

# Integrating Genetic Counselling in Competency-Based Medical Education

**Dr. Sharadkumar Pralhad Sawant<sup>1</sup>, Dr. Amit Manchanda<sup>2</sup>,  
Dr. Shaheen Rizvi<sup>3</sup>, Dr. Priyatama Sharadkumar Sawant<sup>4</sup>,  
Viren Sharadkumar Sawant<sup>5</sup>**

<sup>1</sup> Department of Anatomy, <sup>4</sup> Department of Ayush,  
Prince Medical College and Hospital, Sikar, Rajasthan, India

<sup>2</sup> Department of Anatomy, Prince Medical College and Hospital, Sikar, Rajasthan, India

<sup>3</sup> Department of Anatomy, Geetanjali Medical College, Geetanjali University,  
Udaipur, Rajasthan, India

<sup>5</sup> Final Year M.D., Volgograd University Medical College, Russia.

## Abstract

The rapid advancement of genetics and genomics has revolutionized modern medicine, transforming the diagnosis, prevention, and management of numerous hereditary and multifactorial diseases. In the era of precision medicine, genetic counselling has emerged as an indispensable component of healthcare delivery, enabling patients and families to understand genetic risks, inheritance patterns, diagnostic options, and preventive strategies. Competency-Based Medical Education (CBME), introduced by the National Medical Commission, emphasizes learner-centered education, clinical competence, ethical practice, communication skills, and patient-centered care. Incorporating genetic counselling into CBME is essential for preparing future physicians to address the growing burden of genetic disorders and to apply genomic knowledge effectively in clinical practice. Genetic counselling enhances students' understanding of medical genetics, improves communication abilities, promotes ethical decision-making, and strengthens empathetic patient care. It also supports preventive medicine, reproductive counselling, neonatal screening, cancer genetics, and personalized therapeutics. The present article explores the significance, principles, applications, educational relevance, challenges, and future prospects of genetic counselling within the framework of CBME. The integration of genetic counselling into undergraduate medical education can substantially improve healthcare quality, promote ethical medical practice, and advance precision medicine in modern healthcare systems.

**Keywords:** Genetic Counselling, Competency-Based Medical Education, Medical Genetics, Precision Medicine, Ethical Healthcare, Genomics, Medical Education, Genetic Disorders

## 1. Introduction

The field of medical genetics has undergone extraordinary progress during the past few decades due to advancements in molecular biology, genomics, biotechnology, and diagnostic medicine. Genetic disorders contribute significantly to morbidity, mortality, congenital anomalies, infertility, intellectual

disabilities, metabolic diseases, and cancers worldwide. Consequently, healthcare professionals increasingly encounter patients requiring genetic evaluation and counselling. (1)

Genetic counselling is a specialized communication process that assists individuals and families in understanding the medical, psychological, familial, and reproductive implications of genetic diseases. It involves risk assessment, interpretation of family history, explanation of inheritance patterns, discussion of diagnostic investigations, and guidance regarding preventive and therapeutic options. (2)

Modern medical education is shifting toward Competency-Based Medical Education (CBME), which focuses on outcome-based learning, skill acquisition, ethical professionalism, communication competence, and lifelong learning. Within this educational framework, genetic counselling occupies a vital position because future physicians must possess adequate genomic literacy and counselling competencies to provide holistic patient care. (3)

The integration of genetic counselling into CBME helps medical students develop scientific knowledge, empathy, ethical sensitivity, clinical reasoning, and communication skills essential for contemporary healthcare practice. As genomic medicine becomes increasingly important in specialties such as pediatrics, obstetrics, oncology, endocrinology, neurology, and reproductive medicine, the need for competent physicians trained in genetic counselling continues to grow.

The present article discusses the importance of genetic counselling in CBME and highlights its educational, clinical, ethical, and societal implications. (4)

## **Material and Methods**

The present article is a narrative review based on an extensive analysis of literature related to genetic counselling, medical genetics, genomics, and Competency-Based Medical Education.

Relevant information was collected from textbooks of medical genetics, peer-reviewed scientific journals, educational guidelines, and publications from databases such as PubMed, Scopus, Google Scholar, and Web of Science. Literature published between 2000 and 2025 was reviewed using keywords including “Genetic Counselling,” “Competency-Based Medical Education,” “Medical Genetics,” “Genomic Medicine,” “Ethics in Genetics,” and “Precision Medicine.”

