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DOCTORAL SCHOOL | FIELD OF MEDICINE

HABILITATION THESIS

EXPLORING THE INTERSECTION OF IMMUNOLOGY, NANOMEDICINE, AND INFLAMMATORY SYNDROMES: PATHOPHYSIOLOGY AND A MULTIDISCIPLINARY PERSPECTIVE ON SYSTEMIC HEALTH

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My habilitation thesis, entitled *Exploring the Intersection of Immunology, Nanomedicine, and Inflammatory Syndromes: Pathophysiology and a Multidisciplinary Perspective on Systemic Health*, represents a comprehensive synthesis of my professional, academic, and scientific activity, as well as a projection of my future research directions. The thesis is structured into three major sections: scientific, professional, and academic achievements (Section I); career perspectives and future development objectives (Section II); and general conclusions (Section III).

The thesis lies at the intersection of three major fields—immunology, nanomedicine, and inflammatory syndromes—and proposes an integrated vision of systemic health, with practical implications for fundamental research, clinical applications, and medical education.

Over the course of two decades of activity, I have developed a solid portfolio of interdisciplinary research, reflected in articles published in peer-reviewed journals, book chapters, and participation in national and international research projects. As detailed in Section I, my research is structured around three major directions: (i) the pathophysiology of autoimmune diseases and immunology (1.2.1), (ii) nanomedicine in pathophysiology and therapy (1.2.2), and (iii) the pathophysiology of infections and systemic health (1.2.3). My contributions include highlighting the role of chronic inflammation and immune dysregulation in pathologies such as rheumatoid arthritis, systemic lupus erythematosus, and ankylosing spondylitis, emphasizing the complex links between periodontal health and cardiovascular risk. Overall, these results strengthen the connection between fundamental immunological mechanisms and their implications for systemic health.

Another major research direction, detailed in Section I, subsection 1.2.2, concerns nanomedicine, where I have participated in the design and characterization of nanometric materials and structures with direct medical applications, such as antibacterial gels and coatings, controlled drug-delivery systems, and biomaterials with regenerative potential. These studies highlight their translational value by integrating nanotechnology into modern therapeutic approaches and by addressing challenges generated by antimicrobial resistance and chronic diseases that are difficult to treat.

The thesis also emphasizes a consistent teaching and mentoring activity, presented in Section I, subsection 1.1, carried out both at the university level within the *"Carol Davila" University of Medicine and Pharmacy* and in pre-university education. Between 2008 and 2025, I taught courses and practical sessions in pathophysiology and immunology and supervised more than 70 undergraduate and master's theses, contributing to the training of future generations of physicians

and researchers. In parallel, I have served as a biology teacher at the *"Mihai Viteazul" National College* in Bucharest and as a coordinator of national Olympiad teams under the Ministry of Education and Research, playing an important role in preparing students for national and international competitions—a role recognized through numerous national and international distinctions and awards. This dual involvement—within both higher education and pre-university education—reflects a strong educational vocation, complemented by academic management and coordination activities.

Regarding future perspectives, presented in Section II of the thesis, I propose the consolidation of research in the major directions that already define my activity—immunology, nanomedicine, and pathophysiology—while also developing complementary areas such as oral and systemic pathology, as well as educational innovation. The objectives include expanding interdisciplinary and international collaborations (2.1), attracting competitive research grants, and implementing translational projects (2.2) that integrate immunological and nanotechnological approaches in addressing public health challenges such as antimicrobial resistance and emerging infections. I also plan to publish additional research articles, book chapters, and review papers (2.3) aimed at strengthening the international visibility of these studies and ensuring the dissemination of results to the scientific and biomedical community.

As emphasized in Section III of the thesis, the impact of my activity manifests at three major levels: (i) advancing biomedical science through the elucidation of pathophysiological mechanisms and the proposal of innovative therapeutic approaches, (ii) strengthening biomedical education through the implementation of modern teaching and mentoring methods, and (iii) contributing to public health through the integrated approach to autoimmune diseases, infectious pathologies, and the challenges generated by nanomedicine.

In conclusion, the habilitation thesis reflects my ability to integrate scientific research, teaching activity, and academic coordination roles into a coherent and evolving professional endeavor. The contributions presented confirm the originality and relevance of the research directions developed, their formative impact on students and young researchers, and my commitment to strengthening the international visibility of Romanian biomedical science. These elements naturally justify the habilitation as an essential step in the consolidation of my academic and professional career.