

# Operations management in healthcare essay sample

[Business](#), [Management](#)



Europe is facing the challenge of delivering high quality and affordable healthcare to its citizens. Prolonged medical care for an ageing population, increasing costs to manage chronic diseases, new but costly treatment possibilities, the need for more healthcare personnel, and the demand for high-quality patient treatment are important factors in this context.

Developments in (information) technology allow the redesign of medical processes, which means changing 'traditional' operations management. Patient treatment requires the cooperation of healthcare providers from various medical disciplines and organizations. Across these disciplines, diagnostic and therapeutic procedures must be planned and prepared, appointments must be made, medical interventions accomplished. Results of procedures are obtained, transferred and evaluated. Patient treatment processes are currently typically sub-divided into function-centered and organization-centered views, and optimization efforts stop at the doors of these organizations. Patients have to wait because resources (e. g., physicians, rooms, or technical equipment) are not available. No integrated view is available on the various medical procedures involving individual patients.

Medical procedures cannot be performed because information is missing or required procedures have been postponed or cancelled. An unnecessary long duration of a treatment process can increase the invasiveness of the treatment and therefore the discomfort for the patient and the costs for the healthcare organization. These trends will accelerate because healthcare increasingly involves many different organizations in healthcare chains, making overall process awareness more difficult. To counter the trend

towards longer treatment processes, unnecessarily increased costs, unsatisfactory insight into patient statuses and patient discomfort, a change is needed in the way healthcare is delivered. The key in this change is process optimization, where the healthcare process of a patient is treated as an integrated whole, even if it involves many medical disciplines and autonomous organizations. This requires a close alignment between the healthcare process, healthcare organizations and information about the patient.

However, current organizational structures and information systems offer only sub-optimal support. Emphasis needs to shift from a physician-oriented, intra-departmental view towards a patient-oriented, end-to-end health chain view. The departmental and chain views must be jointly considered and optimized. Internal layout and control must be redesigned such that both the interests of the patient and of the organization are addressed. A wide variety of complex strategic and operational decisions have to be made that contribute to the simultaneous optimization of quality of care, costs, and patient lead-time. Development of an adequate information infrastructure will be an essential element in obtaining an end-to-end health chain view.

This information infrastructure will need to support electronic patient dossiers. Addressing the complexity of the developments sketched above requires an operations management approach that is both multi-disciplinary and model-driven – two of the main characteristics of the Beta Research School. The Beta Healthcare program started with the official kick-off that took place at a healthcare symposium in October 2007. The program

addresses problems in the healthcare domain in a science-based and practice-relevant way. In the program, research topics have been defined on the basis of five aspects of operational processes in healthcare that each require substantial improvement: process structure, flexibility, efficiency, effectiveness, and trust. The topics are based on the strengths of the research groups in Beta. Below, we describe research topics per process aspect.

Providing process structure in healthcare: Support for business processes that span multiple autonomous organizational entities is required in order to manage medical supply chains, intramural distributed healthcare and transmural healthcare. Coupling process management to the service-oriented computing paradigm is investigated to obtain networks of loosely-coupled, encapsulated collaborative healthcare functions. In the healthcare domain, explicit process specifications are often missing or not followed in practice. Research in process mining shows how specifications can be constructed from historic logs and conformance of practice to specifications can be analyzed. Process patterns play a role as abstract building blocks for processes, including the role of human performance aspects in process execution.

Providing flexibility to healthcare: Automated support for flexibility aspects plays an important role at process design time and run time, including attention for explicit exception management, to deal with the many unforeseen (or uncommon) circumstances in medical processes. The advent of new (information) technologies changes the way healthcare professionals

perform clinical processes (e. g. using clinical guidelines). This requires research into human performance management in medical contexts, e. g., changing generalist/specialist trade-offs, and job quality management in the context of technological developments. In healthcare networks, geographically sparse resources (such as costly machines or highly qualified specialists) must be allocated such that usage characteristics can be optimized over the healthcare network and logistics sub-processes (e. g., the transport of a patient) can be flexibly interwoven in healthcare processes.

