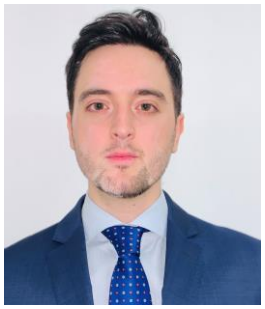
Towards Resilient Health Systems: Novel Engineering Paradigms for the Management of Healthcare Organizations

Abstract

Success in evolution is a matter of adaptability, i.e. the ability of a system to adapt to the surrounding environment. Such a capability, in humans, is driven by the intelligent use of the available resources to maximize the probability of survival. Nowadays, intelligent resource planning is of utmost importance for the survival of healthcare organizations. Indeed, while current health policies require excellent levels of assistance with substantial cuts in spending, the enormous pressure on healthcare systems resulting from the burden of CoViD-19 caused the overload of hospitals and intensive-care units, almost leading public and private health structures to collapse.

In view of the need to reorganize public and private health systems in the CoViD and post-CoViD era, the future paradigms of care must be flexible, scalable, and intelligent. The evolution of care should be also consistent with the “Next Generation EU” plan, which is encouraging policymakers to invest in innovative and sustainable health solutions. In this context, the use of management and simulation strategies along with tools to process and analyse large number and variety of biomedical data can help in defining new standards of healthcare best practices and contribute to the introduction of performance indicators to monitor the transition of health systems towards a “new-normality”. In addition, with the introduction of artificial intelligence, smart healthcare organizations can be imagined by combining the high predictive power of machine learning algorithms with tuneable and interpretable simulation models. Such innovative approaches could offer a different perspective in understanding complex healthcare processes, suggesting new solutions to control and improve them, with the goal of building a new generation of adaptable and resilient health systems.

This speech aims to review and discuss older and newer approaches to the management of healthcare organizations from an engineering perspective. Currently available engineering and managerial tools to analyze, improve, and control healthcare processes will be examined. Benefits and drawbacks of using simulation models and artificial intelligence algorithms to develop effective clinical decision support systems that facilitate healthcare decision-making processes will be discussed. Recent case studies, research works, and practical applications will be also illustrated. Finally, new frontiers in the design of intelligent health systems will be outlined and potential methodological routes, based on the combined use of simulation and machine learning, towards a paradigm shift in the healthcare management will be presented.



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Since 2014 he has been conducting research in the field of biomedical engineering and healthcare engineering. He worked as software programmer and healthcare ICT consultant for two national private firms operating in the field of healthcare information systems. Meanwhile, he carried out research at the Center for Advanced Biomaterials for Healthcare of the Italian Institute of Technology and participated in research collaborations with the Erasmus Medical Center of Rotterdam, with the School of Pharmacy and Biomedical Sciences of the University of Central Lancashire, and with the Department of Experimental and Clinical Medicine of the University "Magna Græcia" of Catanzaro. He is also co-founder of Kyme NanoImaging Srl, a biotech start-up developing products for Medical Imaging.

At University of Naples “Federico II”, he has been continuously collaborating with research groups affiliated to the Department of Electrical Engineering and Information Technology, the Department of Chemical Materials and Production Engineering, the Department of Public Health, and the Department of Advanced Biomedical Sciences.

His research background and competences cover several aspects and disciplines in the biomedical engineering domain, spanning from the processing and analysis of biomedical signals and data to the modelling and simulation of health systems, to the design of biomaterials and nanotechnologies for medical applications, and to the business development of biotech solutions. Indeed, he carried out research in the field of nanomedicine, contributing to the design of nanocarriers for enhanced Magnetic Resonance Imaging applications. He has been working in the field of biosignal processing, regarding the use of linear and nonlinear techniques to process and analyze foetal heart rate variability from cardiotocographic traces and regarding the development of personalized rehabilitation platform for chronic elderly patients. He is also conducting research in healthcare management, with a specific focus on the application of Lean Six Sigma principles, statistical analysis and simulation models for the improvement of healthcare services.

Currently, his main research activities are focused on both the analysis of cardiotocography signals and on the development of simulation models to support clinical decision-making and management of healthcare organizations.