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Tackling One Health risks –From current practice to future perspectives

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Microbial Risk Analysis (MRA)—comprising risk assessment, risk management, and risk communication—plays a pivotal role in protecting public health and ensuring food safety across the globe. Yet, the accelerating transformation of food systems, the emergence of novel microbial hazards, and the growing recognition of One Health interdependencies increasingly challenge the effectiveness of traditional MRA frameworks. Globalization, climate change, antimicrobial resistance, and biodiversity loss are reshaping the dynamics of pathogen emergence and transmission along the human-animal-environment interface, demanding risk analysis approaches that are flexible, adaptive, and fit for these complex realities.

In this contribution, we critically examine the current state of microbial risk analysis and explore pathways toward its future evolution in line with the One Health paradigm. Drawing on a systematic literature review, insights from a global survey of food industry professionals, and a computational proof-of-concept study using AI-based agent modeling, we provide an integrated perspective on methodological gaps, practical challenges, and opportunities for innovation. Our findings confirm that Codex Alimentarius-aligned risk assessment remains the prevailing standard. However, across sectors, there is a growing call for participatory and integrated approaches capable of addressing the complexity of emerging risks and diverse food system contexts. Survey results highlight substantial variation in risk perceptions, implementation strategies, and decision-making processes, particularly influenced by company size, regulatory environments, and geographic region. Misconceptions such as the belief in the feasibility of "zero risk"further emphasize the need for improved communication and stakeholder engagement.

To help bridge these gaps, we showcase the potential of AI-supported, agent-based modeling to facilitate transparent risk negotiation and consensus-building across stakeholder groups. By aligning scientific rigor with inclusive, participatory processes, we argue that MRA can be strengthened as a central pillar of One Health, supporting informed decision-making and balanced solutions in the face of complex, cross-sectoral challenges. Our work advocates for the evolution of microbial risk analysis into a dynamic, collaborative, and digitally empowered discipline—better prepared to address the interconnected risks of our shared ecosystems.

Keywords

Risk Analysis, risk management, risk assessment, negotiation, artificial intelligence, large language models, One Health

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19

Professional Status of the Speaker

Senior Scientist

Junior Scientist Status

No, I am not a Junior Scientist.

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