The collected data were critically evaluated, organized, and synthesized to develop a comprehensive understanding of the importance of genetic counselling in undergraduate medical education.

## **Concept of Genetic Counselling**

### **Definition**

Genetic counselling is a communication process that aims to help individuals and families understand and adapt to the medical, psychological, familial, and social implications of genetic disorders.

### **Objectives of Genetic Counselling**

- i. Assessment of genetic risk
- ii. Explanation of inheritance patterns
- iii. Interpretation of genetic test results
- iv. Guidance regarding reproductive choices
- v. Emotional and psychological support
- vi. Promotion of preventive healthcare
- vii. Facilitation of informed decision-making

## **Competency-Based Medical Education (CBME)**

### **Overview**

CBME is an outcome-oriented educational approach designed to ensure that medical graduates acquire essential competencies required for patient care and professional practice.

### **Core Principles of CBME**

- i. Student-centered learning
- ii. Competency acquisition
- iii. Integration of knowledge, skills, and attitudes
- iv. Early clinical exposure
- v. Self-directed learning
- vi. Reflective practice
- vii. Continuous assessment

The CBME curriculum implemented by the National Medical Commission recognizes the importance of communication skills, ethics, professionalism, and patient-centered care, all of which are integral to genetic counselling.

## **Importance of Genetic Counselling in CBME**

### **1. Enhancing Understanding of Medical Genetics**

Genetic counselling improves students' comprehension of:

- i. Chromosomal disorders
- ii. Single-gene disorders
- iii. Multifactorial inheritance
- iv. Mitochondrial inheritance
- v. Prenatal genetic abnormalities
- vi. Cancer genetics
- vii. Pharmacogenomics

This knowledge forms the foundation for precision medicine and evidence-based healthcare.

### **2. Promoting Patient-Centered Communication**

Genetic counselling requires physicians to communicate complex scientific information in a compassionate and understandable manner. Medical students learn:

- i. Effective communication skills
- ii. Active listening
- iii. Empathy
- iv. Cultural sensitivity
- v. Non-directive counselling approaches

These skills significantly improve doctor-patient relationships.

### **3. Strengthening Ethical and Professional Competencies**

Genetic counselling exposes students to important ethical issues such as:

- i. Confidentiality
- ii. Informed consent
- iii. Prenatal diagnosis

- iv. Selective termination
- v. Genetic discrimination
- vi. Disclosure of genetic risks

CBME emphasizes ethical professionalism, making genetic counselling highly relevant in medical training.

#### **4. Supporting Preventive and Predictive Medicine**

Genetic counselling contributes greatly to preventive healthcare by identifying individuals at risk for hereditary disorders. It facilitates:

- i. Carrier screening
- ii. Prenatal diagnosis
- iii. Neonatal screening
- iv. Cancer risk assessment
- v. Lifestyle modifications
- vi. Early therapeutic interventions

This aligns with the preventive and community-oriented goals of CBME.

#### **5. Developing Clinical Decision-Making Skills**

Medical students participating in genetic counselling learn:

- i. Family pedigree analysis
- ii. Risk calculation
- iii. Diagnostic interpretation
- iv. Clinical reasoning
- v. Evidence-based management

These competencies improve diagnostic accuracy and clinical judgement.

#### **6. Advancing Precision Medicine**

Precision medicine utilizes genetic information to personalize treatment strategies. Genetic counselling helps future physicians understand:

- i. Genomic diagnostics
- ii. Personalized therapeutics
- iii. Pharmacogenomics
- iv. Targeted therapies
- v. Individualized patient management

This represents the future of modern medicine. (5)

### **Applications of Genetic Counselling in Clinical Practice**

#### **1. Prenatal and Reproductive Counselling**

- i. Consanguineous marriages
- ii. Recurrent pregnancy loss
- iii. Congenital anomalies
- iv. Advanced maternal age
- v. Prenatal screening

## **2. Pediatric Genetics**

- i. Developmental delay
- ii. Metabolic disorders
- iii. Congenital malformations
- iv. Intellectual disabilities

