Introduction

Surgical intervention at the level of the uterus can lead to myometrial or endometrial scar defect that can lead to infertility, the consequence of endometrium or myometrial

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cicatrization and the qualitative modification of the endometrial cells and also endometrial cavity. These damages can determine the loss of the basic function of the endometrium, as well as the loss of the antiseptic barrier role of the cells , which can also results beside obstetric complications in local infections, with the possibility of germs ascending, resulting in endometritis and/or salpingitis or even pelvis inflammatory disease.

Most studies have reported that the common risks of obstetric complications associated in pregnancy who have undergone uterine surgery were spontaneous loss of pregnancy, uterine rupture with increased neonatal morbidity and mortality due to extreme prematurity, premature ruptures of membranes and abnormal placentation (1,2).

The obstetric prognosis is not severely affected sometimes after a single intervention on uterus, but repeating the procedure can increase the risk of infertility and obstetric complications. especially with associated diseases such as obesity type 2 or type 3 or an anterior caesarean section.

Methodology and Discussion

A systematic review was conducted from the literature in ScienceDirect, PubMed, Web of Science and Cochrane Library databases were thoroughly searched from 2000 to 2022. Only studies published as full-length articles were included and pregnancy outcomes were assessed by rates of live birth, miscarriage, premature delivery,uterine ruptures and cases of abnormal placentation.

The data extracted from the literature are not very homogeneous, but we made a metaanalysis in 7 studies where the risk of spontaneous miscarriage following conception is relevant from values between 5-15% for women with one uterine surgery, reaching up to 22-27% according to some statistics for women with repeated uterine surgery, but without specification of surgery technique. Premature rupture of the membranes is approximately 2-3 times more frequent in pregnant women who have undergone previous uterine surgery especially fibroid surgery, compared to those without any type of uterine surgery. [2,3,4]

In one study conducted by Shanga on 124 patients in whom uterus surgery was performed, 79 patients obtained a pregnancy. In 63 of them the birth occurred at term (50,8 %), while the

premature birth (under 37 weeks) was reported in 8% of patients. 14 of patients suffered a spontaneous abortion in the first trimester (11,3%), a higher value than found in the general population (8%). [11]

Another study of evaluation was carried out by Pitter by comparing 872 women after uterine surgery robot-assisted myomectomy from whom 107 patients obtained a pregnancy. From these pregnancy, spontaneous abortions occurred in 18.9%, preterm delivery prior to 35 weeks of gestational age occurred in 17,4 %, one uterine rupture was documented. It is mentioned that higher preterm delivery rates were significantly associated with a greater number of fibroids removed and anterior location of the largest incision (compared with all other sites).In the same study a total of six placental abnormalities were reported four placenta praevia and one placenta acreta and one placenta percreta. [8,9,15,17]

The largest study was made by Sizzi and compared and followed the prognosis of 386 pregnancies obtained from a total number of 1683 women that had uterine surgery. In 300 of them the birth occurred at term (70 %), while the premature birth (under 37 weeks) was reported in 5 % of patients. It is mentioned that a higher miscarriage rate in the first trimester (20%), could be corelated with an increase in the number of more than 3 fibroids or the location and size of the fibroids seems to influence particularly the risk of major complications (Fig 1, Fig 2). [14]

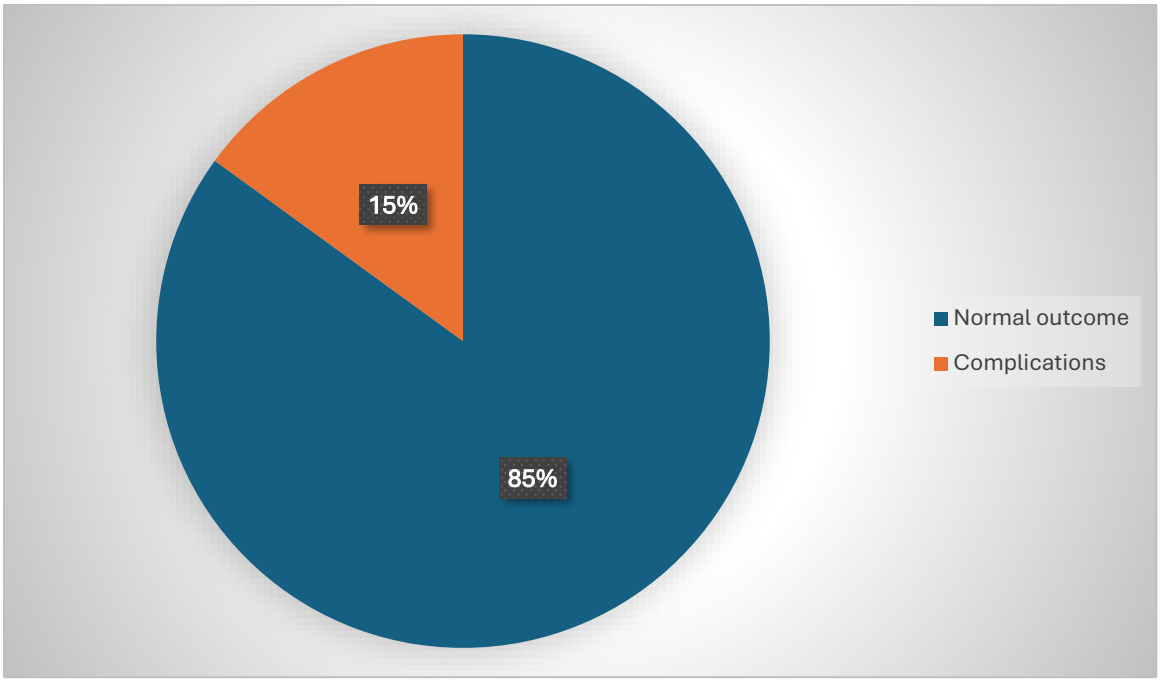

Fig Nr.1,The percentage of pregnancies with obstetric complications without uterine surgery

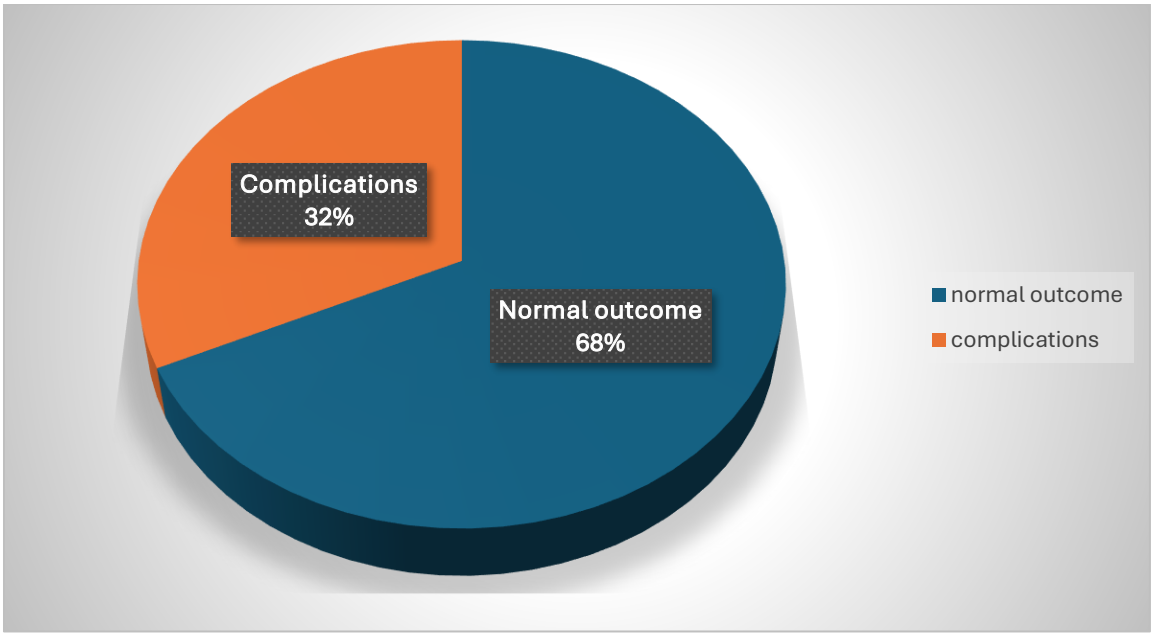

Fig.2.The percentage of pregnancies with obstetric complications with uterine surgery

From all the data analysis it is suggested that if the excision of the tissue is greater than 55 mm, regardless of the type of surgical technique practiced, the obstetric prognosis is severely affected, by increasing the number of miscarriage and premature births, but especially by increasing the percentage of births with extreme prematurity, which implies a morbidity and increased neonatal mortality, especially in patients with other diseases associated. [12,14]

The risk of neonatal mortality from the studies is in a range of 15- 21% higher in pregnant women with anterior uterine surgery compared to pregnant women with the same pregnancy age but without any uterus pathology.

From all the surgical techniques used for the uterus, fibroid surgery made by open surgeries or laparotomies affects the obstetric prognosis the most, while laparoscopic myomectomy and hysteroscopic polypectomy influence it the least, perhaps due to the fact that these two procedures are indicated with a predilection for patients with minimal fibroids or minimal endometrial polyps. The excision of an important portion of the myometrium or endometrium tissue can cause the loss of mechanical and implantation support for a future pregnancy and cause a lot of the obstetric complications especially premature rupture of the membranes, resulting in premature birth. Other authors have suggested that the physio pathological mechanisms could be influenced by the different quality of the fibroblasts following the repair of the damaged tissue or by other factors, such as the insufficiency of the defence mechanisms and alteration of the immunological system. [2,8]

Conclusion

Regardless of the surgery technique used and all the immunological and physiological mechanisms involved, uterine surgery causes a higher risk of miscarriage in the first trimester, premature birth, especially through rupture of the membranes, compared to the general population, uterine rupture and abnormal placentation. It is important to know these obstetrical problems because many patients diagnosed with uterin pathology are young and the obstetric prognosis is very important in this group of patients. Pregnancy management in a patient with a history of uterine surgery includes also screening for lower genital tract infections, hormonal pathology and assessment of cervical length in the second trimester by transvaginal ultrasound. The lack of direct comparisons of different uterine surgery in studies where pregnancy is wanted by a significant number of women is, however the most important limitation because important difference may exist in the characteristics of women offered the the same or different treatment. The administration of obstetric supportive treatment does not improve the obstetric prognosis significantly but with such a wide range of new and emerging treatment options, it is important to understand which pregnancy are likely to respond optimally to a specific treatment, in order to individualize appropriate and effective management for patients.

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Issues in a case of perianal /anal adenocarcinoma in men

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Lorena Iordache[14], Camelia Firoiu[15]

Abstract

Perianal/anal adenocarcinomas are very rare primary malignancies known to have complex etiopathogenesis involving dietary factors, genetic predisposition, infectious agents, especially human papilloma virus (HPV) infection, and various pathological conditions, including long-standing perianal fistulas, inflammatory bowel diseases, or diabetes.

We report a case of 46 age man presented with persistent perianal abscess and fistula who underwent surgical excision of fistulous tract. Clinically, in addition to the local pain and discomfort, the patient also accused a significant recent weight loss. Histopathological examination surprisingly revealed a diffuse adenocarcinomatous infiltration of the perifistulous submitted fragments, raising the suspicion of an underlying subclinical anorectal carcinoma. The subsequent native pelvic MRI investigation described a perianal intersphincteric fistulous tract associated with postoperative distal posterior fibrous tract and also a non-inflammatory sigmoid diverticulum, without mesenteric adenopathy, being inconclusive for colorectal cancer. However correlating the immunohistochemical study with the histopathological result, the diagnosis was that of an anal adenocarcinoma possibly secondary to chronic HPV infection, excluding colorectal conventional adenocarcinoma.

This clinical case draws the attention to the consequences of persistent/untreated HPV anogenital infection, including in men, and emphasizes the fact that prophylactic vaccines

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targeting HPV sexually transmitted infection, both in women and men, can also prevent a subtype of anal/ perianal adenocarcinomas.

Keywords: anal /perianal adenocarcinomas, diagnostic challenge, prevention

Introduction

Perianal/anal adenocarcinomas are very rare primary malignancies accounting 5%-19% of all anal canal cancers and 1.5% of all gastrointestinal tumors, representing a real diagnostic and therapeutic challenge with still not well-established management strategies (Beal, et al., 2003; Ferrer, et al., 2013).