Providing resource efficiency in healthcare: Improvement of the utilization of scarce resources is required by the development and use of master schedules for mono-resources (e. g., operating theatres) and multi-resources. The research in this area considers flexibility of resources, the use of advance demand information and the coordination of planning problems over the various stages within the hospital process chain. The complex interplay between actors providing resources and actors requiring resources (typically patients) goes beyond capabilities of traditional scheduling strategies.

A promising approach is the agent-oriented paradigm, where autonomous software agents negotiate on behalf of their owners on market places in a goal-oriented fashion. Many processes in healthcare are inherently of a non-routine nature. It is an as yet unresolved issue whether traditional performance management principles can also be effectively applied in these non-routine work processes. Work is often organized in self-managing teams, who are facing increased pressure to optimize both efficiency of their work

processes and quality of the service they provide to clients. Projects linking team performance management and psychological well-being of team members, service quality and client satisfaction can assist healthcare organizations in optimizing individual and team contributions to organizational performance.

Providing effectiveness in healthcare: Modern job demands imposed on healthcare employees imply renewed investigation of available, often limited, job resources (such as job control, emotional support and ergonomic aides). Allocation of matching job resources is an important avenue for further research in this area. An example would be to increase emotional support from supervisors and colleagues to combat emotional demands by irate patients.

Providing trust in healthcare: Safety management in today's healthcare is still in its infancy. Detailed specifications of the analytic heart of a safety management system – i. e. predictive risk analysis and retrospective incident analysis – and the accompanying implementation process are badly needed. Transaction management is important in complex, dynamic healthcare processes to guarantee dependable process semantics, e. g., to ensure that all steps in a process are indeed performed or to ensure that the right medical information is available only to the right people at the right time.

Program management

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### Involved senior researchers

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### Research highlights

Agent-based Scheduling in Healthcare: In cooperation with Catharina Hospital Eindhoven (one of the two large regional hospitals in Eindhoven), the application of software agents for scheduling of intensive care units is being researched. Scheduling decisions in hospitals are often taken in a decentralized way. This means that different specialized hospital units decide autonomously on patient admissions or operating room schedules. In this project, an agent-based model is developed for the selection of an optimal mix for patient admissions. The model is based on an extensive case analysis, involving data analysis and interviews. The focus is on the coordination of different surgical patient types with probabilistic treatment processes involving multiple hospital units. Unplanned arrival of other patients (partly) requiring the same hospital resources is included in the model. Planning and Scheduling in Healthcare: In cooperation with Erasmus MC and regional hospitals like Isala klinieken Zwolle and SKB Winterswijk, robust planning and scheduling of operating theatres is studied.

Using mathematical programming techniques, discrete event simulation, queuing analyses and meta-heuristics, problems are studied on each

hierarchical level of control, e. g.: (strategic level) the capacity dimensioning of the operating theatre, (tactical level) the determination of the amount of slack planned to obtain robust schedules, (operational level) sequencing of elective surgeries to minimize emergency surgery waiting time. In collaboration with AMC Amsterdam, the access time to CT scanners has been reduced from 4 weeks to 3 days, by optimizing the schedule and reducing the process variability. In cooperation with Leiden UMC, AMC, ORTEC, UMC Utrecht, MST Enschede, Isala klinieken, Deventer Ziekenhuis, SKB Winterswijk, ORBIS group, and College Bouw Zorginstellingen, research is performed to optimize the end-to-end care pathway, i. e., to optimize the care pathway along all involved departments or institutions by development of robust planning and scheduling techniques, and analytical and simulation models.

Workflow Management in Healthcare: In cooperation with (and co-funded by) Amsterdam Academic Medical Center, a research project is being carried out to provide theories and artifacts in order to apply workflow technology in academic hospitals. In general, there is a need to support the diagnostic and therapeutic trajectory of healthcare processes. A number of difficulties commonly arise when hospitals attempt to automate healthcare processes, because these processes are diverse, require flexibility, and multiple medical departments can be involved in the diagnostic and treatment process. A large case study has been carried out in order to identify what kind of flexibility needs to be provided by workflow management systems in order to be applied in the hospital domain. Based on these results, the focus will be



on planning aspects and on the support of (small) processes which can be initiated and terminated at any time during the treatment process.

