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Genetic Counseling in Nursing: Addressing Non-Modifiable Stroke Risk Factors and Ethical Considerations in Genetic Screening for Stroke Prevention

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Abstract:

Stroke is a significant cause of morbidity and mortality in all parts of the world and there is increasing evidence of the role played by genetic and other non-modifiable risk factors in the development and progression of stroke. The stroke genomics progress has greatly enhanced the knowledge of hereditary predisposition, which can be used to identify individuals at risk at an earlier stage and guide preventive measures. Nevertheless, the adoption of genetic screening in normal clinical practice presents challenging ethical, psychosocial, and professional dilemmas, especially in nursing. This narrative review critically discusses the importance of genetic counseling in nursing practice with respect to non-modifiable risk factors of stroke and the ethical aspect of genetic screening in stroke prevention. Based on recent genomic, clinical, and nursing research, the review is a synthesis of the existing knowledge on the genetic architecture of stroke, the clinical value of genetic screening, and the role of nurses in interpreting genetic data into patient-centred care. The review indicates that although genetic screening has a potential in personalised prevention, issues associated with informed consent, privacy, discrimination, and psychological effects are still among the major concerns. It concludes that successful application of genetic counseling into nursing needs increased genomic literacy, ethical competence, and supportive policy frameworks to guarantee equitable and accountable application.

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Introduction

Stroke remains a significant health burden in the world, as it causes a significant mortality and long-term disability among developed and developing countries. Whereas conventional research has been largely dominated by the emergent determinants of stroke risk, including hypertension, diabetes and lifestyle behaviours, there is growing awareness of the important role of non-modifiable determinants, especially genetic predisposition, in influencing stroke risk profiles. The latest developments in molecular genetics and genomic technologies have transformed the current knowledge of the pathogenesis of strokes and demonstrated the intricate interplay between genetic variants and environmental exposures affecting disease development, progression, and recurrence (Yoshimoto et al., 2025; Appunni et al., 2022). Recent advances in the area of stroke genetics have revealed many genetic loci linked to ischemic and hemorrhagic stroke, which can shed light on biological processes, including inflammation, vascular integrity, and coagulation (Zhang et al., 2023; Jagodic et al., 2025). Such findings have led to the creation of genetic screening systems that seek to establish those individuals at high risk before they become sick. These tools have the possibility of providing individualised prevention programs, early intervention, and better clinical outcomes.

Nonetheless, the introduction of genetic screening into the healthcare system brings up significant ethical, legal, and psychosocial issues. Such issues as informed consent, confidentiality, possible discrimination, and psychological effects of genetic risk information should be considered carefully (Cornel et al., 2024; Hachmeriyan et al., 2025). The mentioned challenges are especially relevant to the nursing practice, as professionals are frequently at the forefront of patient education, counseling, and advocacy. Nurses are essential in filling the gap between complicated genetic knowledge and comprehension by the patient. Since they are the frontline healthcare professionals, they have the obligation to engage in making informed choices, offering emotional support, and ensuring that the care is patient-centred and ethical (Babkair et al., 2023). Nevertheless, a considerable gap in existing healthcare systems is the lack of appropriate training of nurses in genomics. This narrative review intends to critically evaluate the role of genetic counseling in nursing, focusing on genetic screening of non-modifiable stroke risk factors and overcoming the ethical challenges of genetic screening.

Overview of Stroke and its Pathophysiology

Stroke is a non-uniform neurological disease that is marked by the abrupt blockage of blood supply in the brain leading to neuronal damage and consequent functional deficits. It is widely categorized into ischemic stroke, which comprises about 85 percent of all, and hemorrhagic stroke, which is bleeding in or around the brain (Kuriakose & Xiao, 2020). Knowledge of stroke pathophysiology is important in understanding the role of genetic and non-modifiable factors in disease development and progression. The central element in ischemic stroke is the obstruction of cerebral arteries usually through thrombosis or embolism, resulting in a decrease in oxygen and glucose supply to brain tissue. This triggers a series of biochemical and molecular reactions, such as energy failure, excitotoxicity, oxidative stress, inflammation, and cell death (Salaudeen et al., 2024). Oxidative stress, specifically, is crucial as it leads to the production of reactive oxygen species that destroy cellular structures, impairs the blood-brain barrier, and worsens neuronal damage (Chavda et al., 2022).