Based on their particular histogenesis these tumors are classified in two main types bearing the two specific immunoprofiles: those of colorectal type originated in the intestinal epithelium of superior colorectal zone that are CK7(−), CK20(+), CDX2(+), and those of transitional /anal gland (duct) type with CK7(+), CK20(−), CDX2(−) immunoreactivity; they can be either mucinous or non-mucinous and may associate perianal Paget's disease (Herfs, et al.,2018; Liao, 2022)

Most perianal /anal adenocarcinomas are of colorectal phenotype and in advanced stages it can be extremely difficult to differentiate them from lower rectal adenocarcinomas directly extending in this area. Similar to these tumors, hereditary cases are rare, and the well-known risk factors for colorectal cancer such as excessive red and processed meat diet or tobacco use only associate a moderate risk in sporadic cases (Lynch & Chapelle, 2003; Liang, et al., 2009; Chan, et al., 2011; Brenner et al., 2014)

The tumors of transitional /anal gland (duct) type are grouped under the term of perianal /extramucosal adenocarcinomas and include mainly anal gland (duct) adenocarcinomas and fistula associated adenocarcinomas, but also tumors originated in other non-fistulating local glandular structures as acquired or congenital malformations or embryological remnants. (Nagtegaal & Washington, 2019). These tumors still possess a poorly understood pathogenesis that involve various factors and condition eliciting a persistent local chronic inflammation, such

as preexisting abscesses /fistula or Crohn's disease, and, more recently, high-risk human papilloma virus (HPV) infection. The frequent clinical similarity with benign lesions and the limited mucosal expression are common causes of delayed diagnosis and advanced stage at presentation, with a poorer prognosis including higher rates of pelvic failure and distant metastases (Belkacémi, et al., 2003).

Anal gland /duct adenocarcinomas have an infiltrative growth pattern corresponding to a specific intramural subtype of anal canal adenocarcinoma and its diagnosis is sometime done by exclusion since the normal epithelial structures of origin are generally not detected in histological specimens (Ferrer, et al., 2013). Even though some authors have established certain histologic criteria for classifying anal gland (duct) carcinoma, such as small and haphazardly dispersed glands invading the anorectal area, scant mucin production, lack of an intralumenal component, and CK7 positivity, the histologic appearance is often indistinguishable from that of mucinous-type conventional colorectal adenocarcinoma making the diagnostic even more difficult (Wong, et al., 2002; Hobbs, et al., 2001). Currently, a primary adenocarcinoma of the anal canal that involves the wall of the anorectal area without neoplastic changes in the luminal mucosa and not associated with a preexisting fistula is considered to be of anal gland (duct) origin irrespective of the extent of mucin production (Shia, 2010).

Fistula associated perianal /anal adenocarcinomas are found on a background of chronic inflammation with persistent mucosal regeneration as in inflammatory bowel diseases including Crohn's disease or in non-specific inflammation with abscesses /dilatation of anal glands (ducts) manifested as perianal /anal persistent fistula, and may be related both with colorectal type glandular mucosa and anal glands (ducts). The morphology and immunophenotype of these tumors are similar to that of anal gland (duct) adenocarcinomas. A significant proportion of these tumors are mucinous and remain to be differentiated from tumors of anal gland (duct) origin since histochemical evaluation suggesting similar mucin characteristics between fistula-associated tumors and glands (ducts) tumors (Palmieri, et al., 2021; Ferrer, et al., 2013; Herfs, et al., 2018; Fenger & Filipe, 1981). It is also to mention, the coincidental implantation of rectal cancer in an anal fistula is extremely rare (Ishiyama, et al., 2006).

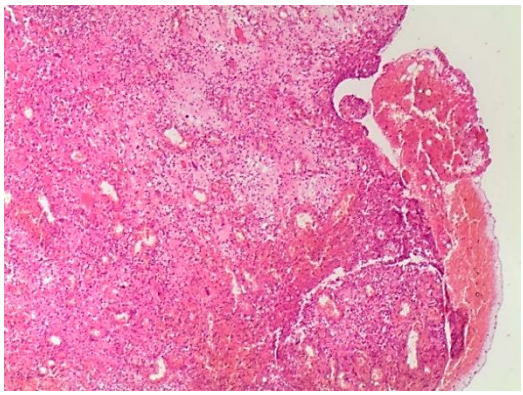
Furthermore, given recent epidemiological evidence linking sexually transmitted HPV infection to perianal/anal adenocarcinomas, they can be divided into HPV-dependent or HPV-independent tumors. Sexual intercourse, ascending or retrograde infection from the perineum,

fomite inoculation, or preventive colonoscopy have been cited as possible sources of infection (Lin, et. al, 2018; Deschoolmeester et al., 2010; Pérez et al., 2010; Bucchi et al., 2016). Some authors have found that nearly half of transitional /anal glands (ducts) type adenocarcinomas are related to high-risk mucosal tropic HPV infection and have demonstrated HPV16/18 DNA, viral oncogene expression and p16 immunopositivity in a significant number of cases (Liao, 2022; Lin, et al., 2018; Herfs, et al., 2018; Hafez, et al., 2022). These tumors also share some similarities to those of high-risk HPV-related endocervical adenocarcinoma, including the early infiltrative /destructive pattern of invasion with irregularly infiltrating malignant glands associated with stromal reactions such as desmoplasia and inflammation (Voltaggio, et al., 2020; Ronnett, 2016). Moreover, HPV-related tumors appear to be associated with increased inflammatory reactions and antiviral response and may have a better prognosis, possibly related to responsiveness to immunotherapy, although they have proven clinically more aggressive course. In addition, the HPV vaccine has already demonstrated high efficacy in preventing anal infection with HPV16/18. (Gorvel & Olive, 2023; Zhou, et al., 2024; Stier, et al., 2016)

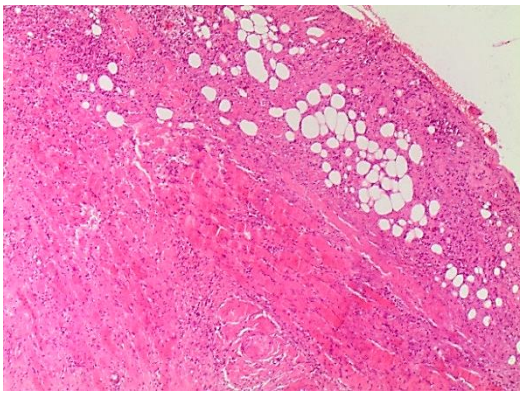
Case presentation

We report a case of a 46-year-old man, presented with persistent perianal abscess/fistula and associated clinical manifestations such as local pain, discomfort, induration and spotting, as well as recent significant unexplained weight loss. The local examination did not raise any suspicions, and the patient underwent anal fistulotomy for a benign condition, with wide excision of the inflamed anal and perianal perifistulous tissue which was sent for routine pathological examination.

Histopathologically, the examined fragments were predominantly represented by fibroconnective tissue including areas of adipose tissue and sparse striated muscle fibers, some of which also having surface squamous epithelium originating in the squamous area of the anal canal and/or in the skin of the perianal region. All of these fragments showed large areas of marked chronic ulcerative inflammation (Figure 1, A &B) and multiple foci of extensively infiltrative adenocarcinoma.



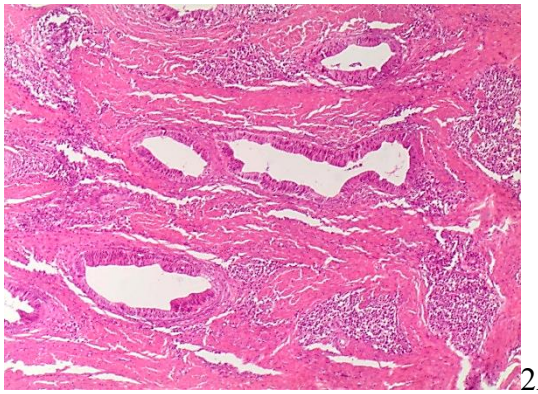
1A



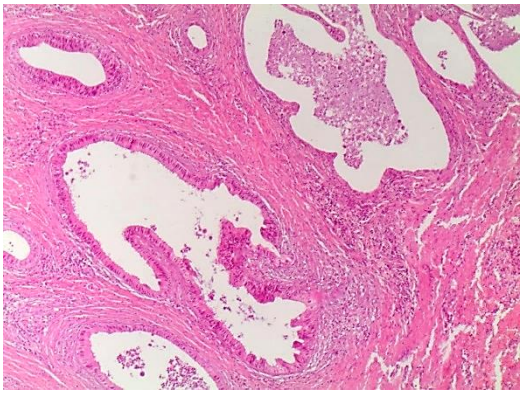
1B

Figure 1. Perifistulous tissue (H&E Stain) – superficial (1A, 40x) and deep (1B, 40x) perianal tissue fragments with extensive chronic ulcerative inflammation

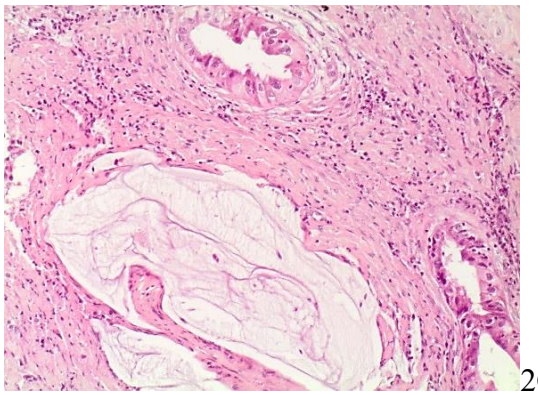
The carcinomatous proliferation consisted of well-formed, widely spaced, and diffuse infiltrative malignant glands with a morphology of moderately differentiated adenocarcinoma, involving the tissue fragments from the deep anal /perianal area (Figure 2A and 2B) and associated with marked stromal inflammatory response or variable desmoplasia, areas of necrosis and scattered extracellular mucin pools (Figure 2C).



2A



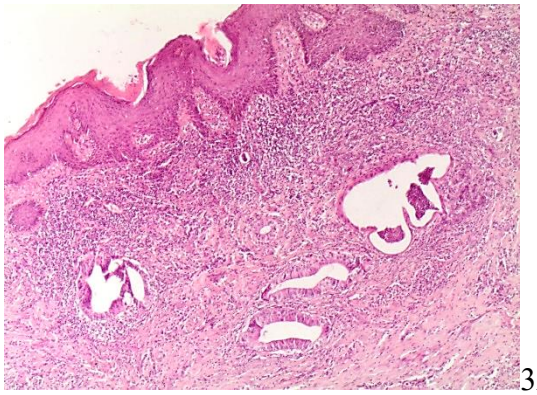
2B



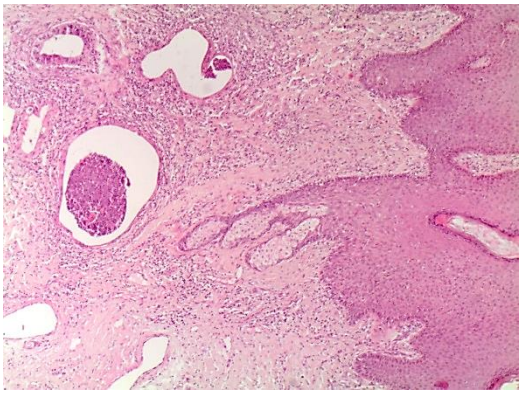
2C

Figure 2. Anal/perianal deep infiltrative moderate-differentiated adenocarcinoma (H&E Stain) – well-formed diffusely infiltrative malignant glands (2A and 2B, 40x) associated with marked stromal inflammatory response (2A, 40x) or desmoplasia (2B, 40x) and sparse extracellular mucin pools (2C, 100x)

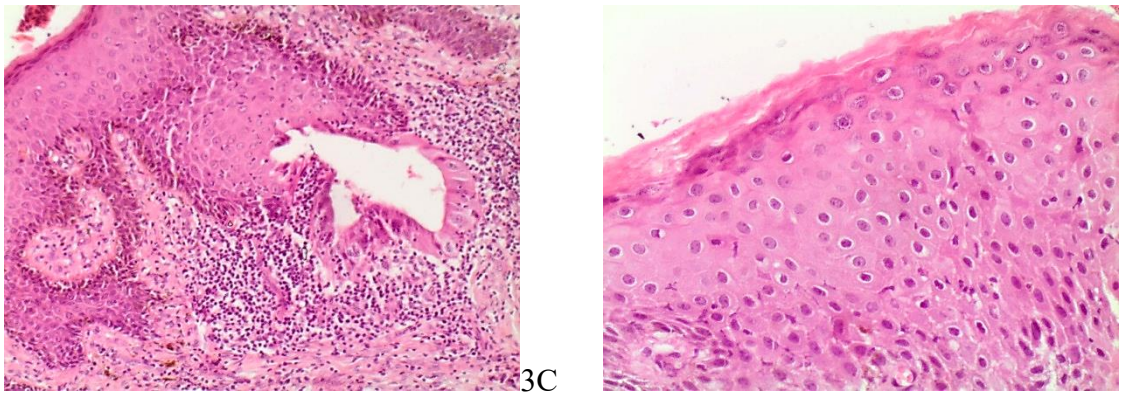
The tumor was also found extensively growing in submucosa of squamous zone of anal canal (Figure 3A, 40x) and in perianal skin (Figure 3B, 40x), abutting /invading suprajacent squamous epithelium (Figure 3C, 100x), where was associated focal squamous cell atypia suggestive for HPV cytopathic effect (3D, 200x)



3A



3B



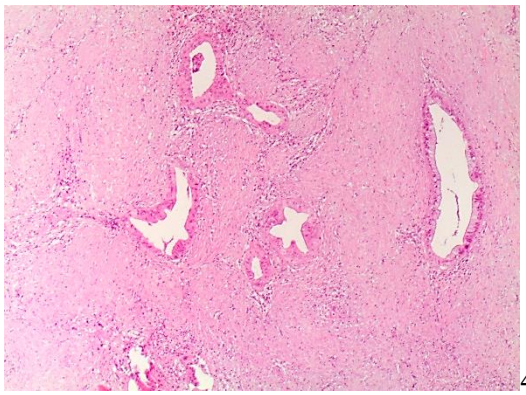
3C

3D

Figure 3. Anal/perianal superficial extensive moderate-differentiated adenocarcinoma (H&E Stain) – malignant glands growing extensive in submucosa of squamous zone of anal canal (3A, 40x) to the perianal skin (3B, 40x), abutting /invading suprajacent epithelium (3C, 100x); focal associated koilocytotic atypia (3D, 200x)

Although the overall architecture suggested at first glance a subclinical colorectal type of anal adenocarcinoma, the infiltrative/destructive growth pattern was somewhat specific for the intramural (extramucosal) type of anal canal adenocarcinoma, either of anal gland (duct) origin or fistula-associated adenocarcinoma, requiring a differential diagnostic between these two subtypes of anal adenocarcinoma. A secondary tumor extending from neighboring organs was also considered.