## **3. Cancer Genetics**

- i. Breast cancer
- ii. Ovarian cancer
- iii. Colorectal cancer
- iv. Familial cancer syndromes

## **4. Neurological Disorders**

- i. Muscular dystrophy
- ii. Huntington disease
- iii. Neurodegenerative disorders

## **5. Pharmacogenomics**

- i. Drug response prediction
- ii. Adverse drug reaction prevention (6)

## **Teaching Genetic Counselling in CBME**

1. Teaching Methods
2. Lectures
3. Provide foundational knowledge of genetics and counselling principles.
4. Case-Based Learning
5. Enhances clinical application and problem-solving abilities.
6. Role Play and Simulations
7. Improve communication and counselling skills.
8. Early Clinical Exposure
9. Allows interaction with patients having genetic disorders.
10. Integrated Teaching
11. Combines anatomy, physiology, biochemistry, pathology, and clinical medicine.
12. Self-Directed Learning
13. Encourages independent exploration of genetic advancements. (7)

## **Challenges in Teaching Genetic Counselling**

1. Limited Faculty Expertise
2. Many institutions lack trained genetic counsellors and educators.
3. Inadequate Infrastructure
4. Limited availability of molecular diagnostic facilities affects practical exposure.
5. Rapidly Expanding Knowledge
6. Continuous advancements in genomics make curriculum updating challenging.
7. Ethical Complexity

8. Genetic information often involves sensitive ethical and social issues.
9. Psychological Impact
10. Students must learn to address emotional responses of patients and families compassionately. (8)

### **Discussion**

The growing burden of genetic diseases and the emergence of genomic medicine have transformed healthcare delivery worldwide. Consequently, physicians require not only scientific knowledge but also communication, ethical, and counselling competencies to manage genetic conditions effectively. (9) CBME provides an ideal educational framework for integrating genetic counselling into undergraduate medical education. Unlike traditional rote-based teaching, CBME promotes competency acquisition, reflective learning, and holistic patient care. Genetic counselling perfectly complements these objectives by fostering clinical reasoning, ethical sensitivity, professionalism, and empathetic communication. (10) Medical students trained in genetic counselling become better equipped to identify hereditary disorders, interpret genetic investigations, counsel patients regarding risks and preventive measures, and support informed decision-making. Furthermore, genetic counselling strengthens preventive medicine by enabling early diagnosis and timely interventions. (11)

The incorporation of genetic counselling into CBME also supports interdisciplinary learning. Students integrate knowledge from anatomy, embryology, physiology, biochemistry, pathology, pediatrics, obstetrics, oncology, and psychiatry. Such integration enhances deeper understanding and long-term retention of concepts. (12)

Despite its importance, several challenges hinder implementation, including lack of trained faculty, insufficient infrastructure, limited awareness, and curriculum overload. Institutions must therefore strengthen faculty development programs, establish genetic counselling units, promote interdisciplinary teaching, and utilize digital learning technologies to improve genetic education.

As medicine moves toward precision healthcare, physicians with competencies in genetic counselling will play an increasingly important role in disease prevention, diagnosis, and individualized treatment.

### **Conclusion**

Genetic counselling has become an essential component of modern healthcare and medical education. In the framework of Competency-Based Medical Education, it significantly contributes to the development of competent, ethical, empathetic, and scientifically skilled physicians.

The integration of genetic counselling into CBME enhances students' understanding of medical genetics, communication skills, ethical decision-making abilities, clinical reasoning, and patient-centered care. It also supports preventive medicine, precision healthcare, and lifelong learning.

Medical institutions should therefore prioritize structured teaching of genetic counselling through integrated curricula, clinical exposure, simulation-based training, faculty development, and interdisciplinary collaboration. Strengthening genetic education in undergraduate medical training will ultimately improve healthcare quality, promote ethical practice, and advance the future of precision medicine.