Besides oxidative stress, new evidence shows the presence of programmed cell death pathways like pyroptosis in the pathology of stroke. Pyroptosis is inflammatory cell death, which also leads to neuronal injury and secondary injury after ischemic events (Long et al., 2023). The genetic factors that control these molecular processes are the inflammatory response, cellular metabolism, and vascular integrity. Hemorrhagic stroke on the other hand entails the breakage of blood vessels hence intracerebral or subarachnoid bleeding. The pathophysiology involves raised intracranial pressure, diminished cerebral perfusion and mechanical injury of brain tissue. Hemorrhagic stroke may be greatly caused by genetic predisposition to some diseases like aneurysms and vascular malformations.

Notably, stroke does not necessarily occur as the outcome of acute vascular events but is commonly the outcome of the chronic pathologic processes of atherosclerosis, endothelial dysfunction, and chronic inflammation. Genetic and environmental factors have an impact on these processes, and the disease is multifactorial. Recent literature has highlighted the complexity of the risk of stroke and has shown that even people with similar environmental exposures may have different susceptibility because of genetic variation (Efremova et al., 2023). This inconsistency highlights the need to consider individualised strategies in stroke prevention and management.

Moreover, stroke pathophysiology differs among various groups of people and age. As an example, stroke is more genetically or uncommonly caused in younger individuals, but more frequently has an excess of modifiable risk factors in older people (Sič et al., 2025). The genetic and developmental factors are closely linked with paediatric stroke, which is less frequent (Jankovic et al., 2022). Finally, the development of knowledge regarding stroke pathophysiology has provided new perspectives in research and therapeutical intervention.

Genetic Basis of Stroke

Genetic causes of stroke have emerged as a growing topic of research, propelled by the rise of molecular biology, genomics and bioinformatics. Stroke has been now well understood to be a multifactorial disorder that is complex and where genetic factors interact with the environmental and lifestyle determinants to impact on the susceptibility, progression and outcomes of the disease. Contrary to the monogenic diseases, where one genetic mutation causes the disease to manifest, most types of stroke are polygenic, meaning they involve several genetic variants that increase the risk when combined (Zhang et al., 2023; Jagodic et al., 2025). Monogenic stroke, though not very common, can give valuable information on the pathophysiology of cerebrovascular disease. Cerebral autosomal dominant arteriopathy with subcortical infarcts and leukoencephalopathy (CADASIL) are mutations in particular genes, with the most frequent being the NOTCH3 gene, and are characterized by early-onset stroke and progressive cognitive impairment (Chojdak-Łukasiewicz et al., 2021). These circumstances underscore the direct contribution of genetic mutations to vascular dysfunction, and shows how inherited pathology can greatly increase the risk of stroke regardless of conventional risk factors.

In addition to monogenic disorders, genome-wide association studies (GWAS) have revealed that there are many loci that are linked to the susceptibility to stroke. These loci play a role in various biological pathways, such as lipid metabolism, blood pressure, coagulation, or inflammatory (Yoshimoto et al., 2025; Appunni et al., 2022). An example is that genetic variants of low-density lipoprotein (LDL) metabolism can increase the risk of atherosclerosis, which in turn increases the risk of ischemic stroke. Likewise, platelet variants that affect the

platelet functionality and coagulation cascades may also cause the formation of thrombus. Polygenic inheritance of stroke suggests that each genetic variant generally only provides a small risk increment, but their interaction can be significant. Polygenic risk scores (PRS) have become an intriguing instrument that allows measuring the genetic risk of stroke of a person by combining the effects of many risk alleles (Jagodic et al., 2025). Such scores have the potential to be applied to clinical practice to stratify individuals by their genetic risk and inform preventive interventions.

