"VASILE GOLDIȘ" WEST UNIVERSITY OF ARAD
MULTIDISCIPLINARY DOCTORAL SCHOOL
MEDICINE DOMAIN

Modern Integrative Medicine: Linking Genetic Susceptibility, Innovation in Biomaterials, and Preventive Strategies in a Translational Approach to Human Pathology

HABILITATION THESIS

ABSTRACT

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Arad, 2026

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The habilitation thesis entitled “Modern Integrative Medicine: Linking Genetic Susceptibility, Innovation in Biomaterials, and Preventive Strategies in a Translational Approach to Human Pathology” summarises the main research directions, professional activity, and academic contributions developed after obtaining the degree of Doctor of Medicine and highlights the progressive consolidation of an interdisciplinary academic profile oriented toward integrative and translational medicine. Currently, I hold the position of associate professor in the departments of Genetics and Odontotherapy, with teaching responsibilities in Endodontics and Complementary Therapies at the Faculty of Dentistry of the “Vasile Goldiș” Western University of Arad. Additionally, I hold the title of senior physician in general dentistry and senior physician in endodontics, with expertise in acupuncture and homoeopathy, and I coordinate the residency program in the specialty of General Dentistry.

The paper is structured into three sections. Section I presents the evolution of my scientific, professional, and academic career, as well as the definition of the three major research directions that have emerged throughout my career. This section is organized into four chapters: Chapter 1 – Summary of scientific, professional, and academic achievements; Chapter 2 – Genetic Susceptibility and Clinical Implications in Human Pathology; Chapter 3 – Biomaterial Performance and Material–Biological Tissue Interaction; Chapter 4 – An Integrative Model for the Prevention of Oral Pathologies and Occupational Risk Factors: The Interaction Between Behavior, Biological Microenvironment, and Therapeutic Interventions in Translational Medicine.

The scientific work carried out during this period focused on understanding the biological mechanisms underlying human pathology and on identifying innovative

solutions for diagnosis, treatment, and prevention tailored to the individual characteristics of each patient. In this regard, the thesis is structured around three major, complementary research directions that integrate the genomic perspective on disease with the development of functional biomaterials and modern prevention strategies. The first research focus of my career is the study of genetic susceptibility and phenotypic variability in human pathology, with an emphasis on the clinical and developmental analysis of rare genetic syndromes. The research conducted aimed to characterise clinical manifestations longitudinally, correlate them with identified genetic alterations, and highlight the role of modifier factors in the phenotypic expression of the disease. The investigation of conditions such as orofacial-digital syndrome type I, Wolf–Hirschhorn syndrome, and Adams–Oliver syndrome type 3 has highlighted the complexity of the pathogenic mechanisms involved and the heterogeneity of disease progression, aspects with direct implications for clinical management and genetic counselling. My personal contributions focused on documenting the natural history of these syndromes across different clinical contexts, integrating imaging and molecular data into the diagnostic process, and formulating hypotheses about the roles of chromosomal mosaicism and modifier genetic variants in shaping phenotypic variability. These results support the need to adopt an integrative genomic model, in which individualised analysis of the genetic profile becomes an essential element in establishing therapeutic and preventive strategies. In this context, the research direction aligns with current trends in modern medicine, oriented toward personalised medicine and the use of complex biological data to optimise clinical decisions.

A second research direction addresses the role of functional biomaterials and preventive strategies within regenerative medicine and the management of chronic inflammatory pathology. The studies conducted analysed the interaction between biomaterials and the tissue environment, the mechanisms involved in biological integration and bone remodelling, and the influence of microbial biofilms on clinical progression. This research direction highlights the conceptual shift from predominantly structural therapeutic approaches toward biologically oriented interventions aimed at stimulating tissue regeneration and improving treatment predictability. The results obtained have contributed to understanding how bioactive biomaterials and

nanomaterials can influence the inflammatory response, mineralisation processes, and the long-term stability of therapeutic interventions. Concurrently, the research has highlighted the importance of microbial biofilm control and personalised preventive interventions in reducing the risk of chronic pathology. An integrated analysis of biological, genetic, and behavioural factors has enabled the formulation of explanatory models regarding the progression of inflammatory diseases and the identification of avenues for early intervention.

A third relevant area is represented by modern prevention and health education strategies, integrated into a patient-centred model of medicine focused on early risk identification. This approach addresses the role of preventive strategies and health education in reducing the risk of chronic disease and optimising treatment outcomes. Analysis of the interaction between genetic, biological, and behavioural factors has highlighted the importance of early preventive interventions and their adaptation to the patient's individual profile. This perspective highlights that medical progress depends not only on technological innovation but also on the healthcare system's ability to integrate scientific knowledge into current practice and promote effective preventive behaviours.

The three major directions are united by a shared vision oriented toward translational medicine, in which the results of basic research are applied in clinical practice and contribute to the development of therapeutic and preventive models tailored to the patient's biological complexity. Overall, the thesis highlights the maturation of a coherent academic trajectory and the consolidation of an independent research direction, characterised by the integration of genetic susceptibility, innovation in biomaterials, and preventive strategies within a modern conceptual framework, with direct relevance to contemporary medicine and the development of medical interventions tailored to the individual needs of the patient.

Teaching and clinical work are presented as integral to academic development, contributing to the validation of scientific observations and the formation of a comprehensive medical perspective. My involvement in teaching genetics and other specialities, coordinating student activities, and participating in interdisciplinary projects reflects my active role in training future generations of professionals and promoting evidence-based medicine.

The second section describes the plans for the evolution and development of my professional, scientific, and academic career, as well as the strategies for implementing these development directions.

The third section presents the bibliographic sources that outline the scientific context of the studies conducted and the professional contributions presented in this thesis.