



### 3.5. Accelerating digital innovations: from Bench to Bedside in 6 months

#### Roadmap and goal

Implementing AI and data science into clinical applications is a challenge. Literature indicates four important impediments that hamper a smooth translation from bench to bedside: organization and commitment, non-multidisciplinary teams, data management and interoperability, scalability to sustainable and responsible digital solutions.

At first glance the path Ymke de Jong (Data & AI Partnerships Lead at Philips) and her team chose to accelerate digital innovation is simple. And that's a good thing. A 6-months cycle, 4 phases and a lot of collaborative expertise. Relevant for all e/MTIC roadmaps and many projects that intend to develop data-driven solutions. When you take a closer look, her research is nevertheless quite a challenge.

#### Approach

To tackle the problems of bringing data science from research to the clinic, a methodology has been set up to accelerate a process of digital innovation in a specific area of healthcare. This is done by working in teams consisting of clinical and technical experts, with expertise in data science & AI, medicine, IT and business. The 'Bench to bedside methodology', developed between Catharina Hospital (CZE), Philips and TU/e, has three design criteria:

1. Co-create; have one case from CZE with Philips support and one case from Philips with CZE support;
2. Quick feed-back; have 6 months innovation cycles;
3. Increase adoption by sharing; share learnings to all parties involved by innovation sessions and demos/ presentations.

Every '6-months innovation cycle' covers four phases: identification of clinical requirements, identification of technical requirements, building the proof-of-concept (PoC), and testing the PoC. After each innovation cycle we discuss if and how to continue to make steps to the bedside.

Since January 2020 different projects started with 10 experts with weekly working sessions on-site (Catharina Hospital and High Tech Campus Eindhoven) and later on digitally due to Covid-19. Since then, our team grew and every 6 months new deliverables have been created, tested, and validated. Topics we have been working on include:

1. Capacity management improvement using AI methodologies
2. Nursing notes analytics to extract nurse worry
3. Nursing notes analytics to prevent in-hospital falls
4. Patient similarity cardiac ischemia decision support

Insights to our approach can be illustrated from these use cases. For example, nurse worry was already

referred to in the TRICA section: nurses spend a lot of time with patients which helps them develop a good judgement about the patient's condition. One aspect of that judgement is called nurse worry, which is subjective information on how well patients are doing. We hypothesized that nurse worry could be extracted from their daily notes and might have predictive power on certain aspects of deterioration of the patient. Subsequently, we have applied and compared different AI/NLP (Natural Language Processing) techniques to extract nurse worry from the textual content of nursing notes and evaluated that worry in the context of augmenting Early Warning Scores (EWS).

In the case of Capacity Management improvements using AI methodologies: Given the capacity challenges hospitals are facing, efficient use of OR, ICU and ward resources will be vital to provide the timely care that patients need. The increased demand for care, partially delayed due to the COVID-19 pandemic, requires optimization of the planning and use of resources. We have investigated AI-driven approaches that provide true, actionable insights based on available data. Machine learning technologies based on specific individual patient characteristics allowed for the creation of customized models to optimize OR, ICU and ward utilization. These predictive models, implemented in an adaptive user interface, will support surgery planners by creating an optimized surgery schedule. Such schedule is essential for an effective





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use of capacity management, leading to improved patient and staff satisfaction.

#### Results

Next to these Proof-of-Concepts themselves, Ymke summarizes the results of the methodology pilot: "In a short period of time, we achieved more together than we were able to do on our own. Working together on algorithm development within the hospital systems shows the challenges on data management directly at the source. Incorporating these challenges at the beginning of the project, will prevent time-intensive migrations and frustration in a later phase. By starting from a relevant clinical need and continuously involving clinicians during the creation of a new tool, the likelihood for acceptance is expected to be much bigger. All participants appreciated the contributions of each team member. Their different knowledge and background led to a quicker mutual understanding and increased creativity. Learn from each other's knowledge and therefore being able to make fast and important steps."

#### Learnings from the e/MTIC approach

The e/MTIC ecosystem supports bringing data & AI solutions from the bench to the bedside on 2 levels. e/MTIC brings together the 'golden triangle' of partners to accelerate clinical innovation. One of the pitfalls of digital innovation is the lack of a multi-disciplinary approach throughout the innovation process, where a multidisciplinary approach is a pre-condition to start a project with e/MTIC. In addition, the e/MTIC

framework agreement helps to quickly start a new project, without the need to negotiate on collaboration agreement for every new project. This allows our experts to focus on their core capabilities.

We believe digital innovation in healthcare can be further accelerated if privacy terms on data sharing are clarified, which is difficult given the rapidly changing regulatory environment in Europe. In addition, digital innovation in healthcare is not only a technical field, but also requires understanding of business models and re-imburement. Especially digital solutions ask for innovation of the financial model from idea to deployment to achieve a lasting impact in healthcare.

Ymke reflects: "It is not enough to build smart algorithms, to develop intelligent machine learning processes or to build an ingenious data management program. If you cannot implement your solution in a healthcare environment it is skilful but a waste of energy. Therefore, the presence of all involved partners is so extremely important. By starting from a relevant clinical need and continuously involving clinicians during the creation of a new tool, acceptance proceeds more quickly and more solidly. You develop, work and grow together. You appreciate your fellow team member and the difference in background and expertise will bring more creativity and better, quicker results. That is the way I like to contribute to accelerate innovation in healthcare."

