Editorial: ESI XXXI - OR applied to Health in a Modern World

by Roberto Aringhieri, Vincent Knight and Honora Smith

Roberto Aringhieri, Dipartimento di Informatica, Università degli Studi di Torino, Corso Svizzera 185, 10149, Torino, Italy

Vincent Knight, School of Mathematics, Cardiff University, Senghennydd Road, Cardiff, CF24 4AG

Honora Smith, Mathematical Sciences, University of Southampton, Highfield, Southampton, SO17 1BJ, UK

The Association of European Operational Research Societies (EURO) provides, through the EURO Summer and Winter Institutes, an excellent forum for PhD students and early career researchers to discuss their research at length with experts in the field, as well as forming links with other early stage researchers that will endure throughout their careers.

The Italian and United Kingdom OR Societies supported the organization of a EURO Summer Institute (ESI) on the theme of "Operational Research applied to Health in a Modern World". ESI XXXI took place at the astonishing Fortress of Bard, Italy, from June 11 to June 20, 2014.

OR modelling for health care has developed with the complexities of the modern world. Healthcare systems are often awash with data but managers are unable to to make good use of the data as they are faced with problems needing immediate attention. Furthermore, such systems should reflect a patient-centred and societal perspective focusing on outcomes rather than only on key performance indicators. ESI XXXI brought together those issues proposing new modelling and solution techniques to aid decision makers in the fields of health and disease management, patient flow and all aspects of optimal use of scarce resources.

At the end of the selection process for ESI XXXI, following the eligibility rules stated by EURO, eighteen participants were selected from 46 expressions of interest from all over the world. Furthermore, three participants were selected under a partnership with the Canadian CREATE program (Collaborative Research and Training Experience) in Healthcare Operations and Information Management. The final list of delegates able to attend was as follows:

1. Papiya Bhattacharjee, IIT Kharagpur, India
2. Nardo Borgman, University of Twente, the Netherlands
3. Aleida Braaksma, Academic Medical Center, University of Twente, the Netherlands

4. Omar El-Rifai, École Nationale Supérieure des Mines de Saint-Étienne, France
5. Anna Graber-Naidich, University of Toronto, Canada
6. Paolo Landa, Università degli Studi di Genova, Italy
7. Mário Amorim Lopes, Universidade do Porto, Portugal
8. Manolitzas Panagiotis, Technical University of Crete, Greece
9. Melanie Reuter, Karlsruhe Institute of Technology, Germany
10. Ines Raschendorfer, University of Kaiserslautern, Germany
11. Paolo Tubertini, Università degli Studi di Bologna, Italy
12. Pieter van den Berg, Delft University of Technology, the Netherlands
13. Maartje van de Vrugt, University of Twente, the Netherlands
14. Houra Mahmoudzadeh, University of Toronto, Canada
15. Jennifer Morgan, Cardiff University, United Kingdom
16. Sheetal Prakash Silal, University of Cape Town, South Africa
17. Julie Vile, Cardiff University, United Kingdom
18. Jacqueline Wirnitzer, Karlsruhe Institute of Technology, Germany

The organizing committee decided also to allow the attendance of three self-funding guest students: they were Anne Zander, Karlsruhe Institute of Technology, Germany; Davide Duma, Università degli Studi di Torino, Italy; Saber Mashaal, Medical Institute, Pulmonology, Al Ain Hospital, UAE. These guests were able to attend talks and participate in discussions and social events; they were not, however, permitted to present papers.

ESI XXXI was organized around tutorials, paper presentations and discussions, and parallel discussion panels. All the tutorials had an exposition part, while some of them had also a second part including exercises and hands-on practice. For the paper presentation and discussion each paper was assigned to an ESI senior expert for an in-depth analysis and study. All students had a 60-minute slot assigned, in which they gave a presentation, followed by a discussion. Each day, the final session was a parallel discussion panel – lasting two hours – in which groups of participants discussed the paper presented in the previous sessions. Each group was composed of the paper's author, a senior expert and students interested in the topic of the paper. Usually, students and senior experts moved between groups. The list of senior experts is the following:

1. Roberto Aringhieri, Università degli Studi di Torino, Italy
2. Sally Brailsford, University of Southampton, UK
3. Vito Fragnelli, Università degli Studi del Piemonte Orientale, Italy
4. Paul Harper, Cardiff University, UK
5. Vincent Knight, Cardiff University, UK
6. Stefan Nickel, Karlsruhe Institute of Technology, Germany
7. Marion Rauner, University of Vienna; Austria
8. Giovanni Righini, Università degli Studi di Milano, Italy

9. Honora Smith, University of Southampton, UK

For more details about the ESI XXXI, please refer to the official report published on the EURO website:
https://www.euro-online.org/web/pages/309/last-activity-reports.

This journal special issue is one of the two planned after ESI XXXI. The other one will appear in Health Systems shortly. In this special issue, we have collected all the contributions regarding a single aspect of a healthcare system exploiting innovative OR modelling and solution approaches. This special issue is composed of eight [nine] papers.

This special issue ranges over a wide spectrum of healthcare issues. We commence with emergency services and then turn to scheduled patient services, optimising the use made of costly resources such as scanners and operating theatres in hospitals.

