Big Data supporting Public Health policies

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To illustrate the power of Health Care Management, we report the following examples regarding a centred pathway analysis. In [1], the author applies system dynamics to the development of national policy guidelines for the U.K. health service. The tested policies include the use of ‘intermediate care’ facilities aimed at preventing patients needing hospital treatment. Intermediate care, and the consequent reductions in the overall length of stay of all patients in community care, is demonstrated here to have a much deeper effect on total patient wait times than more obvious solutions, such as increasing acute hospital bed capacity.

More generally, the key message is that affordable and sustainable downstream capacity additions in patient pathways can be identified, which both alleviate upstream problems and reduce the effort for their management. Operations Management (OM) and Operations Research (OR) methods proved to be effective in developing and evaluating strategies to adapt health systems to changing environment taking into account limited resources.

Big Data and Health Care Management

A defining characteristic of today’s data-rich society is the collection, storage, processing and analysis of immense amounts of data. This characteristic is cross-sectoral and applies also to health care. Big Data is generated from an increasing plurality of sources and offers possibilities for new insights, for understanding human systems at the systemic level to develop personalized medicine, prevent diseases and support healthy life.

From the Health Care Management perspective, Big Data are a key enabling technologies to support detailed health system analysis. Exploiting big data, one can replicate the behaviour of a whole health system modelling how each single patient flows within her/his pathway. Such a possibility opens the road to many analysis at the health system level.

Case Study: Overcrowding

Large number of non-urgent patients: in 2013, the 90.53% of (total 1,768,800) of the accesses to the ED network of Piemonte are non-urgent.

Case Study: Simulation approach

Discrete Event Simulation to evaluate the impact of 5 clusters, which are:

- Area of Turin: the largest one, 20 EDs
- Cuneo 1: close to Liguria, 7 EDs
- Cuneo 2: close to area of Turin, 6 EDs
- Valle di Lanzo: 2 EDs
- Alba and Bra: 2 EDs

5 different scenarios obtained by varying the percentages of EMS patients (i.e., transported by EMS): from 7% to 27%. Currently ranges in [13.3%, 14.2%].

Case Study: dynamic allocation policies for a regional network of emergency departments

At the regional level, the Emergency Department (EDs) system can be seen as a network of EDs cooperating to maximize the network outputs (number of patients served, average waiting time, ...) and outcomes in terms of the provided care quality.

Usually, an Emergency Medical Service (EMS) transports the patient to the closest ED that can handle the need of immediate care. Further, EMSs usually do (or can) not take into account the ED workload level when assigning and transporting a patient to an ED. More than the 85% of patients arrives at the ED autonomously (no-EMS patients).

Dynamic Allocation Policies (DAP): EMS patients are allocated to the ED having the current minimum workload among those belonging to the closest cluster of EDs. Otherwise, the closest ED rule applies.

Case Study: Preliminary Results

- General improvement of the waiting times of the EMS patients.
- Larger improvements for the EMS patients are obtained for larger clusters: from 35 to 51 minutes in Turin, which means a reduction ranging from 28.25% to 45.32%.
- As soon as the percentage of the EMS patients are greater than 20%, also the waiting times of no-EMS patients improves (up to 7.58% in Turin).

Conclusions

Health Care Big Data can enable the development of accurate quantitative models representing several health systems (supply side). On the other side, Regional Health Systems need tools for evaluating their performance (at large) in the light of planned re-organization (demand side). It is worth noting the need of promoting the matching between the supply and the demand.

Ongoing work: improving DAP forecasting the ED demand and the corresponding workload, which depend on the gravity of the forecasted patients.

References