On close examination one found few anal gland (ducts) elements entrapped in the carcinomatous proliferation with some degree of cytological atypia but no certain evidence of malignant change (Figure 4, A and B) and without particular significance since it is already known that the diagnostic of anal (duct) adenocarcinoma does not require the evidence of continuity with histologic normal structures.


4A

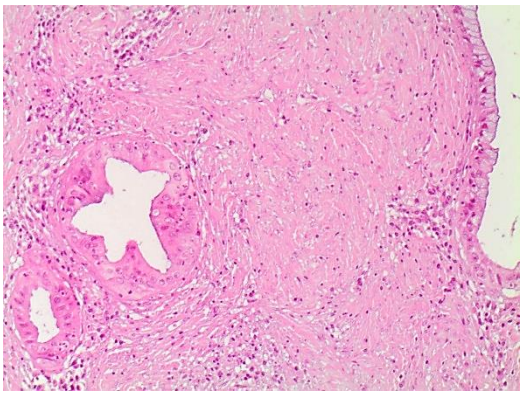

4B

Figure 4. Anal/perianal adenocarcinoma (H&E Stain) – incidental entrapped apparently anal gland (duct) elements (4A, 40x) with some degree of cytological atypia (4B, 100x)

The histopathology report mentioned an anal /perianal invasive moderately-differentiated adenocarcinoma, without specifying the histological type or whether it was primary or secondary, and definitive pathological diagnostic and classification of this anal/perianal adenocarcinoma required both the immunohistochemical evaluation on histological specimens and the imaging investigation of the anal /perianal area that are also necessary to exclude the secondary tumors as metastasis or direct extension from adjacent organs.

Reevaluating the clinical history, it was noted that the patient had been investigated for chronic perianal fistula over several years, including colonoscopy, that was unremarkable with normal appearing rectal and anal canal mucosa ruling out the suspicion of both inflammatory bowel disease and colorectal cancer.

Current native pelvic MRI investigation described a perianal intersphincteric fistulous tract measuring 1.3/0.7 cm in the axial plane and associated with postoperative distal posterior fibrous tract but without mesenteric adenopathy being inconclusive for colorectal cancer; it was also found a sigmoid diverticulum lack of inflammatory signs.

Immunohistochemical profile of tumor cells was CK20(-), CK7(+), CDX2 weakly (+) somehow similar to that of normal anal glands(ducts) / transitional zone epithelium of the anal

canal; additionally, the tumor demonstrated an index of proliferation Ki67 of 40% and also an intense p16(+) immunopositivity in almost 80% of tumoral cells, being considered a marker of chronic high-risk HPV infection.

The histopathological appearance and immunohistochemical profile of tumor supported the diagnosis of moderated-differentiated anal gland (duct) adenocarcinoma most probably HPV-dependent and excluded a colorectal type cancer. The tumoral features supporting this diagnosis were the well /moderate differentiated morphology; diffusely intramural tumoral growth extending in the submucosal layer, penetrating the sphincter musculature and reaching the perianal fat; lack the intraluminal component confirmed by imaging studies; and the presence of sparse extracellular mucin pools. We can mention that in this case the presence of the perianal fistula not associated with an inflammatory bowel disease, does not exclude the gland (duct) origin of tumor but it can be considered secondary to chronic inflammation in dilated /abscessed anal gland (ducts). It still remains to be debated whether the malignant transformation was due to the prolonged regeneration process in that inflammatory setting associated with a coincidental HPV infection, or primarily involved the HPV oncogenic effect.

Conclusion

Diagnosing and classifying the perianal /anal adenocarcinomas are important both for clinical management and prevention strategies. This clinical case draws the attention to the consequences of persistent /untreated high-risk HPV anogenital infection, including in men, and emphasizes the fact that prophylactic vaccines targeting HPV sexually transmitted infection, both in women and men, can also prevent a subset of anal/ perianal adenocarcinomas

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Lynch syndrome and Endometrial cancer. Case report

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Abstract

Lynch syndrome, also known as hereditary nonpolyposis colorectal cancer (HNPCC) syndrome is a genetic condition that involves autosomal-dominant inheritance of DNA mismatch repair genes mutations. The affected individuals are prone to early development of colorectal cancers and also cancers of different types and various locations, particularly endometrial carcinoma. In women, the Lynch syndrome accounts the majority of inherited cases of endometrial cancers, and the associated cumulative risk can exceed the risk for colorectal tumors.

We report a case of a 54 age woman presented with history of prolonged vaginal bleeding on a background of nulliparity /nulligravidity, with no evidence of cervical lesion at clinical examination; following uterine ultrasound examination, it was found an intracavitary mass arising from isthmus region and prolapsing in endocervical canal associated with markedly diffuse endometrial thickening; the uterine mass was excised and the currenting endometrial sampling was performed; the histopathological report mentioned epithelial changes consistent with endometrial atypical hyperplasia / endometrial intraepithelial neoplasia with areas suggestive for invasive carcinoma; immunohistochemical testing included searching for mismatch repair protein expression and /or microsatellite instability associated with Lynch

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syndrome following the recommendation of the National Comprehensive Cancer Network guidelines. The diagnosis was endometrial endometrioid type grade-2 carcinoma MSH6 – negative highly suggestive for high microsatellite instability MSI-H / Lynch syndrome.

In addition to its therapeutic value, diagnosing Lynch syndrome is important both for the patient and its family members as it involves detection, preventive and /or screening measures for concurrent, developing or incidental cancers and also additionally genetic counselling.

Key words: Lynch syndrome, endometrial carcinoma, clinicopathological inference

Introduction

Lynch syndrome (LS) or hereditary nonpolyposis colorectal cancer (HNPCC) syndrome represents a genetic condition due to defective DNA mismatch repair (dMMR) affecting the 4 LS-associated DNA mismatch repair (MMR) genes - hMLH1, hMSH2, hMSH6, and hPMS2. In the vast majority of cases, it is an autosomal inherited condition related to a predisposition to colorectal cancer (CRC), endometrial cancers (EC) and other cancers in various anatomic sites, while de novo such genetic alteration are very rare (2.3%) (Win, et al., 2011). The estimated overall life time risk for cancer in patients with LS is nearly 80% (Stoffel, et al., 2009).

The MMR-deficient tumor phenotype accounts for 17–33% of all endometrial cancers (Colle & Cohen, 2019) and is frequently found in patients with germinal mutations (Lynch syndrome) (Meyer, et al., 2009) while the sporadic tumors called MMRd or Lynch syndrome-like tumors are rare (Fishel & Kolodner, 1995). Over 90% of diagnosed Lynch syndrome cases demonstrate germline mutations in MLH1 and MSH2, but the women with MSH6 mutation are at higher risk (64–71%) for developing endometrial cancer than those with MSH2 or MLH1 mutations (40–50%) (Hendriks, et all., 2004).

In women with Lynch Syndrome, there is a 40-60% chance of being first diagnosed with endometrial cancer which has proven to be the most common extracolonic sentinel cancer, particularly manifested as irregular vaginal bleeding but without history of endometrial hyperplasia and most often with no associated evidence of estrogen overstimulation such as

obesity, diabetes, exogenous estrogen usage, and polycystic ovarian syndrome; it tends to associate early age of onset (45-55years), presence of multiple and/or bilateral primary cancers, and multiple affected family members (Lu, et al., 2005; Zhao, et al., 2022; Wang, et al., 2013; Garber & Offit, 2005); essentially, a positive family history of Lynch Syndrome or presence of other Lynch Syndrome related cancers raise the suspicion of Lynch Syndrome associated endometrial cancer (Chen, et al., 2006).

MMR-deficient tumors are known to demonstrate some distinctive histopathological features such as: lower uterine segment origin; carcinoma of endometrioid type without hyperplastic endometrium in the background or with poorly differentiated / undifferentiated component; high morphological heterogeneity; high tumor-infiltrating and /or peritumoral lymphocytic response; deeper myometrial invasion, including FIGO grade 1 endometrioid carcinoma but with more than 50% myometrial invasion; frequent lymphovascular invasion; synchronous ovarian cancer (Santoro, et al., 2021; Addante, et al., 2024; Wang, et al., 2013) while other authors have found that a relatively high proportion (58%) of endometrial cancers LS-related do not exhibit such morphological features (Mills, et al., 2014). The most frequently encountered histotypes are undifferentiated/dedifferentiated carcinoma (44%), neuroendocrine carcinoma (42.9%) endometrioid carcinoma high-grade and low-grade (39.7% and 24.7% respectively), mixed variants (33.3%), clear-cell carcinoma (9.8%) and carcinosarcoma (7.3%) (Addante, et al., 2024).

The specific phenotype of MMRd tumors can be identified by immunohistochemistry on pathologic tissue specimens. The evaluation of MMRd and /or MSI in endometrial cancer has proven its importance for Lynch Syndrome screening, histomolecular diagnosis, risk stratification and immunotherapy response (Concin, et al., 2021). Since 2018, the National Comprehensive Cancer Network guidelines recommend universal testing of all endometrial cancers for MSI/MMRd tumors (Koh, et al., 2018). Recently, according to the new ProMisE (Proactive Molecular Risk Classifier for Endometrial Cancer) molecular classification system based on The Cancer Genome Atlas genomic subgroups, endometrial cancers were divided in 4 prognostic subgroups with distinct overall, disease-specific, and progression-free survival (Talhouk, et al., 2017), namely i) POLE-mutated (POLEmut), ii) MMR-deficient (MMRd), both low-grade and high-grade endometrioid endometrial carcinomas (EECs), comprehensively presenting an intermediate prognosis, iii) p53-abnormal (p53abn) and iv) no specific molecular

profile (NSMP), using the immunohistochemical testing for POL-E (DNA polymerase epsilon) mutations, p53 mutations and DNA mismatch repair genes (MLH1, MSH2, MSH6, PMS2) germline mutation in addition to the other known markers as estrogen receptor, progesterone receptor, HER-2 oncoprotein and ki-67 (proliferative index) (Li, et al., 2013). The intermediate prognosis group include microsatellite instability (MSI) or mismatch repair deficient tumors (MMRd) that represent 17-33% of all endometrial cancers (Colle & Cohen, 2019) frequently diagnosed in patients with Lynch syndrome (Meyer, et al., 2009).

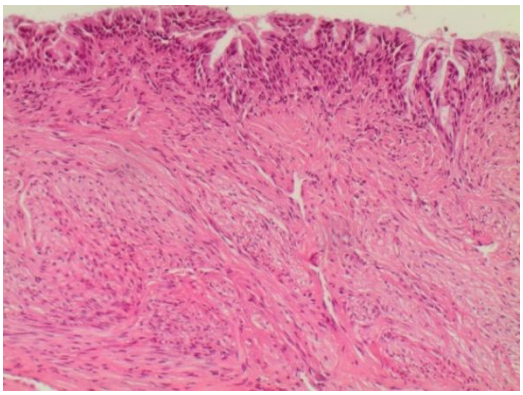
The most important screening measure for Lynch Syndrome consists in pathological evaluation of any newly diagnosed endometrial cancer and is essential for the clinical management of disease, the identification of positive family members and for the development of surveillance strategies (Capasso, et al., 2023). Accordingly, the Surveillance and prophylactic measures currently recommended by European (ESGO/ESTRO/ESP) and American (NCCN) societies have demonstrated significant cancer risk decrease and survival improvement in these patients (NCCN Guidelines®, 2022; Concin, et al., 2021)

Case presentation

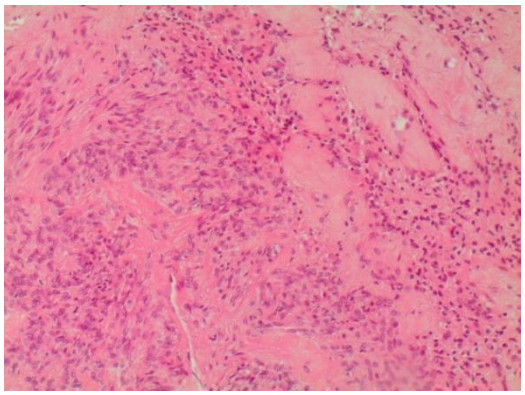
We report a case of 54 aged woman without any previous gynecological examination presented with a history of prolonged vaginal bleeding described as heavy menstrual bleeding and with no evidence of cervical lesion at clinical examination. The history of nulliparity /nulligravidity was the only clinical evidence of hyperstrogenism and the patient did not report any known cancer case among its relatives.