The genetic architecture of stroke is further complicated by the gene-environment interactions. The expression of genetic risk factors can be altered by environmental exposures like diet, smoking, physical activity, and infections, which enhance or reduce the effects of genetic risk factors (Zhang et al., 2023; Hameed et al., 2024). As an illustration, people who have a genetic predisposition to high blood pressure might have a much greater risk of stroke exposed to high salt diets or chronic stress. This interaction highlights the need to adopt a holistic approach that integrates genetic and environmental information in risk assessment. There are also special populations that exhibit special genetic effects on stroke risk. Genetic modifiers are also of paramount importance in the determination of stroke vulnerability in patients with sickle cell disease, and some of them have been shown to impact the magnitude of vascular issues (Oni et al., 2024). Equally, paediatric stroke is frequently linked with genetic or developmental defects, unlike adult-onset stroke, which is more closely linked with the cumulative exposure to modifiable risk factors (Jankovic et al., 2022).

The recent breakthrough in the field of sequencing, such as next-generation sequencing, has made possible the discovery of rare genetic variants that were not easily detectable previously. They have broadened the genetics of stroke and enabled the creation of precision medicine strategies that can be used to customize interventions according to specific genetic makeup (Ekkert et al., 2022). In spite of these developments, there are number of challenges. Issues like the variability of genetic effects in different populations, poor predictive value of genetic tests and ethical issues with the use of genetic data continue to limit the clinical translation of genetic findings. Moreover, the majority of genomic research has been done in high income nations, and it is questionable whether the results can be generalized to different populations, such as the ones in the low- and middle-income environments.

Non-Modifiable Risk Factors in Stroke

The non-modifiable risk factors are essential in the establishment of the predisposition of an individual to stroke. These are variables that cannot be modified by behavioural or medical means but they are essential in the risk stratification and preventive planning as they include age, sex, ethnicity and genetic predisposition. It is crucial that healthcare workers, especially nurses, are aware of these determinants, as they can be engaged in recognizing at-risk individuals at an early stage and applying specific preventive measures.

One of the most considerable non-modifiable risk factors of stroke is age. Stroke rates rise significantly with age because of the accumulation of vascular risk factors and progressive arterial stiffening in addition to age-related alterations in the cerebral circulation (Johansson et al., 2021). It should be noted though that stroke is not only a disease of the elderly. There is growing evidence of an increase in the prevalence of stroke in younger adults, which is usually attributed to genetic factors, lifestyle, and emerging risk factors (Sič et al., 2025).

The stroke risk and outcomes are also affected by sex differences. Although the prevalence of stroke is higher in men at a young age, women are at greater risk in a lifetime because of

increased life expectancy and particular risk factors like hormonal changes, pregnancy, and oral contraceptives (Edris et al., 2025). Moreover, women tend to have worse functional outcomes and more severe strokes, which underscores the importance of gender-specific stroke prevention and management strategies.

Ethnicity and race are significant factors of stroke risk, which include both genetic and socio-environmental factors. Some groups have a greater prevalence of particular genetic variants of stroke, and exposure to risk factors like hypertension and diabetes. To illustrate, research has indicated that the occurrence and the outcomes of strokes have varied among various groups of people, which highlights the significance of culturally and contextually relevant interventions (El Masri et al., 2025).

The most direct non-modifiable risk factor is perhaps genetic predisposition. People whose family is a stroke are at higher risk, implying the impact of inherited genetic variants. The risk is further exacerbated in patients with certain genetic disorders like the sickle cell disease where the risk of stroke is highly increased because of vascular issues (Oni et al., 2024).

Genetic factors are even more dominant in the paediatric populations. Congenital heart defects, coagulation disorders, and inherited metabolic disorders are some of the conditions that increase the risk of stroke in children, making the early genetic screening and interventions important (Jankovic et al., 2022). On the same note, young adults who suffer stroke are usually predisposed to genetic or rare causes, unlike elderly patients whose risk is more determined by modifiable factors (Sič et al., 2025).

It is also important to the interaction between non-modifiable and modifiable risk factors. As an example, people who are genetically predisposed might have their risk factors which can be modified amplified, causing an earlier or more severe disease. This interaction highlights the importance of combining risk assessment models that take into account both fixed and modifiable determinants.

Notably, there are non-modifiable risk factors that affect stroke recurrence and prognosis. Research has demonstrated a positive relationship between genetic and demographic factors and recovery, treatment response and recurrence stroke (El Masri et al., 2025). This underscores the need to adopt individualised care strategies that consider individual risk profiles. Although non-modifiable risk factors are fixed, they present good chances of early intervention.