Problems involving Emergency Medical Services (EMS) are addressed in three papers in this special issue. In the EMS situation studied by Reuter et al [1], stochastic demand is considered. Strategic, tactical and operational questions are addressed, of locations of ambulance bases and ambulances, and numbers of ambulances to deploy. Sample Average Approximation (SAA) is applied to a problem with a hard coverage constraint. Van den Berg et al [2] develop a linear formulation of the Maximum Expected Covering Location model that offers significantly improved solution times, enabling larger problem instances to be tackled than with previous non-linear versions. Stochastic travel times are addressed. The technique is applied to the entire region of Amsterdam, in the Netherlands. Vile et al [3] address different aspects of EMS, in developing a master workforce capacity planning tool that simultaneously predicts future demands, recommends staffing requirements and generates rosters. This planning tool is applied to the country of Wales, UK, but is sufficiently generic for application to any regional EMS planning.

Turning next to the Emergency Department (ED), two papers address the problem of reducing overcrowding from two different point of views. The paper by El-Rifai et al [4] deals with a staff allocation problem during seasonal epidemic crises. The authors propose a policy based on on-call scheduling in order to best balance between demand coverage and labour cost under legal constraints of working time. The problem is modelled as a two-stage stochastic Integer Linear Program (ILP) and solved using a Sample Average Approximation (SAA) method. The paper by van de Vrugt et al [5] deals with the problem of assigning treatment rooms to the residents of different specialties (a surgeon and an internist). Since each resident uses multiple rooms in parallel, the assignment of rooms among the residents is often unbalanced, which affects the blocking probability and waiting and sojourn time of patients. The authors propose a queueing model to investigate

expected sojourn times under different operative settings, determining also the Pareto efficient policies. They further validate the proposed approach using a Discrete Event Simulation model reporting numerical results for a large Dutch teaching hospital and other illustrative cases.

Two papers deal with the optimal utilization of health resources: magnetic resonance and radiation therapy. Bhattacharjee and Ray [6] consider appointment systems for scheduling patients to a hospital facility, such as a Magnetic Resonance Imaging (MRI) scanner. A Discrete Event Simulation is used to compare different scenarios, with classification of patients used to design scheduling rules. Mahmoudzadeh et al [7] develop a constraint generation solution method for robust optimization problems in radiation therapy. Such a problem is usually computationally challenging to solve. To address this challenge, the authors explored different strategies of adding constraints in a constraint generation solution approach, testing their approach using robust intensity-modulated radiation therapy treatment planning for breast cancer.

Wirnitzer et al [8] deal with a problem arising in the emerging field of home care management, that of determining a patient-based roster for nurses. The problem is challenged by the leading requirement of assigning a patient to a limited number of nurses in order to guarantee the continuity of care. The authors propose several functions to measure the care continuity of a given nurse roster, giving rise to nine novel MIP models, also including all the typical hard constraints found in nurse rostering. Finally, they evaluate the proposed models solving 45 real-world-based instances.

Finally, Landa et al [9] turn the focus onto operating theatre planning at an operational level, with optimisation designed to balance two conflicting objectives of, firstly, minimising cancellations and, secondly, maximising the occupation of the operating room. A hybrid two-phase algorithm is developed for this purpose, using Monte Carlo simulation and Local Search metaheuristic.

In conclusion, we would like to thank all those submitting articles to this special issue for their excellent, scholarly papers, to the reviewers for their timely work, to the editorial staff of Elsevier for their management of this special issue, and to the Editor-in-Chief, Professor Martin Utley, for his support and encouragement. Finally, thanks go to all who made the EURO Summer Institute on Health a possibility and such a success!

References

[1] S. Nickel, M. Reuter-Oppermann, F. Saldanha-da-Gama, Ambulance location under stochastic demand: A sampling approach, Operations Research for Health Care (2015), http://dx.doi.org/10.1016/j.orhc.2015.06.006

[2] P.L. van den Berg, G.J. Kommer, B. Zuzáková, Linear formulation for the Maximum Expected Coverage Location Model with fractional coverage, Operations Research for Health Care (2015), http://dx.doi.org/10.1016/j.orhc.2015.08.001

[3] J.L. Vile, J.W. Gillard, P.R. Harper, V.A. Knight, Time-dependent stochastic methods for managing and scheduling Emergency Medical Services, Operations Research for Health Care (2015), http://dx.doi.org/10.1016/j.orhc.2015.07.002

[4] Omar El-Rifai, Thierry Garaix, Xiaolan Xie, Proactive on-call scheduling during a seasonal epidemic, Operations Research for Health Care (2015), http://dx.doi.org/10.1016/j.orhc.2015.07.001

[5] M. van de Vrugt, R. J. Boucherie, Assigning treatment rooms at the Emergency Department, Operations Research for Health Care (2015), http://dx.doi.org/10.1016/j.orhc.2015.06.004

[6] P. Bhattacharjee, P. K. Ray, Simulation modelling and analysis of appointment system performance for multiple classes of patients in a hospital: A case study, Operations Research for Health Care (2015), http://dx.doi.org/10.1016/j.orhc.2015.07.005

[7] H. Mahmoudzadeh, T. G. Purdie, T. C.Y. Chana, Constraint generation methods for robust optimization in radiation therapy, Operations Research for Health Care (2015), http://dx.doi.org/10.1016/j.orhc.2015.03.003

[8] J. Wirnitzer, I. Heckmann, A. Meyer, S. Nickel, Patient-based nurserostering in home care, Operations Research for Health Care (2015), http://dx.doi.org/10.1016/j.orhc.2015.08.005

[9] P. Landa, R. Aringhieri, P. Soriano, E. Tànfani, A. Testi, A hybrid optimization algorithm for surgeries scheduling, Operations Research for Health Care (2016), http://dx.doi.org/10.1016/j.orhc.2016.01.001