The initial investigation was uterine ultrasonography which revealed an intracavitary smooth pedunculated solid mass approximately 34mm in diameter with isthmic insertion and endocervical expansion associated with diffuse and significant endometrial thickening up to 18mm and secondary abundant hematometry. Excision of the uterine mass and endometrial sampling were required as the first diagnostic step.

The pathological report mentioned the diagnostic of non-atypical uterine leiomyoma for the intracavitary mass (Figure 1, A and B).



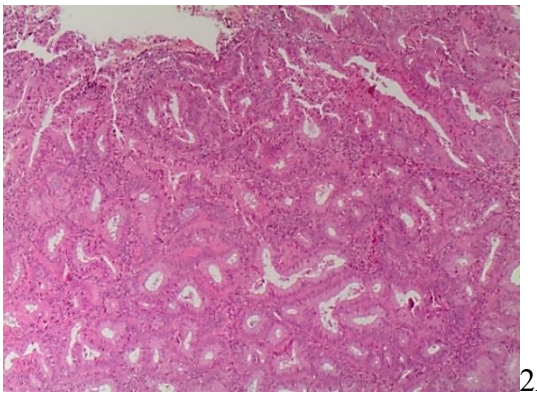
1A



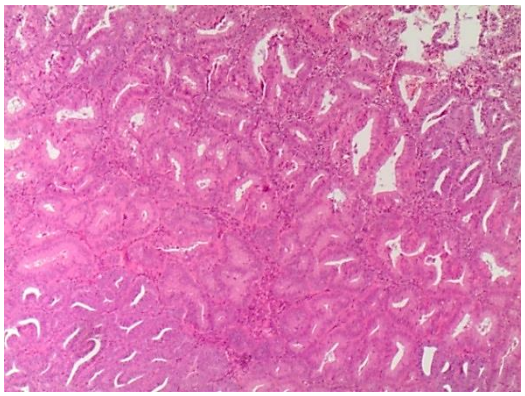
2B

Figure 1. Leiomyoma (H&E Stain) – non-atypical fasciculate smooth muscle proliferation, covered by endocervical – low uterine segment, junctional mucosa (1A, 40x) with variable interstitial hyalinization (1B, 100x)

For endometrial biopsy fragments it was described the extensive replacement of normal endometrium by abnormal overgrowth of frequent atypical endometrial glands suggestive for atypical hyperplasia (AEH) /intraepithelial neoplasia (EIN, including well-differentiated carcinoma) associated with areas suggestive for carcinomatous transformation; there was no areas of normal endometrium in all examined fragments (Figure 2, A and B)



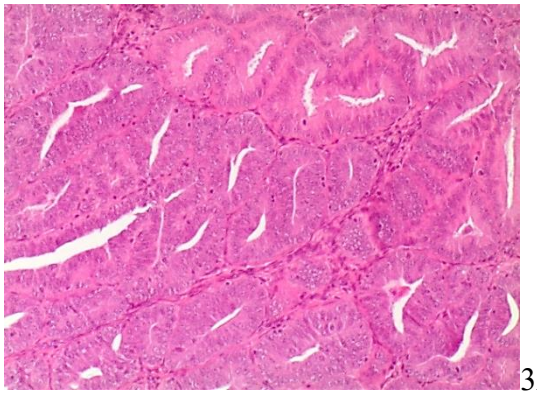
2A



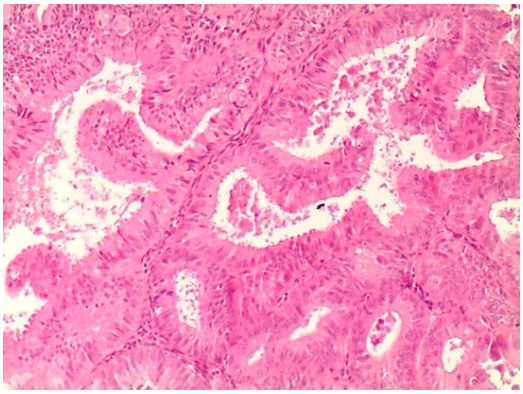
2B

Figure 2. AEH /EIN (H&E Stain) - extensive endometrial hyperplastic /neoplastic changes with variable degree of architectural and cytological atypia (2A and 2B, 40X)

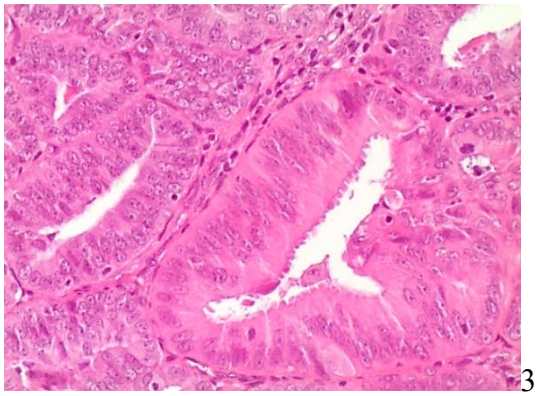
The overall architecture was complex with closely packed often back-to-back tubular, stellate, irregular or branching glands and associated epithelial atypia consisting in elongated or rounded nuclei with increased nuclear: cytoplasmatic ratio, chromatin coarsening and prominent nucleoli, loss of polarity or stratification and presence of mitoses (Figure 3, A, B and C)



3A



3B

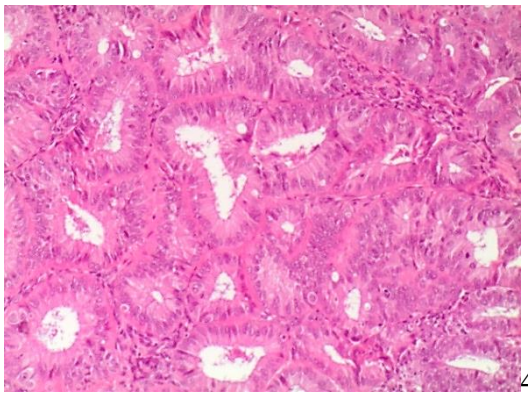


3C

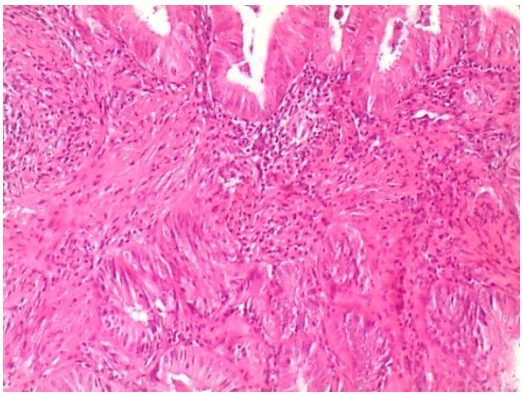
Figure 3. AEH /EIN (H&E Stain) - from areas to areas, markedly crowded glands with little or minimal intervening stroma (3A and 3B, 100x) and increasing cytologic atypia, with mitoses (3C, 200x)

Often the grade of cytoarchitectural atypia increased with depth being also observed features favoring low grade (well and moderately differentiated) endometrioid type carcinoma such as markedly epithelial atypia, increased mitoses including atypical figures, areas of confluent growth with cribriform appearance, apparent desmoplastic stromal response adjacent

to atypical glands, apparent myometrial invasion with the presence of atypical glands adjacent or between smooth muscular fibers and small foci of necrosis (Figure 4, A and B)



4A



4B

Figure 4. AEH /EIN (H&E Stain) with features suggestive for carcinomatous transformation – cribriform structures (4A, 100x) and myometrial invasion (4B, 200x)

Immunohistochemical testing was performed for both diagnostic certainty and prognostic and therapeutic parameters, and followed the recent recommendations of National Comprehensive Cancer Network guidelines for universal testing of all endometrial cancers for MSI/MMRd tumors given the relatively young age of patient and the extensive endometrial involvement. Therefore, a suitable panel of markers was investigated, and the result were as follows: i) ER – heterogenous positive staining in neoplastic cells (invasive and EAH/EIN areas); ii) PgR – negative expression in tumoral cells; positive in EAH /EIN areas; iii) P16 (tumor suppressor protein p16INK4a) – patchy cytoplasmic and /or nuclear positive staining in tumoral cells; iv) P53 (transformation-related protein 53 or tumor suppressor protein p53) – nuclear staining with mosaic pattern in rare tumoral cells, wild-type; v) pMS2 (mismatch repair endonuclease) – intact nuclear staining in tumoral cells; vi) MSH6 (DNA mismatch repair protein) – negative nuclear staining in tumoral cells; vii) Ki-67 (cell proliferation index) – up to 40% in hot-spot areas.

The identified tumoral immunophenotype was strongly suggestive for endometrioid type grade 2 endometrial carcinomas related to high microsatellite instability (MSI-H) or Lynch syndrome. It should be noted that the initial diagnosis of endometrial carcinoma in terms of

histological type and tumor grade may not be entirely consistent with the tumor features in the hysterectomy specimen that will be evaluated for other parameters of prognostic importance such as depth of myometrial invasion, lymphovascular invasion and tumor related lymphocytic response.

As a result, the patient was referred for total hysterectomy with bilateral adnexectomy (for complete diagnostic and possible associated ovarian cancer) and also for further investigations for synchronous tumors (especially colorectal cancer).

Conclusion

Diagnosing Lynch syndrome in patients with endometrial cancer is of crucial importance for secondary cancer risk management for patient and also for identifying family members with incidental cancer or at cancer risk. In addition, obtaining a complete family history of over time occurrence of Lynch syndrome-related cancers in relatives is essential for further surveillance and family genetic counseling.

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Robotic Technologies in Midwifery Practice

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Metin Yıldız[23]

Abstract

Today, the shortage of midwives, combined with increasing patient numbers, is negatively affecting the quality of care.Therefore, the use of artificial intelligence and robotic technologies is becoming increasingly important in midwifery practices to save time and energy, provide rapid access to vital signs, and monitor multiple patients simultaneously. Additionally, these systems support clinical decision-making processes, contributing to the establishment of accurate diagnoses and effective care plans. On the other hand, the fact that robots can work more efficiently than midwives in certain areas, the implementation of care practices through machines, and the disregard for human values can raise ethical and professional concerns. Therefore, it is important to use artificial intelligence and robotic technologies in midwifery with a human-centered approach.

This study aims to examine the potential benefits and limitations of artificial intelligence and robotic technologies in midwifery, as well as the ethical issues involved.

Keywords: Midwifery, Robotic technology, Artificial intelligence.

INTRODUCTION

According to World Health Organization (WHO) projections, the proportion of individuals aged 60 and over in the total population is expected to rise from 12% to 22% between 2015 and 2050(Uyanık et aL). These data reveal that the elderly population is rapidly increasing on a global scale and that the demand for healthcare services will increase accordingly. Therefore, health, social, and economic systems must be prepared to adapt to this demographic change.

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The nursing profession involves planning, organizing, supervising, and evaluating patient care, as well as administering treatments prescribed in writing by a physician, except in emergency (Yıllığı, 2021). However, the increase in the elderly population further increases the need for human resources in healthcare services and increases the burden on existing staff. In this context, the concept of artificial intelligence is gaining importance. Artificial intelligence is defined as the modeling of human intelligence using technological tools and the development of systems capable of making logical-mathematical (Topakkaya & Eyibaş, 2019). In recent years, some countries have developed technologies that can interact with humans, such as artificial intelligence-based robots. It is stated that these systems can make a significant contribution to alleviating problems that may arise from a shortage of healthcare workers (Zhao et al., 2022). According to global projections, the demand for healthcare professionals is expected to reach approximately twice the current number by 2060. Innovative solutions are needed to meet this increase (Leonardsen et al., 2023). Among these solutions, the integration of artificial intelligence and robotic systems into the healthcare sector is particularly noteworthy. Since 2013, rapid development has been observed in this field, and AI-based robots have begun to be used in healthcare(Barrat, 2023). Today, artificial intelligence and robotic technologies, one of its application areas, play an important role in healthcare services (Jiang et al., 2017).The use of artificial intelligence and robotic technologies in healthcare contributes to the advancement of care services and is seen as the beginning of a transformation in the midwifery profession.

The purpose of this compilation is to evaluate the advantages, disadvantages, and ethical issues of artificial intelligence and robotic technologies in the midwifery profession.

Artificial Intelligence in Midwifery

Technology consists of knowledge and skill processes that enable existing and newly developed products to emerge in a higher quality, more qualified, and more economical manner. These innovations, which can be referred to as “needs-based technologies” today, have also begun to be widely used in the healthcare sector. Artificial intelligence enables applications to be executed faster, more effectively, and at lower cost thanks to its capabilities for analysis, learning, and problem-solving.