### **Declaration by Authors**

**Ethical Approval:** Approved

**Acknowledgement:** The authors are thankful to Dr. Piyush Sunda, Paediatrician, Chairman of Prince Eduhub and Prince Hospital, and Dr. Ramratan Yadav, Consultant Surgeon and Professor at Government Medical College, Sikar. The authors are also thankful to the faculty and staff of the Department of Anatomy, Prince Medical College, for their continuous support and encouragement throughout the study. Special appreciation is extended to the body donors and their families whose noble contribution to medical education continues to inspire generations of future doctors. Authors also acknowledge the immense help received from the scholars whose articles are cited and included in references of this manuscript. The authors are also grateful to authors / editors / publishers of all those articles, journals and books from where the literature for this article has been reviewed and discussed.

**Source of Funding:** None.

**Conflict of Interest:** The authors declare no conflict of interest.

**Authors' contributions:** Sharadkumar Pralhad Sawant (SPS) conceptualized the study, designed the framework of the manuscript, and prepared the original draft with critical intellectual inputs. Priyatama S. Sawant (PSS) substantially assisted in scientific writing, organization of content, and refinement of the manuscript. Viren S. Sawant (VSS) carried out an extensive and systematic review of the relevant literature and contributed to the compilation of scholarly references. S. Rizvi (SR) performed meticulous proofreading, language editing, grammatical corrections, and Amit Manchanda (AM) done plagiarism assessment to ensure the academic integrity and originality of the manuscript. All authors reviewed and approved the final version of the manuscript for publication.

## References

1. Harper PS. Practical Genetic Counselling. 8th ed. Boca Raton: CRC Press; 2021.
2. National Medical Commission. Competency-Based Undergraduate Curriculum for the Indian Medical Graduate. New Delhi: NMC; 2019.
3. Nussbaum RL, McInnes RR, Willard HF. Thompson and Thompson Genetics in Medicine. 9th ed. Philadelphia: Elsevier; 2023.
4. Biesecker BB, Peters KF. Process studies in genetic counseling: Peering into the black box. *Am J Med Genet.* 2001;106(3):191-198.
5. Skirton H, Patch C. Factors affecting the clinical use of genetic testing by medical specialists. *Public Health Genomics.* 2013;16(4):156-163.
6. Offit K. Genomic profiles for disease risk: Predictive or premature? *JAMA.* 2008;299(11):1353-1355.
7. Dr. S. P. Sawant, Dr. S. Rizvi, Role of Clinical Anatomy in First MBBS Curriculum, *MOJ Anatomy and Physiology* 2017; Vol 3, Issue 1; Received: May 24, 2016 | Published: January 9, 2017, 0076 Peer-reviewed open access journal *Genamics Journal Seek*, Similarity Check, Scilit, OCLC, World Cat, ROAD. eISSN: 2471-139X, DOI: [10.15406/mojap.2017.03.00076](https://doi.org/10.15406/mojap.2017.03.00076)
8. Korf BR, Berry AB, Limson M, et al. Framework for development of physician competencies in genomic medicine. *Genet Med.* 2014;16(11):804-809.
9. Burke W, Emery J. Genetics education for primary-care providers. *Nat Rev Genet.* 2002;3(7):561-566.
10. Dr. S. P. Sawant Dr. S. Rizvi, Teaching Anatomy to Undergraduate Students, *International Journal of Anatomy and Research*, 2015, Vol 3, Issue 3, Page No. 1212-15, Open Access, Peer Reviewed, Quarterly Publishing Online/Print Journal SCOPUS, Index Medicus for South East



Asia Region (IMSER), Sherpa Romeo, SC Imago Journal & Country Rank, DOI: <http://dx.doi.org/10.16965/ijar.2015.172>

11. Lea DH, Kaphingst KA, Bowen D, Lipkus I, Hadley DW. Communicating genetic and genomic information: Health literacy and numeracy considerations. *Public Health Genomics*. 2011;14(4-5):279-289.
12. Guttmacher AE, Collins FS. Genomic medicine — A primer. *N Engl J Med*. 2002;347(19):1512-1520.
13. Dr. S. P. Sawant, Dr. S. Rizvi, ECE As A Novel Teaching-Learning Method In Curriculum of Anatomy, *International Journal of Anatomy and Research*, 2015, Vol 3(3):1207-11. Open Access, Peer Reviewed, Quarterly Publishing Online/Print Journal SCOPUS, Index Medicus for South East Asia Region (IMSER), Sherpa Romeo, SC Imago Journal & Country Rank, DOI: <http://dx.doi.org/10.16965/ijar.2015.171>