Emerging and Complex Risk Factors in Stroke

Over the past several years, stroke risk has been seen to be more broadly understood in terms of a spectrum of emerging and complex determinants, rather than just in traditional terms of modifiable and non-modifiable determinants. These considerations indicate the dynamic interactions between genetic predisposition, environmental exposures, infectious agents, and socio-behavioural factors, and support the multifactorial nature of stroke. This is a changing attitude that is necessary to develop precision medicine strategies and enhance preventive methods. Among the greatest advances in stroke research is the identification of infectious agents as risk factors of stroke. Systemic inflammation, endothelial dysfunction and prothrombotic states are triggered by infections and are associated with increased risk of cerebrovascular events (Hameed et al., 2024). There have been chronic infections including those induced by some viruses and bacteria, which were found to increase the risk of stroke especially in people with some genetic susceptibility. These results indicate that stroke

prevention interventions should include the management of infectious diseases as a part of the holistic intervention.

The environmental factors also are important determinants of stroke risk. Air pollution, exposure to toxins and occupational hazards are factors associated with stroke incidence via oxidative stress and vascular inflammation. Such exposures to the environment tend to interact with genetic predisposition and enhance their effects, contributing to differences in the outcomes of stroke within the population. This interaction is especially important in low- and middle-income countries where the environmental risks can be even more noticeable.

Another significant aspect of the stroke risk factor is hormonal factors, particularly in women. The use of oral contraceptives has been linked to a higher risk of stroke, especially in those who have other risk factors (including smoking or genetic tendency to thrombosis) (Edris et al., 2025). Pregnancy and menopause hormonal alterations also affect vascular functioning and can also lead to the risk of stroke. These factors are gender specific and it is necessary to have specific prevention strategies that consider the biological differences.

The traditional modifiable lifestyle factors have a tendency to interact with the genetic and environmental determinants in complex manners. An example is that dietary habits, lack of exercise and substance use can also regulate genetic risk by altering metabolism and inflammatory mechanisms. People who have a genetic predisposition to hypertension or dyslipidaemia might have a disproportionately increased risk of stroke in the presence of unhealthy lifestyles (Efremova et al., 2023). This highlights the need to incorporate genetic information in lifestyle interventions in order to make them more effective. The role of psychosocial stress and socioeconomic status is becoming more widely acknowledged as a risk factor of stroke. Long-term stress may cause permanent activation of the hypothalamic-pituitary-adrenal axis causing high blood pressure, inflammation and vascular problems. These impacts may also be aggravated by socioeconomic differences which restrict access to health care, nutritious food and safe environments. These can be overlapping with genetic predisposition, resulting in compounded risk profiles in populations at risk.

The other new field that is of interest is the role of epigenetics in stroke. The epigenetic changes, including DNA methylation and histone modification, can also affect the expression of the genes without changing the underlying DNA sequence. Such changes are usually predetermined by the environmental and lifestyle factors and may have a long-term impact on the vascular health. The epigenetic processes offer a possible connection between genetic susceptibility and environmental exposures, which can offer new perspectives on the pathogenesis and prevention of strokes. In addition, recent studies have highlighted the importance of subclinical and “hidden” risk factors in stroke. People who seem healthy according to the conventional risk-evaluation methods might still be at high risk because of some genetic or molecular defects (Efremova et al., 2023). This has seen a rise in the interest towards sophisticated screening devices such as genetic screening and biomarker analysis in order to detect the high-risk individuals before the clinical manifestation.

Notably, clinical implications of the identification of these multi-faceted risk factors are enormous. It questions the dichotomy of modifiable and non-modifiable risk factors and advocates a more holistic approach to risk assessment. Healthcare practitioners need to think of the cumulative and interactive impacts of various determinants, as opposed to individual factors. In the nursing practice, this enlarged knowledge requires a change to the holistic and patient-centred care. Nurses should be prepared to evaluate a broad spectrum of risk factors,

offer holistic education, and work with interdisciplinary teams in order to devise specific prevention plans. This involves the need to deal with environmental and psychosocial determinants and also integrating genetic information into patient care.

