FACULTY OF ENGINEERING

DEPARTMENT OF MANAGEMENT SCIENCE AND ENGINEERING

Emergency Logistics in Healthcare

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Abstract: Healthcare involves both medical and logistical activities. While medical professionals are responsible for designing medical aspects, Operations Research (OR) can offer quantitative decision support for designing logistical processes. The role of logistics is especially pronounced in (prehospital) emergency care, where the time until treatment can have a crucial impact on the patient outcome. Prehospital emergency care is provided by Emergency Medical Services (EMS), which face a variety of planning problems that can be addressed with OR methods. On the operational planning level, the dispatching decision determines which ambulance to send to an emergency – for instance, whether it should always be the closest one – while relocation strategies locate ambulances dynamically. Tactical decisions include the allocation and shift planning for ambulances as well as for ambulance crews. Coordination centres in EMS need to create shift schedules and assign their call-takers and dispatchers to shifts, considering availability requirements for fluctuating call volumes, legal requirements such as maximum shift lengths or rest days as well as staff preferences regarding ride sharing or common lunch breaks. On the strategic planning level, decisions must be made regarding the location of ambulance stations and the design of EMS districts. These planning problems can be addressed by a combination of queuing theory, mathematical programming and simulation, which can be combined with machine learning techniques, for instance, to improve the parameterization of models. A crucial yet often overlooked step in applying quantitative models in healthcare is ensuring that the chosen objective criteria genuinely contribute to enhancing patient care. Drawing on an applied project focused on EMS, this talk will showcase planning problems and corresponding modelling approaches in emergency logistics illustrating how OR can make a tangible impact and contribute to policy changes.

Bio: Stefan Nickel is a Full Professor at the Karlsruhe Institute of Technology (KIT) in Germany and one of the directors of the Institute of Operations Research, where he holds the Chair in Discrete Optimization and Logistics and serves as the speaker of the institute. Since 2011, he has also been one of the directors of both the Karlsruhe Service Research Institute (KSRI) and the FZI Research Center for Information Technology. In addition, he has been a member of the Executive Board at FZI since 2023. He is the Editor-in-Chief of *Operations Research, Data Analytics and Logistics*. He coordinated the Health Care Working Group within the German Operations Research Society (GOR) and served as President of GOR from 2013 to 2014. From 2019 to 2024, he served as Vice President of IFORS on the EURO Executive Committee and was a member of the Administrative Committee (AC) of IFORS. Stefan Nickel has authored or co-authored 13 books and more than 180 scientific articles in his research areas, including Locational Analysis, Supply Chain Management, Health Care Logistics, and Online Optimization. He received the EURO Award for the Best *EJOR* Review Paper in 2012, as well as the Elsevier Award for the *EJOR* Top-Cited Article (2007–2011). In addition, he has led numerous industry projects with major companies such as BASF, Lufthansa, Miele, and SAP.