



**IOSUD TITU MAIORESCU UNIVERSITY OF
BUCHAREST
DOCTORAL SCHOOL OF MEDICINE**



HABILITATION THESIS SUMMARY

CURRENT TRENDS AND FUTURE PERSPECTIVES IN THE ASSESSMENT OF MICROCIRCULATION AND THE MANAGEMENT OF PATIENTS WITH SEPSIS AND SEPTIC SHOCK

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Throughout my professional, academic, and scientific research career, I have been constantly concerned with optimizing the management of critically ill patients. Since the beginning of my research activity, one of my main areas of interest has been the study of sepsis and septic shock, from a thorough understanding of its physiopathology, the development of innovative methods of treatment and early diagnosis, the use of artificial intelligence, and the follow-up of survivors after an episode of sepsis and the study of post-sepsis syndrome.

I presented my initial research in this field in my doctoral thesis entitled "Early diagnosis of septic shock through non-invasive exploration of oral microcirculation," defended in 2022. I subsequently continued my postdoctoral research, which is presented alongside the objectives, plans, and future directions of research in my habilitation thesis entitled "Current developments and perspectives in the assessment of microcirculation and the management of patients with sepsis and septic shock."

The thesis is structured in 12 chapters, preceded by a table of contents and abstract, followed by a bibliography containing the references on which the habilitation thesis was based, including publications to which I personally contributed in the chosen field.

In the first chapter, we presented the main pathophysiological mechanisms of septic shock, the role of microcirculation in the progression of sepsis, and recent developments in this field, such as the implementation of artificial intelligence in the diagnosis of septic shock, which has the potential to revolutionize the management of these patients. The study's conclusions emphasize that artificial intelligence provides tools for early diagnosis and prognosis, as well as for personalizing treatment. Machine learning and deep learning algorithms have been shown to detect sepsis with superior sensitivity and specificity compared to conventional methods, sometimes up to 12 hours before the onset of obvious clinical symptoms. At the same time, the effective and ethical implementation of these technologies requires interdisciplinary collaboration between physicians, researchers, and engineers, as well as the development of clear regulatory and data protection policies.

The contribution made by this research effort is in line with the consolidation of personalized medicine and the integration of advanced digital tools into clinical practice, with a direct impact on reducing mortality and improving the quality of care in intensive care units.

The second chapter is dedicated to conventional methods and techniques for evaluating microcirculation. Research and innovation in this

field led to the granting of a patent in 2024 by the Romanian State Office for Inventions and Trademarks for the invention "Digital Videocapillaroscope," a device developed in collaboration with recognized specialists from various fields (engineers and doctors from different specialties: Anesthesia and Intensive Care, General Surgery, and Cardiovascular Surgery). Our invention has received internal and international validation through more than 45 awards (gold medals and special prizes) during participation in high-value scientific events dedicated to innovation, invention, and scientific creativity.

The third chapter analyzes technological innovations in the study of microcirculation. Recent advances in imaging and physiological monitoring have opened up new perspectives for the assessment of microcirculation, overcoming the limitations of conventional methods and providing a better understanding of microvascular dysfunction in septic shock. These technologies are distinguished by their ability to provide real-time, non-invasive or minimally invasive data with superior resolution and increased sensitivity to subtle changes in tissue perfusion.

Chapter IV, entitled "Protocol for the assessment of microcirculation in septic shock," combines early diagnosis, multimodal monitoring, biomarker integration, targeted therapeutic interventions, and an educational and operational feedback system. Through its systematic application, clinical variability can be reduced, therapeutic decisions can be improved, and the survival rate for critically ill patients can be significantly increased.

Chapter V is entitled "Therapeutic results in the assessment of microcirculation in septic shock". This study resulted in the publication of other articles in prestigious ISI-indexed journals, presentations at various scientific events, and the publication of the monograph entitled "Perspectives in the early diagnosis of sepsis and septic shock" (Hamangiu Publishing House, 2023).

Therapeutic results and prognosis remain strongly influenced by the persistence of microcirculatory dysfunction, the recurrence of infections, and the impact on long-term quality of life. In this regard, artificial intelligence and big data analysis open up new perspectives for predicting evolution and personalizing interventions.

Chapter VI describes therapeutic outcomes in immunocompromised patients with sepsis, immune system impairment and infection risks, the interaction between sepsis and cancer, diagnostic challenges, management strategies, gaps and future directions for research, and implications for clinical practice and recommendations. This study was published in the prestigious journal *Critical Care*, ISI indexed with an impact factor of 8.8, and received funding from the Division of Pulmonary and Critical Care Medicine at the Mayo Clinic, Rochester, USA.

Septic shock in immunocompromised cancer patients is a major emergency, with a still severe prognosis, but with prospects for improvement through an integrated and personalized approach. Early diagnosis, rapid and appropriate antibiotic therapy, early admission to intensive care units, and multidisciplinary management are key elements in reducing mortality. At the same time, the use of emerging technologies and the development of strategies tailored to the immunological characteristics of these patients can contribute decisively to improving outcomes.

Chapter VII summarizes my research concerns regarding conventional and modern methods used in the diagnosis of sepsis and septic shock. This study was published in the Romanian Journal of Military Medicine.

The comparison between conventional and modern methods in the diagnosis of sepsis and septic shock shows that the future management of these patients depends on an integrated approach. Clinical scores and standard biomarkers remain the cornerstones, but they must be complemented by advanced biomarkers, rapid molecular tests, and continuous digital monitoring. Artificial intelligence algorithms represent a promising frontier, capable of transforming complex data into real support for clinical decision-making.