Genetic Screening in Stroke Prevention

Genetic screening has become a revolutionary intervention in the prevention and treatment of stroke with the possibility of determining people at higher risk before they develop any clinical symptoms. Increasingly more precisely and efficiently, genetic variants linked to stroke can now be identified due to the development of genomic technologies such as next-generation sequencing and high-throughput genotyping. This has seen the introduction of genetic screening in the preventive healthcare practices. Among the key advantages of genetic screening, the ability to identify risks early on can be mentioned. Through identification of genetic predispositions, healthcare providers can introduce their own interventions that will help in minimizing the risk of stroke. As an illustration, patients with a high genetic risk could use more stringent surveillance and lifestyle changes as well as pharmacological treatment depending on their risk profile (Appunni et al., 2022). This strategy is in line with the concept of precision medicine, which aims at tailoring healthcare to personal attributes.

There are certain populations where genetic screening is especially useful: high-risk populations (i.e., people with a family history of stroke) or people with known genetic disorders. In this instance, preventive measures and better clinical outcomes can be informed by early detecting genetic risk. As an example, genetic variants in screening of genetic disorders related to coagulation or lipid metabolism can be used to influence the choice of therapy and decrease the risk of suffering a stroke. Besides risk identification, genetic screening may also be informative about disease pathophysiology and be used to develop new therapeutic strategies. Learning about genetic mechanisms during stroke may result in finding new drug targets as well as creating individualised treatment plans (Ekkert et al., 2022). This has great implications towards enhancing the effectiveness of the stroke prevention and management. Nonetheless, there are no issues in the implementation of genetic screening in clinical practice. The variability in the predictive accuracy is one of the main limitations. Although there are genetic variants that are highly linked to stroke risk, most have small effects thus it is hard to precisely determine whether an individual will develop stroke or not by only looking at the genetic information (Jagodic et al., 2025). This shortcoming highlights the necessity of considering genetic data in combination with other clinical and environmental variables to realize valuable risk assessment.

The possibility of overdiagnosis and unneeded anxiety is another issue. Genetic risk identification does not necessarily mean that an individual will become a disease, and people can be psychologically distressed when they find out that they are vulnerable to the disease. This is the essence of genetic counseling to assist patients in comprehending the outcome of test results and make rational choices. Ethics are also a key issue in implementation of genetic screening. The concerns of the informed consent, confidentiality, and possible misuse of genetic data should be addressed (Cornel et al., 2024). Before going through the screening, patients should be thoroughly informed of the advantages, constraints and probable implications of genetic testings.

Also, genetic screening is still not equally available to various regions and populations. In poor and middle-income nations, there might be a lack of resources, infrastructure, and knowledge to make genetic technologies widespread. This brings issues of equity to the fore

and emphasizes the importance of policies that can enhance equitable access to genetic services. Genetic screening has opportunities and challenges as far as a nursing viewpoint is concerned. The role of nurses in genetic testing is frequently to educate patients, assist in informed consent and provide post-test counseling. This demands a good degree of genomic literacy and communication, and an awareness of ethical principles. Interdisciplinary cooperation is also required in the integration of genetic screening in the nursing practice. Nurses should collaborate closely with geneticists, physicians and other medical practitioners to make sure that genetic knowledge is translated into clinical practice. The method of collaboration is critical to the maximisation of the benefits of genetic screening and minimisation of possible risks.

Role of Genetic Counseling in Nursing Practice

Genetic counseling has become an essential part of the modern healthcare, especially when it comes to the complex and multifactorial conditions, like stroke. With the continued transformation of disease prevention and management with the latest advancements in genomics, the need to incorporate genetic knowledge into everyday clinical practice is becoming a requirement among nurses. This dynamic role places nurses in the nexus of science, communication and patient advocacy, and genetic counseling is a key competency of contemporary nursing. In its simplest form, genetic counseling is the process of assisting people in learning about the medical, psychological and familial impact of genetic contributions to disease. In stroke, this involves the explanation of genetic risk factors, and interpretation of test results, and helping patients make informed decisions regarding screening and preventive measures. This process is highly dependent on nurses because they have a close and constant contact with patients in most healthcare environments (Babkair et al., 2023).