Moreover, the application of process mining techniques is researched in the context of healthcare processes. Transactional Processes in Healthcare: The applicability of advanced transactional and contractual constructs is investigated in the medical domain. The application of these constructs should lead to improved reliability of operational healthcare processes, both from the point of view of healthcare providers and healthcare consumers (e.g., leading to improved patient safety). A case study is being undertaken at the cardio-thoracic department of Catharina Ziekenhuis Eindhoven. As a scientific basis, the approach developed in the XTraConServe NWO project is applied. In this project, a service-oriented approach has been developed towards execution of transactional contracted business services. The approach includes a Business Transaction Framework that includes a flexible library of Abstract Transaction Components (ATCs), explicit Transactional Quality of Service (TxQoS) specification, ATC composition techniques, and an enactment architecture.

#### Key publications

Elkhuizen, S. G., Sambeek, J. R. C. van, Hans, E. W., Krabbendam, J. J. & Bakker, P. J. M. (2007). Applying the variety reduction principle to management of ancillary services. *Health care management review*, 32(1), 37-45. Grefen, P. W. P. J. (2006). Towards dynamic interorganizational business process management (text keynote speech). In S. M. Reddy (Ed.),

Proceedings 15th IEEE International Workshops on Enabling Technologies: Infrastructures for Collaborative Enterprises (pp. 13-18). Manchester. Hans, E. W., Wullink, G., Houdenhoven, M. van, & Kazemier, G. (2008). Robust surgery loading. *European Journal of Operations Research* 185(3), 1038-1050. Hutzschenreuter, A. K., Bosman, P. A. N., Blonk-Altena, I., Aarle J. van, & La Poutré, H. (2008). Agent-based patient admission scheduling in hospitals. In: *Proceedings 7th International Conference on Autonomous Agents and Multi-Agent Systems*, Estoril, Portugal, 2008. Litvak, N., Boucherie, R. J., Rijsbergen, M. van, & Houdenhoven, M. van (2008). Managing the overflow of intensive care patients. *European Journal of Operational Research* 185(3), 998-1010.

#### National and international cooperation

The program stretches across (almost) all groups participating in the Beta research school, and therefore is in itself already a cooperative effort between many groups at Eindhoven University of Technology and University of Twente. In the context of the acquisition of funds, cooperation has been set up with University of Amsterdam, Amsterdam Academic Medical Center, ORTEC and Leiden UMC. The healthcare program has a close link with NGB (the Dutch organization for operations research). In November 2007, an NGB healthcare symposium was organized with the support of Beta. Also, the program is linked to the CHOIR healthcare knowledge center of the University of Twente. International cooperation is currently distributed among the Beta groups participating in the program. Because the program has been operating for a short time only, there is no international

collaboration at program level yet. Clearly, this is a development to strive for.

#### Application of research and collaboration with industry

Application of the research in the healthcare industry is seen as a very important aspect of the program. Given the specific nature of the healthcare domain, application should preferably be performed in a collaborative setting, i. e., with active participation of healthcare organizations. Currently, a number of active collaborations is underway, both with healthcare organizations (like hospitals) and organizations that are service or product providers to the healthcare field (such as software developers), and government (Netherlands Board for Healthcare Facilities).

#### Outlook 2008-2014

The healthcare program was started in 2007 (official kick-off in October) and is therefore still in the startup phase. In the short to medium term, the program will be further established along the lines described above. The following developments are seen as important in this context:

Intensifying the cooperation between the various sub-disciplines participating in the program. The requirements originating from the multidisciplinary nature of the healthcare operations management area on the one hand and the multidisciplinary character of the Beta research school on the other make this a natural development. Intensifying collaboration with the practical healthcare domain in the form of larger application-oriented projects. Currently, a number of smaller projects are already in operation.

Initiatives for larger efforts are underway and funding is being sought.

Transfer and reapplication of scientific approaches, techniques and tools (mainly software) from other application domains to the healthcare domain.

Scheduling principles can be transferred from other domains that also require flexible, case-based operations management. Business models and software solutions from the e-business domain can be reinvestigated for use in distributed, flexible healthcare networks. National and international recognition of Beta as a multidisciplinary expertise center for operations management in healthcare.