Artificial intelligence and robotic technologies in midwifery, while a relatively new development, are becoming increasingly important in healthcare systems. These technologies have the potential to become an indispensable tool in professional midwifery in the future, thanks to their features that support care (Büyükgöze, 2019);(Thuemmler, 2017).

Robotic Technologies Used in Midwifery

Da Vinci

During surgery, robotic systems and artificial intelligence-supported technologies assist surgeons, increasing their effectiveness while reducing the workload of nurses in the operating room and lowering the risk of human error(Locsin & Ito, 2018).

Xenex

These technologies, used in various healthcare applications, contribute to the elimination of microorganisms, thereby reducing the incidence of hospital-acquired infections (MacFie & McNaught, 2019).

Robot Cody

Patients' daily care needs, such as bathing in bed, dressing, and mobilization, are facilitated by artificial intelligence and robotic systems. The camera and laser technologies incorporated into these systems enable the identification of which areas of the patient require special cleaning(Kandemir et al., 2023).

Ro-bear

This AI-powered system is a tool that assists healthcare personnel in physically demanding tasks such as transferring patients from a wheelchair to a bed (MacFie & McNaught, 2019).

SAM

This robot has advanced navigation capabilities, visits patients' rooms at regular intervals to monitor their condition, supports care processes with its training capacity, and can assess patients for fall risk (Merih & Akdoğan, 2021).

TUG

These robots used in healthcare facilities perform tasks in material handling and logistics processes; they transport medicines, medical supplies, and laboratory samples, contribute to the safe storage and management of medical waste, and can provide services such as meal delivery to patients (Akgerman et al., 2022).

Paro Terapi

These robots, used particularly in nursing homes and hospitals, provide emotional support to patients and contribute to their psychosocial well-being by increasing social interaction(Akyazı & Baştemur, 2024).

IV Robot

RIVA is a technology that ensures intravenous medications are prepared in the correct dosage and administered safely(Şendir et al., 2019).

Robot Grace

This robot, used in highly contagious pandemic situations such as COVID-19, enables the monitoring of patients' vital signs and can also provide supportive services such as speech therapy to patients (Merih & Akdoğan, 2021).

Veebot

It is a technology that can perform blood collection by identifying the most suitable vein in the patient with an 83% accuracy rate(Lin et al., 2022)

The Advantages of Artificial Intelligence and Robotics in Midwifery

It has been observed that the number of nurses and midwives worldwide is insufficient to effectively meet healthcare needs. This deficiency has negative effects on health outcomes. A study in the literature reports that an increase in the number of patients per midwife both raises patient mortality and leads to an increase in the burnout rate among midwives(Saraee et al., 2017). The use of artificial intelligence and robotic technologies in midwifery practice increases the effectiveness and efficiency of services while significantly reducing the workload of midwives(Robert, 2019; Şendir et al., 2019). This situation allows midwives to save time and

energy, enabling them to focus more on their primary tasks of providing care and therapeutic communication. As a result, while the quality of patient care and health outcomes improve, an increase in midwives' professional satisfaction levels is also observed (Clipper et al., 2018). Midwives are often at risk of physical injury due to intense and demanding working conditions.

The use of robotic technology helps reduce the physical strain on midwives, thereby contributing to a decrease in such injury rates (Saadatzi et al., 2020). Another important advantage of artificial intelligence is that it supports midwives in the process of making accurate clinical diagnoses. According to studies in the literature, when artificial intelligence support is used, the rates of midwives and physicians making correct clinical diagnoses have increased by 12% and 10%, respectively(Kalil et al., 2018; Karal & Turan, 2021; Özdemir & Bilgin, 2021). Artificial intelligence-supported decision systems enable faster and more accurate assessment of complex clinical situations; they facilitate the creation of personalized treatment plans by providing evidence-based recommendations. This approach contributes to the more effective and safer delivery of patient care and treatment (Martinez-Ortigosa et al., 2023). Drug safety is of critical importance in patient safety and the preservation of health. Midwives, who play a significant role in healthcare services, devote a large portion of their working hours to drug administration. As reported in the literature, medication errors rank first among the most common errors encountered by midwives in their professional lives(Yöntem et al., 2019). A study conducted by Juhl et al. (2022) demonstrated that artificial intelligence technologies have significant effects on drug safety. The study found that artificial intelligence-supported systems can reduce medication errors, guide nurses in managing medications for patients undergoing treatment in different clinics, and increase overall safety. Additionally, thanks to artificial intelligence systems, patients' vital signs such as blood pressure, respiratory rate, oxygen saturation, and heart rate can be continuously monitored, and abnormal conditions can be reported to nurses in real time (Robbins et al., 2017). Early warning systems play a critical role in units where patients' vital signs are continuously monitored, such as intensive care units and emergency departments.

These systems help to quickly detect emergencies while also contributing to increased patient survival rates (Ajerla et al., 2019; Kunt et al., 2021; Smith et al., 2014).

Disadvantages of Artificial Intelligence and Robotics in Midwifery

Artificial intelligence and robotic technologies are considered a threat to the midwifery profession because they have the potential to perform better than humans in certain situations. Robotic systems producing more efficient and effective results than midwives may lead to certain care practices being performed by machines. However, these machines cannot fully replicate the subjective, variable, and particularly individual, humanistic, and holistic qualities of humans; therefore, they cannot completely replace human-based care (Economist, 2016). The humanist approach recognizes that humans are unique beings and emphasizes respect for the individual's beliefs, dignity, rights, and freedoms.The holistic approach aims to address the individual, their family, their environment, and all their needs in a comprehensive manner.

These two approaches form the basis of midwifery philosophy. Artificial intelligence and robotic technologies, however, cannot fully meet the requirements of contemporary midwifery philosophy because they do not embody the humanistic and holistic values found in humans. The use of robotic systems in healthcare raises the issue that legal liability and compensation in cases such as malpractice have not yet been clearly determined (Bacaksız et al., 2020). At the same time, robotic intelligence may not prioritize ethical issues such as patient privacy and data security.

Ethical Issues in the Use of Artificial Intelligence in Midwifery

Today, people are constantly acquiring new knowledge and expanding their knowledge base through personal experiences; this learning process is an area where artificial intelligence cannot yet fully compete. The main reason for this is that artificial intelligence does not yet have the capacity to learn on its own and create new contexts. Therefore, artificial intelligence systems are still dependent on human intervention (Ai, 2018; Güvercin, 2020). The mechanical structure of robots equipped with artificial intelligence makes it impossible for them to take responsibility in adverse situations arising from potential malfunctions or misuse.

Determining legal and criminal liability in an incident involving a robot is a complex process; responsibility may be assigned to different actors such as the manufacturer, programmer, or technician. This situation highlights the limitations of robotic systems in terms of accountability (Güvercin, 2020; Lin et al., 2011; Van Wynsberghe, 2016). In the healthcare sector, the use of robots that provide care to vulnerable groups such as patients, the elderly, and children raises

concerns due to safety and risk of harm. To prevent these risks, technical solutions are needed that will eliminate unpredictable behavior in robots and reduce or minimize security vulnerabilities (Rigby, 2019). Artificial intelligence and robotic technologies continue to develop rapidly, but they can also give rise to new risks that are not yet fully predictable. The development of these technologies in a manner that is secure, transparent, accountable, and meets the needs of humanity; as well as ensuring their use in accordance with ethical values, requires international consensus, a legal framework, and ethical regulations (Güvercin, 2020).

CONCLUSİON

The use of artificial intelligence and robot technology in healthcare services presents significant opportunities for reducing the workload in nursing care and improving service quality. However, ethical principles and the protection of patient privacy should be among the fundamental priorities of the process.Nurses' adaptation to emerging technologies, their continued patient-centered approach, and the integration of these innovations into educational programs will play a critical role in enhancing the quality of nursing care in the future.

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THE ECONOMİC IMPACT OF ARTIFICIAL INTELLIGENCE (AI) IN THE HEALTH SECTOR

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Abstract

AI enhances efficiency in diagnosis, treatment planning, and patient management through components such as machine learning, deep learning, and big data analytics. According to the literature, AI not only improves clinical accuracy but also contributes to cost-effectiveness, resource optimization, and enhanced service quality in healthcare. Furthermore, AI investments promote innovation in the health technology industry, creating employment growth and economic growth. However, high investment costs, ethical issues, and digital inequalities are emerging as factors limiting the sustainability of these technologies. As a result, AI is considered a strategic element that creates transformation in the healthcare sector from both clinical and economic perspectives. This review study was written to examine the economic impacts of artificial intelligence (AI) technologies in the healthcare sector.

Keywords: Artificial intelligence, health, economy

INTRODUCTION:

One of the areas where digital transformation has been most intensely felt in recent years is the healthcare sector. With the advancement of artificial intelligence (AI) technologies, the delivery of healthcare services, decision-making processes, and patient monitoring mechanisms are undergoing a fundamental transformation. AI uses big data analysis, machine learning (ML), and deep learning (DL) techniques to extract meaningful results from complex clinical data,

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thereby providing significant support to physicians in diagnosis, treatment, and disease management. (Fahim, Hasani, Kabba, & Ragab, 2025)

One of the most significant contributions of artificial intelligence in the healthcare field is the improvement of diagnostic accuracy and speed. In imaging-intensive fields such as radiology, pathology, and dermatology, algorithms can detect diseases with accuracy comparable to human experts, and in some cases even higher.(Hou et al., 2024) Additionally, AI-based clinical decision support systems are used in numerous clinical applications, such as identifying drug interactions, creating personalized treatment plans, and improving early diagnosis processes. (Younis et al., 2024)

However, the integration of artificial intelligence into the healthcare sector is not limited to technical developments. Issues such as data privacy, ethical responsibility, algorithmic bias, and explainability are also gaining increasing importance. (Prentzas, Kakas, & Pattichis, 2023). In particular, the “explainable artificial intelligence” (XAI) approach contributes to clinicians' understanding of model decisions and increasing patient confidence. This strengthens physician-machine collaboration, facilitating the sustainable use of AI in healthcare. (Al-Shatnawi, Hayat Sulieman Abu-Shaikha, & Momani, 2025)

In general, artificial intelligence attracts attention with its potential to reduce costs, increase patient satisfaction, and lighten the workload of healthcare professionals in healthcare services. However, issues such as legal regulations, data security, and system integration in transferring algorithmic decisions to the clinical environment are still important areas awaiting resolution. Therefore, systematically examining the effects of AI in the healthcare sector is important for understanding both its current gains and limitations (Buess, Keicher, Navab, Maier, & Tayebi Arasteh, 2025). The purpose of this review is to highlight the economic effects of artificial intelligence on the healthcare sector.

ARTIFICIAL INTELLIGENCE:

The definition of artificial intelligence in the literature is constantly evolving in line with technological advances. Artificial intelligence can be defined as the capacity of a computer or computer-assisted system to perform tasks that normally require human intelligence. This concept refers to all efforts aimed at enabling machines to acquire cognitive skills such as reasoning, inference, learning from experience, and adapting to new situations.

Concepts such as data, algorithm, and machine learning are among the most frequently used. An algorithm is defined as the process of solving a problem and reaching a conclusion quickly through the sequential application of rules and operations, while machine learning is a data analysis method that automates the creation of analytical models.(Öznur & Gezer, 2025)

Artificial intelligence technologies are defined as systems that can act in a way that maximizes the probability of achieving a specific goal by analyzing data obtained from their environment. These technologies include subfields such as machine learning, deep learning, rule-based systems, natural language processing, and speech recognition. Artificial intelligence, which has attracted varying levels of interest throughout history, has gained significant momentum again today and has become central to digital transformation. With the development of Web 3.0, the Internet of Things (IoT), open innovation, big data, and open data approaches, artificial intelligence is pioneering fundamental changes in many sectors, such as finance, automotive, retail, travel, and media. The healthcare sector has also become one of the areas most affected by this transformation.(Sun & Medaglia, 2019) .

ARTIFICIAL INTELLIGENCE TECHNOLOGIES IN HEALTHCARE:

The first initiatives in medical artificial intelligence date back to the early 1970s, when the technology was still in its infancy. The term “artificial intelligence” was first coined in 1955 by John McCarthy at a conference held at Dartmouth College, entering scientific literature. The pioneering work carried out during this period aimed to explore the potential for applying artificial intelligence methods to the life sciences. Contributions from computer scientists such as Edward Feigenbaum, chemists such as Carl Djerassi, geneticists such as Joshua Lederberg, and philosophers of science such as Bruce Buchanan laid the foundations for artificial intelligence research in medicine.(Patel et al., 2009).

The AI market in healthcare is projected to reach $17.8 billion between 2019 and 2025, with AI-powered virtual nurses estimated to save $20 billion annually. AI-powered robotics are valued at $40 billion,(Dicuonzo, Donofrio, Fusco, & Shini, 2023; Marr, 2018) and the increase in healthcare-focused agreements from 20 in 2012 to 70 in 2016 (He et al., 2019), indicate that the use of AI in the healthcare sector has increased significantly and that this trend will continue.

