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Genetic Counselling in the Era of Virtual Reality: Expanding Access and Enhancing Understanding

Mahrukh Nasir[1]

[1]Consultant Genetic Counselor, Aga Khan University Hospital, Karachi, Pakistan.

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Corresponding Author:
Mahrukh Nasir
mahrukh.nasir@aku.edu.

Genetic counselling has become an indispensable component of modern healthcare, particularly in the context of rapidly advancing genomic technologies. As next-generation sequencing, carrier screening, and precision medicine become increasingly integrated into clinical practice, the demand for effective communication of complex genetic information has grown substantially. Genetic counselling not only facilitates informed decision-making but also addresses psychological, ethical, and familial implications associated with inherited conditions. However, accessibility, comprehension barriers, and limited specialist availability remain persistent global challenges.

Virtual Reality (VR) technology offers a promising adjunct to traditional genetic counselling models. By creating immersive, interactive learning environments, VR has the potential to transform how genetic information is delivered and understood. Complex concepts such as chromosomal inheritance, gene mutations, autosomal dominant and recessive patterns, and multifactorial risk can be difficult for patients to conceptualize through conventional verbal explanation or static diagrams. VR platforms can simulate three-dimensional genomic structures and inheritance pathways, allowing individuals and families to visualize genetic processes in a more intuitive manner. This experiential learning approach may improve comprehension, retention, and patient engagement.

Beyond educational enhancement, VR also has implications for emotional preparedness and psychological support. Genetic counselling often involves discussions surrounding hereditary cancer syndromes, prenatal anomalies, neurodegenerative disorders, or rare genetic diseases. These conversations can evoke anxiety and distress. Immersive simulations can be designed to guide patients through potential clinical pathways, helping them anticipate diagnostic procedures or treatment scenarios in a controlled and supportive environment. Such applications may reduce uncertainty and improve coping mechanisms.

In low- and middle-income countries, including regions where genetic counselling services are scarce, VR integrated with telemedicine platforms

could improve equitable access. Remote counselling sessions augmented with immersive modules may bridge geographical gaps and alleviate workforce shortages. Furthermore, VR-based standardized educational tools may support training programs for genetic counsellors, enhancing skill development in communication and ethical decision-making through simulated case scenarios.

Nevertheless, the integration of VR into genetic counselling practice requires careful evaluation. Ethical concerns regarding data privacy, digital equity, and technological literacy must be addressed. Evidence-based validation is essential to ensure that immersive tools genuinely improve patient outcomes rather than simply adding technological novelty. Randomized controlled studies assessing knowledge acquisition, decisional conflict, anxiety levels, and long-term satisfaction are necessary before widespread implementation.

Genetic counselling stands at the intersection of science, ethics, and human experience. Virtual Reality represents not a replacement for the empathic clinician but a complementary instrument that can enrich communication and accessibility. As genomics continues to reshape healthcare, innovative technologies such as VR should be explored thoughtfully to enhance understanding, empower patients, and promote equitable delivery of precision medicine.