The gradual implementation of these technologies can lead to early diagnosis, personalized treatment, and, implicitly, a reduction in mortality and the burden on the healthcare system. In the long term, integrating modern methods into clinical practice will not only save lives but also redefine standards of care in sepsis and septic shock, paving the way for precision intensive care medicine.

Chapter VIII, entitled "New perspectives in microcirculation research in sepsis," confirms that sepsis management must go beyond the traditional approach focused exclusively on macrocirculation and integrate the assessment of microcirculation and endothelial dysfunction. High-risk populations require personalized protocols based on specific biomarkers, advanced monitoring, and tailored therapies.

Precision-guided resuscitation, judicious use of antibiotics, and exploration of host-directed immunotherapies are promising avenues for optimizing outcomes. At the same time, recognition and management of post-sepsis syndrome must become an integral part of care.

Future research should focus on developing personalized diagnostic and treatment strategies that take into account the particularities of each vulnerable group. Inflammatory and endothelial biomarkers, targeted immunotherapy, innovative antimicrobial approaches (including bacteriophage therapy and antimicrobial peptides), and nanotechnology applied to drug delivery are areas with significant potential.

Chapters IX and X refer to the evolution of my scientific and academic career, as well as my professional career, and present my achievements in interdisciplinary and transdisciplinary thematic areas, as well as my managerial skills in research.

My medical career has included successive stages in prestigious clinical units, where I have gained relevant experience in medical management, coordination of activities, and advanced clinical skills in critical patient management.

From the beginning of my professional career, I have aimed to combine clinical and research work with regular participation in national and international conferences dedicated to anesthesia, intensive care, and perioperative medicine. These academic events have given me the opportunity to present the results of my own research, in the form of oral presentations or scientific posters in front of specialists with recognized expertise in the field.

Participating in these events has been an opportunity to explore current topics, compare and integrate different perspectives, and contribute to the development of interdisciplinary links. Thus, each congress and conference provided a framework for learning and knowledge exchange, which helped me to consolidate my professional skills and cultivate an academic attitude oriented towards innovation and collaboration.

At the same time, these experiences have been a veritable school of professional training and maturation, developing my skills in scientific communication, knowledge management, and integration into international research teams. Through this journey, I have been able to capitalise on and promote the results of my research work in a competitive international environment, thus contributing to increasing my academic and professional visibility.

My academic training is complemented by training in health management. I obtained a certificate of complementary studies in Health Services Management from the National School of Public Health, Management, and Professional Development in Healthcare in Bucharest, and subsequently enrolled in a Master's program in Health Services Management (Academy of Economic Studies in Bucharest, 2023–2025). This additional training provides me with the tools necessary to integrate the managerial dimension with clinical practice and scientific research in order to optimize educational and medical processes. I also obtained a Master's degree in Medical Law from the Faculty of Law at Titu Maiorescu University.

Currently, I am an Associate Professor at Titu Maiorescu University, Faculty of Medicine, where I teach, coordinate, and conduct research in the field of Anesthesia and Intensive Care. I also work as a primary intensive care physician, doctor of medicine, at the CF2 Clinical Hospital in Bucharest and

as a grade III scientific researcher at the National Institute for Research and Development in Microtechnology, contributing to the development of interdisciplinary collaborations and the integration of medical research in the context of applied sciences.

My managerial and research coordination skills are demonstrated through my involvement in interdisciplinary projects and the publication of original scientific articles in ISI-indexed international journals. These achievements reflect both my ability to lead and organize work teams and to promote academic excellence through applied and fundamental research activities.

The entire professional career reflects a constant focus on academic excellence, clinical performance, and scientific innovation, supporting both personal development and contribution to the progress of the medical field.

Chapter XI is dedicated to presenting research perspectives. Despite technological advances, the clinical implementation of microcirculation assessment techniques and personalized treatment strategies faces several obstacles. One of the biggest challenges in research on microcirculation assessment in sepsis is the lack of clear standards for interpreting measurements. Currently, there are significant variations between the devices used, the methods of analysis, and the criteria for classifying microcirculatory dysfunction. Without rigorous standardization, comparing results between different studies becomes difficult, and their clinical application remains limited. It is essential to develop guidelines that establish reference parameters for normal and pathological microcirculation so that physicians can make informed decisions based on well-defined criteria. Such an approach would allow early identification of high-risk patients and facilitate the assessment of the impact of therapeutic interventions on tissue perfusion.

Another major obstacle to the integration of microcirculation assessment technologies into clinical practice is their accessibility. Currently, devices for sublingual videocapillaroscopy or near-infrared spectroscopy are only available in research centers or elite medical facilities, which limits their widespread use. For these technologies to become a routine tool in intensive care, it is necessary to develop more affordable, easier-to-use variants that can be integrated into existing equipment in intensive care units.

Chapter XII addresses prospects in the academic and scientific fields. I believe that students and resident physicians are the mainstay of professional training in the field of anesthesia and intensive care, playing an essential role in ensuring a European level of knowledge and skills.

Research in the field of microcirculation and sepsis can be developed through strategic partnerships with prestigious institutions such as the

National Institute for Research and Development in Microtechnologies, Titu Maiorescu University in Bucharest, and other university intensive care clinics.

These collaborations can facilitate the exchange of experience, the development of multicenter studies, and the publication of results in influential international journals.