AI applications in the healthcare sector offer significant opportunities and benefits to everyone from healthcare professionals to patients, and from healthcare providers to researchers (He et al., 2019). AI in healthcare has two main branches, namely virtual and physical, which refer to its modes of application. The virtual branch refers to subcomponents such as machine learning and deep learning. The physical branch refers to physical objects, medical devices, and robots (Hamet & Tremblay, 2017). In other words, the virtual part uses electronic health record systems that utilize various sensors to make treatment decisions, while the physical part assists robots in performing procedures such as surgeries, implants, organ replacements, elderly care, etc (Bindra & Jain, 2024).

Artificial intelligence technologies in healthcare enable multidimensional data analysis, offering revolutionary innovations in processes such as diagnosis, treatment planning, risk prediction, and patient management. These technologies are based on machine learning (ML), deep learning (DL), natural language processing (NLP), speech recognition, image processing, and rule-based expert systems (Fahim et al., 2025). Machine learning algorithms extract patterns from large-scale clinical data, providing high accuracy in disease prediction and decision support mechanisms. Deep learning models, on the other hand, deliver effective results in detecting cancer, infections, and neurological diseases, particularly in image-intensive fields such as radiology, pathology, and dermatology (Hou et al., 2024).

Natural language processing techniques accelerate access to information by interpreting text-based data such as physician notes, patient histories, and electronic health records (Buess et al., 2025). However, explainable artificial intelligence (XAI) approaches increase clinicians' confidence by making models' decision processes more transparent and provide an important framework for ethical use (Prentzas et al., 2023). Large language models (LLMs) and generative artificial intelligence applications, which have developed in recent years, are also opening new horizons in medicine for reporting, medical education, and clinical decision support systems (Buess et al., 2025) . Therefore, artificial intelligence technologies are both improving the quality of healthcare services and creating a turning point that strengthens human-machine collaboration in clinical processes.

THE BENEFITS OF ARTIFICIAL INTELLIGENCE TECHNOLOGIES IN HEALTHCARE:

Artificial intelligence (AI) technologies play a significant role in the transformation of modern medicine by increasing the effectiveness, accuracy, and accessibility of healthcare services. Clinical decision support systems facilitate early diagnosis of diseases, reduce misdiagnosis rates, and enhance patient safety through big data analytics.

AI offers numerous advantages in the healthcare sector. For example, it plays a significant role in transforming modern medicine by increasing the efficiency, accuracy, and accessibility of healthcare services. Clinical decision support systems facilitate early diagnosis of diseases, reduce misdiagnosis rates, and enhance patient safety through big data analysis..(Hassani, Huang, & Silva, 2019) It also helps shorten treatment times. It is known that shorter treatment times will provide significant benefits for patients' mental health. With the development of artificial intelligence technologies, it is predicted that traditional drug production and treatment approaches will be replaced by treatment methods designed according to the genetic characteristics of the individual. This process strengthens the concept of personalized medicine by enabling the development of drugs specific to each individual's DNA. This approach in healthcare is generally referred to as precision medicine (Yeasmin, 2019). In addition, researchers at the Max Planck Institute are conducting experiments on robots smaller than a millimeter that can float in a patient's body fluids and be used to deliver drugs or other medical assistance. These micro-robots, which are expected to revolutionize medical history, are said to be designed to float in human blood circulation or on the surface of the eyeball.(Sunarti et al., 2021)

Another significant benefit of AI technologies is their potential to reduce inequalities in access to healthcare. Cloud-based artificial intelligence systems enhance the inclusivity of healthcare services by providing expert support to clinics in resource-poor regions. (Rajkomar, Dean, & Kohane, 2019). Additionally, natural language processing (NLP)-based applications simplify the management of electronic health records (EHR), reducing the administrative burden on healthcare professionals and strengthening patient-physician communication(Buess et al., 2025). Furthermore, AI-powered early warning systems contribute to the early detection of critical conditions such as sepsis, heart failure, or COVID-19, thereby reducing mortality rates(Li et al., 2024). In all these aspects, artificial intelligence is considered a multifaceted tool

that enhances quality in healthcare, reduces costs, and strengthens a patient-centered approach to care.

THE ECONOMIC BENEFITS OF USING ARTIFICIAL INTELLIGENCE IN HEALTHCARE:

Artificial intelligence (AI) applications significantly increase not only clinical effectiveness but also economic efficiency in healthcare services. AI-based systems used particularly in diagnosis and treatment processes reduce unnecessary examination and treatment costs by lowering misdiagnosis rates, thereby optimizing resource utilization in healthcare institutions (Topol, 2019). Machine learning and deep learning algorithms work with high accuracy rates in the early diagnosis of diseases, thereby improving the quality of patient care and reducing long-term treatment costs (Buess et al., 2025). This situation is considered a concrete example of the principle of cost-effectiveness in health economics.

One of the most significant economic contributions of AI technologies is the increase in workforce productivity. The automation of routine administrative tasks, the acceleration of clinical documentation processes, and the analysis of electronic health records using natural language processing (NLP) enable healthcare professionals to save time(Meskó & Topol, 2023). This allows physicians to treat more patients and increases healthcare service delivery capacity. In addition, AI-based resource planning systems reduce overall operating costs by decreasing hospital stay lengths and intensive care unit utilization rates(Tatomir, 2024).

AI offers significant potential for advancement in patient care and reduction in healthcare costs. The healthcare sector needs innovative solutions to find ways to be more effective and efficient without overspending. The current state of technology points precisely to this area, AI. Rapid developments in technology, particularly in the fields of AI and robotics, are helping to complete the healthcare sector (Sunarti et al., 2021).

CONCLUSION:

Artificial intelligence technologies are fundamentally transforming not only the clinical operations of the healthcare sector but also its economic structure. The literature reviewed in this compilation clearly demonstrates that AI provides cost-effectiveness, increased efficiency,

and optimization of resource utilization in healthcare services. Factors such as accelerated diagnosis and treatment processes, reduced error rates, and lighter workloads for healthcare professionals strengthen the economic performance of healthcare institutions.

At the macro level, AI investments encourage innovation in the healthcare technology market, expand employment opportunities, and contribute directly to economic growth. The increase in digital health investments, particularly through venture capital and public-private partnerships, supports the sustainability of the health economy. However, for these developments to provide lasting benefits in the long term, robust policies based on ethical, legal, and data security foundations must be established.

In conclusion, artificial intelligence is a transformative tool that enhances quality, reduces costs, and boosts economic competitiveness on a global scale in healthcare services. In the future, it is predicted that the more comprehensive integration of AI into healthcare systems will increase both clinical and economic gains. However, the equitable distribution of technological investments, the reduction of digital inequalities, and the preservation of ethical standards are seen as key factors that will determine the sustainability of this transformation.

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Economic Contributions of Technology Use in Health

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Abstract

The use of technology in healthcare has led to significant changes in healthcare systems in recent years. This change has resulted in both an increase in service quality and economic efficiency. Thanks to technological innovations, significant developments have been made in areas such as early diagnosis, accurate treatment methods and remote healthcare services. Electronic health records, artificial intelligence-supported analyses and telemedicine applications contribute to the more effective and sustainable operation of healthcare systems. These developments have brought economic gains such as reduced healthcare expenditure, increased workforce productivity and more efficient use of resources. This review was prepared to examine the economic contributions of technological use in healthcare services and its efficiency-enhancing effects on service delivery.

Keywords: Health, Use of Technology, Economy

Introductıon:

Today, healthcare systems are under increasing pressure due to factors such as population growth, ageing societies, the spread of chronic diseases and limited resources. This situation threatens the sustainability of healthcare services while also increasing the need for more efficient, accessible and cost-effective solutions (Paris et al., 2017). Technological advances have paved the way for transformation in healthcare, leading to fundamental changes in diagnosis, treatment, monitoring and management processes. Artificial intelligence-supported analyses, electronic health record systems, remote healthcare services (telemedicine) and mobile health applications are technological tools that enhance the quality and accessibility of healthcare services while also contributing to cost reduction (Organization, 2025a; Scott Kruse

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et al., 2018). The economic contributions of health technologies are not limited to reducing costs. These technologies also increase labour productivity, support the efficient use of resources, and facilitate the management processes of healthcare services (Topol, 2019). Electronic health records enable easy access to patient information, facilitating faster diagnosis and treatment processes and reducing the need for repeat tests (Buntin et al., 2011). Telemedicine applications, on the other hand, facilitate access to healthcare services, particularly in rural and hard-to-reach areas, thereby reducing both time and transport-related costs (Scott Kruse et al., 2018; Totten et al., 2024). The purpose of this compilation is to evaluate the economic contributions of technology use in healthcare and to highlight the impact of these contributions on the efficiency of healthcare systems. The study will address the potential advantages of healthcare technologies in terms of cost-effectiveness, labour and resource utilisation, in line with the existing literature.

Health Technologies

Health technologies encompass tools, methods, software and organisational systems developed to monitor individuals' health status, diagnose diseases, support treatment processes and improve quality of life. This includes medical devices, diagnostic tests, pharmaceutical technologies, digital health applications, telemedicine systems and artificial intelligence-based decision support systems (Organization, 2025b). The World Health Organisation does not view health technologies as being limited solely to physical devices or digital tools; it also defines the management, policy and evaluation processes that enable these technologies to be used safely, effectively and efficiently within health systems as part of this concept (do Nascimento et al., 2023; Organization, 2025b). Today, the scope of healthcare technologies is rapidly expanding due to the impact of digitalisation. Big data analytics, the Internet of Things (IoT), robotic surgery, wearable health devices and biotechnological innovations are among the key components transforming healthcare delivery (Baiense et al., 2025; Meskó & Topol, 2023). Artificial intelligence-supported diagnosis and treatment algorithms, in particular, strengthen clinical decision-making processes and enhance the quality of healthcare services by reducing the margin of error (Buess et al., 2025). Furthermore, telehealth and mobile health (mHealth) applications contribute to the creation of an inclusive health ecosystem by facilitating access to healthcare services for individuals in remote areas (Ezeamii et al., 2024).

The Economic Importance of Technology Use in Healthcare

Digital health technologies not only enhance the effectiveness of healthcare services but also contribute to economic sustainability by offering cost-effective solutions. Innovative solutions such as artificial intelligence, the Internet of Things (IoT), electronic health records (EHR), remote patient monitoring (RPM) systems, and digital hospital applications are increasing efficiency in service delivery and reducing costs in the healthcare sector (Nguyen et al., 2024; Zhang et al., 2025). However, the rapid development of technological innovations in healthcare, while improving the quality of healthcare services, also significantly affects the structure and size of healthcare expenditures. Although new technologies have the potential to reduce unnecessary tests and interventions by increasing accuracy in diagnosis and treatment processes, they can lead to an increase in healthcare expenditures in the short term due to high initial investment costs (Marino & Lorenzoni, 2019). Artificial intelligence-supported diagnostic tools significantly reduce diagnostic errors, thereby achieving cost savings in healthcare systems (Çalışkan & Çınaroğlu, 2023). Various studies have demonstrated that AI-supported diagnostic systems increase diagnostic accuracy and are effective in reducing healthcare costs by preventing unnecessary medical tests (Jiang et al., 2017; Topol, 2019). A meta-analysis has found that artificial intelligence applications increase cost-effectiveness in healthcare services and can lead to significant long-term economic savings (Esteva et al., 2019; Tekkeşin, 2019). Furthermore, remote monitoring and digital tracking systems significantly reduce healthcare costs by decreasing hospital admissions and emergency department visits in the management of chronic diseases (Dinesen et al., 2016). Remote patient monitoring (RPM) systems reduce hospital admission rates and overall treatment costs by enabling early intervention in the management of chronic diseases. Studies have shown that these systems significantly reduce hospital visits and generate substantial annual cost savings per patient (Zhang et al., 2025). Artificial intelligence (AI)-based diagnostic systems are improving diagnostic accuracy and accelerating healthcare professionals' decision-making processes, particularly in imaging-based fields such as radiology, cardiology, and gastroenterology. AI-supported diagnostic systems developed as part of the HosmartAI project have been reported to improve patient outcomes and reduce costs by providing accurate and early diagnosis in cases of preterm birth risk and coronary artery disease (Chatzikou et al., 2025; Tsiachristas et al., 2025). Digital hospital applications and electronic health record (EHR) systems significantly reduce administrative burdens by preventing data duplication and simplifying bureaucratic

processes; this, in turn, increases healthcare workers' productivity and improves the quality of patient care (Coiera et al., 2025). Nguyen and colleagues' (2024) cost-benefit analysis of digital hospital transformation revealed that digitisation reduced total processing times by up to 30%, with this increase in efficiency translating into significant annual cost savings. Furthermore, the digitalisation process enables the optimisation of internal hospital workflows and more efficient use of resources, thereby contributing to both economic sustainability and patient satisfaction (Nguyen et al., 2024).