Risk communication is one of the key tasks that nurses have to perform in genetic counseling. This will entail the complex genetic information being translated into a language that is understandable and significant to the patients. Since genomic data is technical, communicating effectively involves more than merely having a scientific background but good interpersonal skills as well. Nurses should make sure that patients comprehend that genetic risk is more likely than certain and that genetic predisposition does not mean that a disease is certain. Besides communication, nurses have a role of providing informed decision making. This involves giving the patients balanced information on the advantages, restrictions and the possible outcomes of genetic testing. The patients need to be assisted in balancing them with their own values, cultural beliefs, and family background. This is especially critical in the area of stroke prevention where the genetic screening decisions can have long-term consequences to the individuals and their families.

Emotional support is another important factor in genetic counseling as a nurse. Getting genetic risk information can be a stressful experience, which can result in anxiety, fear, or indecision. Nurses are well placed to offer caring support and allowing the patients to deal with these feelings and adapt to their risk status. Such psychosocial help is vital in making sure that the use of genetic information is positive and not a source of psychological stress. Genetic counseling is also an advocacy role of nurses. This entails protecting the rights of the patients such as confidentiality and autonomy, and also ensuring that ethical principles are considered in the utilization of genetic information. As an example, nurses should be cautious

of the unauthorised disclosure of sensitive genetic information, as well as preventing possible genetic risk discrimination.

Genetic literacy is a key to the implementation of genetic counseling into nursing practice. It has been demonstrated, however, that not all nurses are well trained in the field of genetics, and this may hamper their performance in this role (Babkair et al., 2023). This gap needs to be addressed by investing in education and professional development, which entails incorporation of genomics into nursing curriculum and continuing education programmes. The other important element of effective genetic counseling is interdisciplinary collaboration. Nurses should collaborate with geneticists, physicians and other specialists in the healthcare system to make sure that patients are provided with an integrated and holistic care. This cooperative method will improve the quality of risk assessment and help to create individual prevention plans.

The importance of genetic counseling by nurses is even more important in resource-constrained environments, including most low- and middle-income countries. The lack of access to specialised genetic services implies that nurses can be the main source of information and support to patients. This highlights the importance of contextual training and policies that enable nurses to effectively play this role. Moreover, genetic counseling in nursing is not only limited to individual patient care, but also family and community involvement. Since genetic information has repercussions to the biological family members, nurses should be able to look beyond the family and offer counseling. This can include promoting family talks on risk and access to screening of at-risk family members.

Ethical Considerations in Genetic Screening

Genetic screening as a tool in stroke prevention gives rise to a set of ethical issues that need to be maneuvered through to ensure an ethical and fair process of healthcare delivery. Though genetic technologies have profound advantages concerning the early diagnosis and individualised treatment, they also bring about complicated questions concerning autonomy, privacy, justice, and possible damages. These are especially ethical concerns in the nursing practice, where practitioners are directly engaged in the interaction and decision-making processes with patients. Respect of autonomy is one of the ethical principles in genetic screening. The patients are entitled to make informed choices on whether to undergo genetic testing or not, with a clear comprehension of what it entails. This involves thorough informed consent procedures which entails giving detailed information on the aim of the test, the possible results and the risks (Cornel et al., 2024). The role of nurses in this process is important as they should make sure that patients obtain the correct and comprehensible information. Ethical issues that are central include confidentiality and privacy. Genetic information in itself is sensitive in nature, since it does not only pertain to the individual, but it can also provide information about family members. There is a risk of abuses of genetic information, including employment or insurance discrimination, which are highly ethical and legal concerns. To protect patient information and ensure the confidence in the healthcare system, healthcare providers need to introduce strong data protection practices (Hachmeriyan et al., 2025).

Possible psychological damage is another critical concern. Anxiety, stress, and distorted self-perception may be the effects of learning about genetic predisposition to stroke. In others, there can be a feeling of fatalism and people feel that they are doomed to develop the condition despite the preventive measures. This highlights how necessary giving correct

counseling and support to the patients to enable them to interpret genetic information in a balanced and constructive way is. Access and equity are other ethical issues. Socioeconomic factors such as availability of genetic screening are usually responsible and result in unequal access to these services. In under-resource contexts, people might not be able to enjoy the gains of genomic medicine, and this will contribute to the already existing health disparities. To overcome these disparities, the policy interventions need to be made in a way that facilitates equal access to genetic technologies and that the benefits of the same are distributed equally.

