

SHORT TERM SCIENTIFIC MISSION (STSM) – SCIENTIFIC REPORT

The STSM applicant submits this report for approval to the STSM coordinator

Action number: CA15210 (European Network for Collaboration on Kidney Exchange Programmes)

STSM title: Hungarian-Portuguese collaboration on optimisation and practice of KEPs

STSM start and end date: 27/01/2018 to 03/02/2018

Grantee name: Gyetvai Márton

PURPOSE OF THE STSM/

Three of us visited Ana Viana and her OR group in Porto. From the Hungarian side the visit involved Péter Bíró, a senior researcher, Réka Kis-Benedek, a student in mathematical economics, at Corvinus University of Budapest, who is writing a thesis on kidney exchange programmes, and myself, a PhD student at the OR department of Corvinus University of Budapest. My PhD research is about IP techniques, and I recently joined to a research group at the Hungarian Academy of Science, which is led by Péter Bíró. This research group focus on pairing mechanisms, including the Kidney Exchanges Programmes.

The two main goals of the visit are knowledge exchange and the initiation of joint researches. Besides, I had a personal goal, as a first year PhD student, to learn new Integer programming and simulation techniques from this OR group, that I can use in the research group's research, and also in my PhD research.

DESCRIPTION OF WORK CARRIED OUT DURING THE STSMS

We had very fruitful discussions on optimisation in kidney exchange problems, and implementation of kidney exchange programmes. We describe the main topics for discussions below.

Practical application: The hosts explained the details of the Portuguese KEP, the medical, organisational, and optimisation aspects, including the plans for the international collaboration with Spain and Italy.

Theory of international exchanges: As a potential joint research we discussed the models and solutions concepts developed earlier by Ana Viana and her co-authors on international kidney exchanges, based on the results published in [Carvalho, M., Lodi, A., Pedroso, J. P., and Viana, A. (2017). Nash equilibria in the two-player kidney exchange game. Mathematical

Programming, 161(1-2), 389-417.]. The hosts also presented a new study for the most general model by Viana et al. with simulations.

Testing strategies: We discussed the question of re-optimisation after lab tests. In the European KEPs the compatibility graphs are constructed by virtual crossmatches, and the laboratory tests are only conducted for the cycles identified in the optimal solutions. When a positive crossmatch is found then re-optimisation may be possible, but these policies vary across countries. Ana Viana and her colleagues have several recent publications on closely related questions: maximising the expected number of transplants and robust models for kidney exchange.

DESCRIPTION OF THE MAIN RESULTS OBTAINED

Practical application: The details of the Portuguese KEP indeed gave a good example for the establishment of the Hungarian KEP, which is under progress currently. The propose plan of the Portuguese-Spanish-Italian collaboration may well also be important to know when establishing the co-operation between the Hungarian KEP and the Austrian-Czech joint programme.

Theory of international exchanges: We discussed different possibilities of extending the results of the above mentioned paper [Carvalho et al] and discussed also alternative game-theoretical concepts.

Testing strategies: We identified some new approaches and we considered the possibility of testing them with simulations. These are motivated by practices used in European KEPs.

FUTURE COLLABORATIONS (if applicable)

Practical application: We will consult with the Portuguese colleagues about the implementation of the Hungarian KEP, especially about the software, and data structure used, and the optimisations technique.

Theory of international exchanges: We will work jointly on the possible extensions of the [Carvalho et al] paper, looking for alternative proofs, and considering new solution concepts, such as the core of the international kidney exchange game.

Testing strategies: We are planning to conduct simulations together to test the cost-effectiveness of different testing strategies.