Remote Patient Monitoring (RPM) and Cost Reduction

Remote Patient Monitoring (RPM) systems enable early intervention in chronic disease management, preventing the development of complications and reducing hospital admission rates. It has been demonstrated that RPM programmes, particularly those applied to common chronic diseases such as hypertension and heart failure, provide significant economic benefits to healthcare systems (Zhang et al., 2023). In a study conducted by Zhang and colleagues (2025) on hypertension management, it was reported that RPM applications saved thousands of dollars per patient annually and had a return on investment of 22.2 per cent. (Zhang et al., 2025). These findings demonstrate that RPM technologies not only offer cost-effectiveness but also have the potential to improve patient quality of life.

Digital Hospital Applications and Administrative Efficiency

Digital hospital transformation is considered a significant structural change that increases efficiency in healthcare services and optimises resource utilisation. During this transformation process, the integration of electronic health record (EHR) systems improves clinical decision support processes by ensuring that patient information is stored in a structured and accessible manner in a digital environment. At the same time, the reduction in data duplication and manual document processing leads to a significant increase in speed and accuracy in administrative processes, which positively impacts healthcare professionals' time management (Al Sharif et al., 2024; Shaharul et al., 2023). According to the cost-benefit analysis conducted by Nguyen and colleagues (2024) on digital hospital transformation, digitalisation applications have reduced total processing times by up to 30%; this process optimisation has contributed to significant annual economic savings. These findings reveal that digital health infrastructure is not merely a technological innovation but also a strategic investment tool for the sustainability of healthcare systems (Nguyen et al., 2024).

The Contribution of Digital Health Technologies to Sustainable Development Goals

Digital health technologies make significant contributions, particularly in the area of health and well-being (Goal 3), within the framework of the United Nations Sustainable Development Goals (SDGs). These technologies increase access to healthcare services, expand opportunities for early diagnosis and treatment, and support the reduction of health inequalities (WHO, 2023). Remote patient monitoring systems and mobile health applications, in particular, facilitate access to quality healthcare services for individuals living in rural and hard-to-reach areas (Organization, 2020). Furthermore, artificial intelligence and machine learning-based systems contribute to the sustainability of healthcare systems by enabling more efficient use of resources. These systems reduce hospital admissions by facilitating the early diagnosis and management of chronic diseases, thereby lowering costs and alleviating the burden on healthcare workers (Chatzikou et al., 2025). Electronic health records (EHR) and digitalisation applications optimise data management, thereby improving the quality of healthcare services and reducing bureaucratic obstacles. They also lighten the workload of healthcare professionals, thus saving time and resources in work processes (Al-Assaf et al., 2024; Nguyen et al., 2024). The integration of digital health technologies is considered not only to enhance the effectiveness of healthcare systems but also to be a critical tool in terms of economic, social and environmental sustainability (Chatzikou et al., 2025; Sydow et al., 2022).

Conclusion:

The integration of technological advancements in healthcare services enhances service quality while also supporting economic sustainability. A growing population, an ageing society, and chronic diseases necessitate the development of efficient, accessible, and cost-effective digital solutions for healthcare systems. Artificial intelligence-supported diagnostic systems increase accuracy and reduce unnecessary interventions, while remote patient monitoring (RPM) enables early intervention in chronic disease management, reducing hospital admissions and emergency visits, thereby saving costs (De Guzman et al., 2022; Zhang et al., 2023). Electronic health records and digital hospital applications reduce data duplication and bureaucratic burden in administrative processes, enabling healthcare professionals to use their time more efficiently. Systematic reviews indicate that these interventions are generally cost-effective (Gentili et al., 2022; Puleo et al., 2021). The high initial and maintenance costs of technological innovations

may increase healthcare expenditure in the short term; therefore, managers should carefully conduct cost-benefit analyses and evaluate operational efficiency. The integration of digital health technologies involves not only economic gains but also regulatory and ethical dimensions, and is of critical importance for the sustainability of healthcare systems (Nguyen et al., 2024; Organization, 2023)

The integration of technological developments in the healthcare sector is not merely an effort at modernisation, but also a strategic necessity in terms of the sustainability and effectiveness of healthcare systems. Digitalisation-focused approaches should be adopted in the planning of healthcare policies and resource allocation; technological infrastructure investments should be supported by long-term strategic planning, and concrete policies should be developed to promote the widespread adoption of digital healthcare infrastructure. The current literature clearly demonstrates that digital health technologies are one of the cornerstones of healthcare systems, both in improving the quality of patient care and in ensuring economic efficiency. Therefore, the comprehensive and sustainable integration of digital health technologies will play a critical role in shaping the healthcare systems of the future.

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BUDING SMART AND SUSTAINABLE HEALTH SYSTEM; THE ROLE OF AI IN CLIMATE RESILIENT CARE

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Abstract

As climate-related threats to health intensify, there is a growing imperative to design health systems that are both sustainable and resilient. This review paper examines the transformative role of Artificial Intelligence (AI) in supporting the development of smart, climate-resilient healthcare systems. The primary objective is to evaluate how AI-driven technologies contribute to health system adaptability, early detection of climate-sensitive diseases, and efficient resource allocation in the face of environmental disruptions.

A qualitative methodology was adopted, involving comparative case analysis and a comprehensive review of existing literature. The study explores AI applications in environmental surveillance, predictive analytics, and healthcare infrastructure management. The findings suggest that AI enhances the responsiveness and efficiency of health systems, improves early warning capabilities, and supports sustainability through optimized energy use, reduced emissions, and intelligent planning systems.

The paper concludes that AI offers a promising pathway for integrating sustainability and resilience into modern health systems. However, successful implementation depends on addressing key challenges such as data governance, ethical considerations, and equitable access to technology—especially in low-resource or climate-vulnerable settings. Strategic policy development and cross-sector collaboration are essential to maximizing the benefits of AI in climate-resilient care.

Keywords: Artificial Intelligence, Climate Change, Health System Sustainability, Resilient Healthcare, Smart Health Infrastructure.

1. Introduction

Climate change is increasingly recognized as one of the defining health challenges of the 21st century. Changes in temperature, rainfall patterns, extreme weather events, and shifting ecosystems are producing new and intensified health risks: heat stress, vector-borne diseases, waterborne illnesses, air pollution, food insecurity, and mental health stressors (Ansah et al., 2024; MDPI, 2024). Health systems globally must adapt to this changing landscape—not only by responding to current burdens, but by anticipating future climate-related health threats (Ansah et al., 2024; Robinson et al., 2025).

Traditional health care models risk being outpaced by the velocity and complexity of climate impacts. To cope, systems must become smart, meaning adaptive, data-driven, and proactive, and also sustainable, meaning they minimize environmental footprint while maintaining capacity under stress. Artificial Intelligence (AI) — in its various forms including machine

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learning, deep learning, natural language processing, and predictive analytics — holds promise as a key enabler of this transformation.

This paper presents a conceptual and evaluative review of how AI can support climate-resilient health systems. It addresses three primary questions:

1. How can AI assist health systems to anticipate and respond to climate-sensitive health risks?
2. In what ways can AI contribute to more efficient, energy-aware, and sustainable health infrastructures?
3. What are the main challenges—technical, ethical, governance, equity—that must be addressed for AI to succeed in climate-resilient care?

We adopt a qualitative methodology: a comparative case analysis supplemented by an extensive literature review. The remainder of the paper is organized as follows. Section 2 describes the conceptual framework of climate resilience in health systems. Section 3 discusses specific AI application domains (environmental surveillance, predictive disease analytics, infrastructure and resource optimization). Section 4 presents illustrative case studies. Section 5 outlines key enabling conditions and barriers (governance, ethics, data, access). Section 6 offers recommendations and policy considerations. Section 7 concludes with reflections and research directions.

2. Conceptualizing Climate-Resilient Health Systems

Before delving into AI, it is important to define what "climate-resilient health systems" means, and to identify the system attributes that lend themselves to digital and AI augmentation.

2.1 Defining Resilience and Sustainability in Health Systems

Health systems resilience is generally understood as the capacity to prepare for, absorb, adapt to, and recover from shocks and stresses while maintaining core functions and reorganizing as needed (WHO; Ansah et al., 2024). In the climate domain, this includes dealing with chronic stress (e.g. rising heat, air pollution) and acute shocks (storms, floods, epidemics). Sustainability complements resilience by ensuring that health operations do not themselves exacerbate environmental degradation.

Ansah et al. (2024) and related reviews map how health systems are adapting to climate risk across governance, workforce, service delivery, information systems, financing, and infrastructure dimensions (Ansah et al., 2024). However, many of those adaptations remain partial or localized, constrained by funding, weak institutional capacity, and inadequate integration of climate considerations.

More recently, the ClimHB integrative model further refines resilience to include climate-specific triggers and feedback loops, signaling the interplay between health, ecosystem, and social system dynamics (ClimHB framework, 2024). This model underlines that resilience is not just bouncing back, but transformation and learning under continuing climate stress.

2.2 The Promise of AI for Resilience and Sustainability

AI offers capabilities in pattern recognition, anomaly detection, forecasting, optimization, and decision support — all of which align with the demands of climate-smart health systems (Ayadi et al., 2025; McGovern et al., 2017; Golden et al., 2025). Specifically:

- **Early warning & prediction:** AI can detect signals from environmental, vector, or meteorological data to forecast disease outbreaks or heat waves.
- **Adaptive resource allocation:** AI can optimize allocation of scarce resources (staff, equipment, energy) dynamically in response to unfolding events.
- **Infrastructure efficiency:** AI can monitor, predict, and manage energy use, waste, and emissions within health facilities.
- **Surveillance integration:** AI can fuse multi-modal data (satellite, sensor, health records) to support situational awareness.
- **Decision support:** AI can guide clinicians, public health managers, and policy actors in climate-informed choices.

That said, AI is not a panacea. Its power depends on data, governance, interpretability, fairness, and socio-technical embedding. Several recent reviews call attention to the challenges of model transparency, bias, resource demands, and inequitable access (Resilient AI in Health, 2023; Morley et al., 2021; Perspective AI & Climate Governance, 2024).

3. Domains of AI Application in Climate-Resilient Health

Below we categorize AI use cases into three interlinked domains: environmental and surveillance systems, predictive disease analytics, and resource/infrastructure optimization.

3.1 Environmental Surveillance & Early Warning

To anticipate climate-sensitive threats, health systems need robust environmental monitoring. AI enables:

- **Satellite and remote sensing integration:** AI models can interpret satellite imagery to detect land use change, flood zones, vegetation shifts, and surface temperature anomalies, which can be early indicators of vector habitat change or flood risk zones (Ayadi et al., 2025; Artificial Intelligence in Climate Science review, 2025).
- **Sensor networks and IoT:** Urban sensor arrays that capture air quality, temperature, humidity, water levels, and particulate matter can feed AI models for real-time hazard detection and predictive alerts.
- **Climate risk modeling & downscaling:** AI can improve climate model downscaling to local scales, offering fine-grained forecasts useful for health planning (AI for climate science review, 2025).
- **Hazard exposure prediction:** Coupling AI with geospatial hazard models allows estimation of community-level exposure to extreme weather, heat islands, or flood zones. This supports health departments to preposition resources or issue warnings (AI & climate governance, 2024).

Such surveillance systems provide the upstream signals that enable health systems to pivot from reactive to proactive modes.

3.2 Predictive Analytics for Climate-Sensitive Diseases

AI can enhance disease prediction and early detection:

- **Vector-borne diseases:** Models trained on climatic, land use, and entomological data can forecast outbreaks of malaria, dengue, Zika, or West Nile virus.
- **Heat-related morbidity & mortality:** AI models can predict hospital admissions or mortality spikes under heat wave forecasts, helping to mobilize surge capacity.
- **Respiratory and air pollution–related illnesses:** In settings with deteriorating air quality (e.g. wildfires, urban smog), AI fused with meteorological and exposure data can estimate disease burden and guide advisories (Leveraging AI & CIS, 2025).
- **Waterborne and diarrheal diseases:** Predictive modeling using rainfall, runoff, and sanitation data can anticipate spikes in illnesses like cholera, particularly in flood-affected areas.
- **Syndromic surveillance integration:** Natural language processing (NLP) and machine learning on health-care records, social media, and call center logs can detect anomalies hinting at disease surges.

These predictive capacities allow health systems to issue alerts, allocate preventive resources, and engage communities in risk reduction earlier.

3.3 Infrastructure, Energy, and Resource Optimization

Health facilities themselves must become sustainable and resilient assets. AI can support:

- **Energy use prediction and management:** Hospitals are energy-intensive. Machine learning models can forecast load, detect inefficiencies, optimize HVAC, lighting, refrigeration, and schedule energy usage to minimize carbon footprint (FatehiJananloo et al., 2023).
- **Smart HVAC & climate control:** AI-driven controls can maintain safe internal climates while adapting to external temperature shifts, reducing wasteful overcooling/overheating (Climate & AI in healthcare, 2024).
- **Supply chain and logistics:** AI can optimize procurement, inventory, and distribution of medicines, cold chain vaccines, consumables, reducing waste especially during disruptions.
- **Workforce scheduling and surge staffing:** AI can model demand spikes (based on climate/disease forecasts) and optimize staff deployment, shift schedules, and triage.
- **Facility resilience modeling:** AI can simulate facility robustness under extreme events (flooding, power outages), identifying weak points and planning retrofits.