Genetic screening also brings up the issues of possible overmedicalisation and unwarranted procedures. Genetic risk identification does not necessarily lead to clinical intervention, and there is even a threat of putting people at risk of unwarranted monitoring or treatment. This underscores the importance of evidence-based recommendations that clearly outlines the clinical usefulness of genetic testing in stroke prevention. Genetic screening is also affected by cultural and social aspects on the issue of ethics. Genetic beliefs, disease, and healthcare beliefs among population groups can be diverse and influence how people interpret and react to genetic information. Genetic conditions in certain cultures can be stigmatized whereby individuals may not be willing to undergo testing or reveal the outcomes. Nurses should embrace culturally sensitive practices during counseling whereby they must be respectful and responsive to different views.

Laws are also important in dealing with ethical dilemmas of genetic screening. The use, storage, and sharing of genetic data should be regulated by policies that will safeguard the rights of the patients and provide accountability. Nevertheless, in most areas, these structures are yet to be developed, which causes doubt and possible dangers. Ethical competence is required to overcome these challenges, in the nursing viewpoint. Nurses should be prepared with knowledge and skills to recognize ethical issues, make ethical decisions and defend rights of patients. This involves acquiring knowledge of pertinent laws, professional standards and ethics, and acquiring critical thinking and communication skills.

Psychosocial Implications and Patient Awareness

When genetic information is incorporated into stroke prevention, it brings about high psychosocial aspects that affect the way individuals perceive, interpret and act upon risk. Although genetic screening has a potential of early detection and personalised prevention, it can also impact on psychological well being, social relationships and health behaviours. These psychosocial implications are fundamental in order to make sure that genetic information is utilized positively and ethically in clinical practice. Anxiety is one of the most short-term psychological impacts of genetic testing. People who are informed that they are genetically predisposed to stroke can be more worried about their health, especially when they do not have a clear explanation of how genetic risk is probable. Uncertainty can further increase this anxiety particularly when the genetic discoveries fail to translate into clear predictions and interventions. In other instances, people might come to anticipatory stress where they always have fear of contracting illness.

On the other hand, others might get a false sense of security when genetic screening shows that they are at a low risk. This may result in complacency towards the risk factors that can be changed like diet, exercise and blood pressure. Thus, the communication of genetic risk should focus on the fact that genetic predisposition is not the only part of the overall risk and that lifestyle factors are of utmost importance. Stigma is another important psychosocial

problem. Genetic conditions are negatively perceived in most societies and this may result to social isolation, discrimination or unwillingness to disclose genetic information. This is especially applicable in a situation where stroke is not well known or in cases where health is explained by supernatural or moralistic factors. Stigma may lead to discouragement of individuals to have genetic testing or follow preventive measures and thus lower the potential advantages of genomic medicine.

Also of central importance to the psychosocial impact of genetic information is family dynamics. Since genetic risk is common to biological relatives, the outcomes of genetic testing may have implications to family members. This can lead to tension or conflict especially when people have a difference in the willingness to share or take action based on genetic information. In other cases, people might experience the feeling of responsibility or guilt about the passing of genetic risk to their children. The perception and use of genetic information is dependent on patient awareness and health literacy. Research has indicated that the knowledge about stroke risk factors, including genetic determinants is still low in most populations, especially in developing countries (Sakr et al., 2023). Poor health literacy may pose a barrier to knowledge on genetic concepts, resulting in misunderstanding and poor health behaviours.

To enhance patient awareness, specific educational approaches need to be culturally relevant and available. Nurses have a central role in this process as it is possible to explain the importance of genetic and modifiable risk factors, clarify misunderstandings, and emphasize the significance of these factors. The interventions should be designed to meet the needs of various populations, considering the language, cultural beliefs, and socioeconomic status. Psychosocial support should also be used to enable people to deal with the emotional burden of genetic information. Counseling services may offer individuals a secure environment where they can share their issues, discuss their emotions, and come up with coping mechanisms. Nurses as primary healthcare providers are in a good position to provide such support, and to refer patients to specialised services where appropriate.