Through these optimizations, health systems can reduce operational costs, emissions, and improve reliability under stress.

4. Illustrative Case Studies

To ground the concepts, here we present a few real or emergent case studies (synthesized from recent literature) where AI was leveraged for climate-resilient health strategies.

4.1 AI-Enabled Respiratory Health Monitoring in Africa

A study focusing on Africa explored how AI and data science can help mitigate respiratory health burdens aggravated by climate change (Leveraging AI & Data Science, 2024). In regions where air pollution, dust storms, and climatic variability raise respiratory risk, predictive models were developed using air quality data, meteorology, and hospital admission records. These models helped forecast peaks in asthma, COPD, and other respiratory events, enabling health services to pre-allocate oxygen, medications, and staff to high-risk zones (Leveraging AI & CIS, 2025).

Though promising, these models faced challenges including data scarcity, sensor coverage gaps, and limited computational infrastructure. The study emphasized that strategic investment in data infrastructure and capacity building is critical for scale-up.

4.2 Sustainable Hospital Energy Modeling

An extended review of AI models for hospital energy prediction (Fatehi Jananloo et al., 2023) identified around 17 studies where machine learning was applied to forecast energy consumption in healthcare facilities. These models accounted for occupancy, weather, operational schedules, and facility systems. Findings reveal that AI-based forecasting and optimization can reduce energy use and emissions, particularly if integrated with building management systems.

One exemplar hospital retrofitted its HVAC and lighting systems to respond to AI forecasts, resulting in noticeable reductions in electricity demand during low-usage periods. However, real-time integration, data heterogeneity, and interpretability remain barriers.

4.3 Thailand's GREEN & CLEAN Hospitals Policy

Thailand offers a policy-level example of climate-resilient health planning. In the "GREEN & CLEAN Hospitals" initiative and the National Health Adaptation Plan, the government coordinated adaptation and mitigation strategies in the health sector (Robinson et al., 2025). While not solely focused on AI, these policies create an enabling environment for digital tools. Interviews revealed that while adaptation goals and resource mobilization were well articulated at national level, operationalization at facility levels lagged due to capacity gaps, financial constraints, and weak evaluation frameworks.

This case underscores that AI adoption should be nested within coherent governance and policy ecosystems.

4.4 Comparative AI for Resilience Across Sectors

A systematic review of AI applications across sectors (e.g., agriculture, infrastructure, health) categorized where AI supports adaptation vs mitigation (Ayadi et al., 2025). Health accounted for a smaller share of studies compared to agriculture and infrastructure. Yet in cross-sectoral settings — e.g. combining climate, crop, water, and health data — AI showed more potential for converging impact (Ayadi et al., 2025). For instance, AI models predicting flooding risk could inform both agricultural planning and health resource allocation.

This suggests synergy opportunities: AI built for urban or climate services can be co-utilized by health systems, thereby improving cost efficiency and resilience.

5. Enablers, Barriers, and Risk Mitigation

Despite potential, implementing AI in climate-resilient health care faces significant challenges. Below we group and analyze key factors, and suggest mitigation strategies.

5.1 Data Governance, Quality, and Access

Data governance, quality, and access present significant challenges, particularly in regions that are low-income or highly vulnerable to climate-related risks. These areas often lack dense networks of sensors, comprehensive climatic data, robust disease surveillance systems, and interoperable health information, which limits the availability of reliable data. Additionally, existing data may be biased, incomplete, or unrepresentative, resulting in inaccurate models and potential inequities in decision-making (Resilient AI in Health, 2023). Sharing data across domains, such as climate, health, and geospatial information, is frequently impeded by institutional silos, privacy concerns, and proprietary restrictions. Furthermore, data pipelines can be disrupted during disasters or infrastructure failures, exacerbating the challenge of maintaining consistent and accurate information.

To address these issues, promoting open data platforms and standardized practices, alongside strong anonymization and privacy safeguards, is essential. Cross-sector agreements between relevant institutions—such as ministries of health, environment, and meteorology—can facilitate data integration. Techniques such as transfer learning, federated learning, and the use of synthetic data can help mitigate gaps in available datasets. Building resilient data architectures, including offline caching and distributed storage systems, ensures that data remains accessible even in the face of disruptions.

5.2 Model Interpretability, Trust, and Safety

Model interpretability, trust, and safety are critical considerations in the deployment of AI, particularly in health and climate-related applications. Complex models, such as deep neural networks, often function as black boxes, making it difficult for clinicians and decision-makers to understand and trust their outputs. This lack of transparency can hinder adoption, especially when AI recommendations influence high-stakes decisions. Additionally, AI systems can unintentionally perpetuate existing biases, such as deprioritizing vulnerable or low-income communities, while mispredictions in critical situations—like disease outbreak forecasts—can undermine public confidence. Compounding these challenges is the scarcity of regulatory and

evaluation frameworks specifically designed for AI applications in health and climate contexts (Morley et al., 2021; Resilient AI in Health, 2023).

To address these issues, implementing explainable AI methods, including attention mechanisms and SHAP values, can enhance transparency. Integrating human oversight through human-in-the-loop approaches allows experts to validate, monitor, and override AI outputs when necessary. Establishing standardized testing and validation protocols, along with real-world monitoring, ensures models perform reliably in practice. Finally, developing ethical and regulatory frameworks tailored to the unique challenges of AI in climate-health settings is essential to build trust, ensure safety, and guide responsible use.

5.3 Equity, Access, and Digital Divide

Equity, access, and the digital divide present significant obstacles in the implementation of advanced health technologies. Many rural or low-resource areas lack the necessary computational infrastructure, reliable connectivity, and trained personnel to effectively deploy such systems. As a result, technological innovations in healthcare risk disproportionately benefiting well-resourced regions, potentially exacerbating existing inequalities. Additionally, tools that are not aligned with local cultural, linguistic, and contextual realities may face limited acceptance among communities.

To address these challenges, it is important to develop lightweight, low-resource models and utilize edge computing solutions that do not rely heavily on cloud infrastructure. Engaging local communities through co-creation ensures that technologies are contextually relevant and culturally appropriate. Building local capacity through training programs and establishing regional data science hubs strengthens the ability to adopt and maintain these systems. Furthermore, inclusive governance structures that actively involve marginalized populations can help ensure that the benefits of health technologies are distributed equitably.

5.4 Financial, Institutional, and Policy Barriers

Financial, institutional, and policy barriers pose significant challenges to the adoption of advanced technologies in health and climate sectors. The high initial costs of sensors, computing infrastructure, software, and staff training can be prohibitive, particularly for low-resource settings. Weak institutional alignment and limited governance frameworks often hinder effective cross-sector collaboration, while policymaking frequently lags behind technological advancements, leaving climate and health strategies without integrated digital solutions. In addition, mechanisms for evaluating and monitoring the implementation of new technologies remain underdeveloped.

To overcome these obstacles, public-private and international partnerships can be leveraged to share both costs and risks. Incorporating technology strategies directly into national climate and health plans ensures they are treated as integral components rather than isolated projects. Mobilizing donor support, climate finance, and green bonds specifically aimed at enhancing digital resilience can provide necessary funding. Finally, adopting an iterative approach—from pilot projects to full-scale deployment supported by robust monitoring and evaluation frameworks, helps ensure effective and sustainable implementation.

5.5 Environmental Footprint of AI

The environmental footprint of advanced computational technologies presents notable challenges. Training large models and running data centers require substantial energy, generating significant carbon emissions that can undermine broader sustainability objectives(Climate & AI in healthcare, 2024). Additionally, frequent hardware upgrades contribute to electronic waste, further increasing environmental pressures.

To mitigate these impacts, adopting energy-efficient design practices, such as optimizing architectures and reducing computational demands, is essential. Powering infrastructure with renewable energy sources can further decrease carbon emissions. Extending the lifespan of hardware and implementing circular recycling practices for electronic waste also help reduce environmental strain. Moreover, assessing the full life-cycle impact of technology from production and operation to disposal should be an integral part of system evaluation to ensure responsible and sustainable deployment.

6. Recommendations and Policy Agenda

To move from possibility to practice, we propose the following strategic roadmap for stakeholders:

6.1 Build Cross-Sector Governance Platforms

To strengthen the integration of technology in climate and health initiatives, it is essential to establish institutional mechanisms that connect ministries responsible for health, environment, meteorology, urban planning, and information and communication technology. Creating dedicated climate-health digital steering committees can help align strategic priorities, facilitate data sharing, and ensure accountability across sectors. Additionally, incorporating technological considerations into national climate-health action plans and health adaptation policies ensures that digital solutions are systematically embedded within broader policy frameworks, promoting coordinated and effective responses (Robinson et al., 2025).

6.2 Start Small, Scale Iteratively

Implementation should start with pilot projects focused on regions facing high disease burdens or significant climate risks, supported by clearly defined evaluation metrics to measure effectiveness and impact. Employing modular system architectures enables flexible, plug-and-play expansion as capacity and resources grow. It is equally important to establish continuous feedback loops involving end users such as clinicians and public health officers, ensuring that their insights guide model refinement and improve the relevance and reliability of AI applications over time.

6.3 Invest in Digital and Data Infrastructure

Strengthening digital infrastructure is vital for effective implementation. This includes deploying extensive sensor networks, developing standardized data platforms, and ensuring interoperability across systems to enable seamless information exchange. Efforts should also focus on enhancing digital backbones in underserved regions by improving connectivity and

computing resources. Additionally, establishing data capacity centers and investing in the training of local data scientists will help build long-term expertise and foster self-sufficiency in managing and analyzing health and climate data.

6.4 Develop Ethical, Regulatory, and Evaluation Frameworks

Developing ethical and regulatory frameworks tailored to the use of AI in climate and health contexts is essential for ensuring fairness, accountability, and transparency. This process should involve the co-creation of ethical guidelines that address the unique challenges posed by these technologies. Rigorous model validation, clinical trial–style testing, and continuous post-deployment monitoring must be mandated to guarantee reliability and safety. Promoting openness through peer-reviewed methodologies and reproducible research further strengthens trust and scientific integrity. Additionally, establishing governance structures that define responsibilities for AI safety, risk management, and liability will help safeguard both users and affected communities.

6.5 Promote Inclusive Design and Capacity Building

Active community engagement and capacity building are central to the equitable integration of AI in health and climate initiatives. Involving communities, clinicians, public health professionals, and local decision-makers in the design and implementation process ensures that technologies are contextually relevant and responsive to real needs. Comprehensive training programs in AI literacy, data science, and digital tools should be offered across health systems to strengthen local expertise and foster confidence in technology use. Moreover, deliberate efforts must be made to ensure that the advantages of these innovations extend to marginalized and rural populations, promoting inclusivity and reducing existing disparities in access to healthcare and technology.

6.6 Leverage International Financing and Collaboration

Mobilizing financial and collaborative support is key to advancing digital resilience in climate-health systems. Accessing climate-focused funding sources, such as the Green Climate Fund, along with contributions from global health donors, can help subsidize the development and deployment of digital infrastructure. Promoting South–South cooperation through knowledge exchange and technical assistance enables climate-vulnerable nations to share experiences, best practices, and innovative solutions tailored to similar contexts. Additionally, fostering open-source ecosystems and developing shared AI toolkits encourage collaboration, transparency, and cost-effective scaling of digital solutions that benefit a wider range of communities.

6.7 Monitor Environmental Footprint and Sustainability Metrics

Incorporating environmental sustainability into AI implementation is essential for minimizing its ecological impact. Implementation plans should include carbon accounting, energy consumption tracking, and e-waste monitoring to ensure that technological advancements align with sustainability goals. Prioritizing energy-efficient models and operating systems powered by renewable energy sources can significantly reduce the carbon footprint of AI applications.

Furthermore, establishing continuous feedback loops allows for the optimization of models not only in terms of accuracy and performance but also with respect to their environmental efficiency, fostering a balance between innovation and ecological responsibility.

7. Conclusion and Future Directions

Climate change is reshaping the health risks landscape. To respond, health systems must evolve beyond reactive care into anticipatory, resilient, and sustainable systems. AI, properly conceived and applied, offers powerful tools — from environmental surveillance and disease forecasting to infrastructure optimization and decision support.

But AI's promise is contingent. The success of AI in climate-resilient health care depends on robust data ecosystems, trustworthy models, equitable access, ethical governance, and integration within policy frameworks.

Key research and development areas for the future include:

- Methods for explainable, low-resource AI tailored to constrained settings.
- Federated, privacy-preserving learning across institutions and domains.
- Joint climate-health modeling that links environmental, socioeconomic, and disease systems.
- Longitudinal impact evaluation studies measuring health, equity, and environmental outcomes.
- Mechanisms to embed AI in national and global health governance, climate policy, and financing.

In closing, AI is not a silver bullet but a powerful lever. If deployed thoughtfully with equity, sustainability, and governance, AI can help usher in a new era of health systems that are not just resilient to climate change, but actively part of our planet's sustainable future.

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