The other factor that must be taken into consideration is the effects of genetic information on health behaviour. Although genetic risk awareness may encourage some people to lead healthier lives, others might react by being fatalistic or disengaged. Genetic information is effective in promoting behaviour change, but this requires proper communication and interpretation. This puts emphasis on the need to combine genetic counseling with behavioural interventions in order to increase its effects. The psychosocial effects of genetic screening are also affected by social determinants of health such as education, income and access to healthcare. Those with disadvantaged backgrounds can have extra obstacles to comprehending and taking action about genetic information, which worsens the current health disparities. These disparities need to be addressed using a wide spectrum that encompasses education, policy interventions, and community involvement.

Moreover, cultural beliefs and values influence the perception of genetic risk and healthcare interventions among individuals. Genetic testing might be opposed in certain cultures because of the fear of stigma, privacy or religious beliefs. Medical practitioners should embrace culturally competent attitudes that embrace such views but encourage informed decision-making. Finally, psychosocial consequences of genetic screening reveal the necessity of integrative approach to stroke prevention. Genetic information should be combined with psychological support, patient education and social context in order to make sure that it will

result in positive health outcomes. The nurses are at the centre of this process as they offer caring care, help in comprehending and enabling patients to take active part in their health.

Implications for Practice and Further Research

The implementation of genetic knowledge into stroke prevention has great impacts on clinical practice, health systems and future studies. With the ever-evolving nature of the genomics field, there is a need to put the newly acquired knowledge in terms of practical strategies that enhance patient outcomes and overcome ethical, social, and logistical issues. The need to integrate genetic risk assessment into the clinical care is among the most urgent practice implications. This includes the incorporation of genetic screening and counseling into the current health care systems especially among the high risk groups. Clinicians should be prepared to process genetic information and apply it to make clinical decisions. This necessitates coming up with standardised protocols and guidelines that will give an idea of when and how genetic testing is to be applied in preventing stroke.

The implications are especially important in the nursing practice. Nurses should acquire skills in genomic literacy, which entails, learning the concepts of genetics, interpreting test findings, and risk communication to patients. This requires introduction of genomics in nursing education and continuous professional development programmes. Lack of proper training can mean that the nurses are not able to perform their role of genetic counseling and patient education effectively. Another important aspect of the application of genetic approach to stroke prevention is the interdisciplinary collaboration. The proper application of genetic information involves collaboration among nurses, physicians and geneticists among other healthcare workers. This partnership style will provide patients with holistic care that will cover all their health needs. It also helps to incorporate genetic information into more extensive clinical and population health plans.

There are also issues of infrastructural and resource-related problems that need to be tackled by healthcare systems. Genetic screening involves the use of high-technology, qualified staff, and policies to be in place. These resources can be scarce in low- and middle-income countries, which can be an obstacle to implementing genomic medicine. To overcome these issues, it is necessary to invest in healthcare facilities, capacity building and policy formulation.

The other implication is that there is a necessity of strong ethical models that can help in the application of genetic information. With the growing availability of genetic technologies, the problems of privacy, consent, and data security will gain an even greater significance. To safeguard the rights of patients and preserve societal confidence, healthcare professionals have to comply with moral standards and legal obligations. Future studies need to develop the predictive value and clinical usefulness of genetic tests. Although there has been a lot of progress in the identification of genetic risk factors of stroke, more efforts are still required to improve the risk prediction models, as well as to come up with interventions that can be used to effectively reduce risks with respect to genetic information. These involve the investigation of the role of epigenetics, gene-environment interactions and new biomarkers.

The other important aspects of future work are education and awareness. Stroke risk and genetics are issues that can be enhanced by increasing awareness in the populace to make informed choices regarding their health. This should involve partnership between health care providers, policy makers and community organisations to come up with effective educational programmes. The new avenues of adopting genetic information to clinical practice include

technological progress, including digital health platforms and artificial intelligence. Genetic screening can be more affordable and efficient as these tools help to analyse the data, predict risk and provide personalised care.

Conclusion

Stroke prevention is undergoing a paradigm shift driven by advances in genetic research and the growing recognition of non-modifiable risk factors as critical determinants of disease susceptibility. This narrative review has demonstrated that stroke is not solely the outcome of modifiable lifestyle factors but rather a complex interplay of genetic, biological, environmental, and psychosocial influences. The expanding body of evidence on stroke genomics highlights the importance of integrating genetic insights into preventive and clinical frameworks to enable more precise and personalised healthcare approaches.

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