



Overview of the project

The burden of longer life expectancy with a prevalence of chronic diseases and multimorbidity on the rise is becoming unsustainable for public healthcare. The problem is systemic and risks the sustainability of the current healthcare model in Europe. Digital health transformation together with Value-Based Healthcare (VBHC) could ease the burden pressure improving protocols and pathways and making them more efficient. Unfortunately, adoption of digital tools, like Artificial Intelligence, remains poor, failing to breach acceptance barriers.

Furthermore, the need of protocol assessments tools is a system-level problem that affect to all the agents in the healthcare system:

- Hospital managers: with the need to improve and redefine healthcare processes without reducing the quality of health system

- Clinical staff: cannot have a proper understanding on multi-disease treatment protocols interactions

- Patients and families: cannot obtain a more efficient healthcare that improves their quality perception

- Insurers: cannot offer competitive solutions

Interactive Process Mining (IPM) is the best Machine Learning (ML) approach to study clinical pathways and patient care flows for supporting healthcare improvement, because it is a methodology, specifically conceived to involve the clinical expert in the production of the AI models, incorporating their medical and clinical knowledge in building and interpreting the models.

“ Digital health transformation together with Value-Based Healthcare (VBHC) could ease the burden pressure improving protocols and pathways and making them more efficient. ”

VALUE solution proposes a new framework to enable the collaboration of the clinical, technical, and management staff to adopt VBHC approaches. It includes a technological product and a method to foster the discussion among all the actors involved in the healthcare delivery, which will provide a full interoperable Interactive Process Mining tool that can be combined with a Clinical Data Repository (CDR) and/or a Real-Time Locating System (RTLS), offering optimization services to healthcare organizations.

The adoption of the VALUE solution by Hospitals will boost a VBHC transformation overcoming most of the current barriers and providing a healthcare system focused on patients' health as the key indicator.

The main objective is to provide an innovative Interactive Process Mining-based software to dive into the internals of the clinical pathways finding out the real steps performed by patients. Unlike other technologies, the VALUE solution will not omit information in the generation of new knowledge and offers detailed step-by-step maps of what happens in the clinical practice.

The first phase of the project is focused on developing a Minimum Viable Product (MVP) consisting of an Interactive Process Mining software interoperable with available hospital information systems.

Through a validated methodology to train healthcare professionals, the solution will be systematically deployed in the following phases, following an iterative method, at 6 different clinical and hospital scenarios identifying bottlenecks, finding best clinical pathways available in each one of the scenarios: emergency care flow, cardiac disease and patient management, and pain management.

Clinical Use Cases

MUSCULOSKELETAL DISEASE

Use case at Servicio Madrileño de Salud, SERMAS

The use case planned focuses on the Musculoskeletal disease care-flow. A care flow affected by issues like high prevalence, high burden of disease due to disability and chronicity, in which patients follow a clinical pathway fragmented between primary and specialized care and between specialties.

The use case aims at gathering clinical and operational insights to improve on the following aspects, tasks and processes:

- Referral to the right care at the right time
- Reduction of unnecessary care loops for patient
- Eliminate redundancies between the actions of health professionals
- Staff resources' planning and allocation
- Measure quality of care and impact on disability



CARDIOLOGY

Use case at Instituto de Investigaciones Biomédicas de Salamanca, IBSAL and Complejo Asistencial Universitario de Salamanca, CAUSA

The use case at IBSAL focuses on cardiac patients suffer long waiting lists, long time to diagnosis and long time to treatment. In addition, the clinical pathway suffers from segmentation between primary and specialized care with a denoted low level of coordination for both derivation and follow-up between general practitioners and the cardiology service at the hospital. Such suboptimal setup impact on both satisfaction of the patient and the care team. The use case analyzes the entire external consultation process, with a special focus on the management of the patient with heart failure.

Currently, the use case pursues to 1) reduce time to diagnosis - from first patient appointment to diagnosis notification-, 2) improve the discharge rate of patients to be followed by GP 3) increase patient satisfaction.



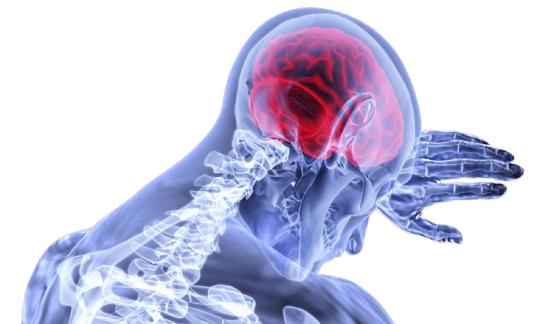
EMERGENCY ROOM CARE FLOW AND STROKE PATIENTS

Use case at Hospital Universitari Vall d'Hebron, HUVH

Vall d'Hebron Hospital will run two different use cases, one targeting the improvement of emergency room (ER) care flow and other focusing on the stroke patient flow.

The first use case will focus on optimizing the door-diagnosis and the door-treatment time in the triage level 3 ER patients and acute stroke patients. The second use case will optimize the follow up of stroke acute phase process.

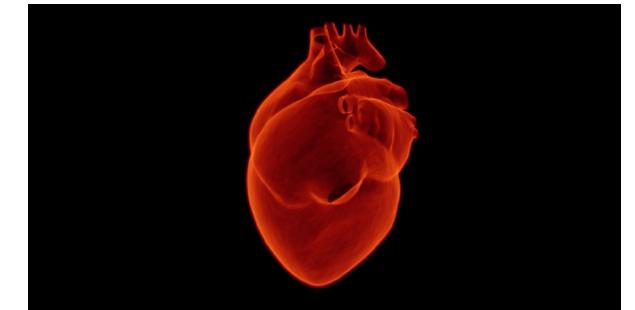
In both, the ER care flow and the stroke pathway, time is an important issue. To detect the steps in these care processes that will allow us to reduce the time and improve patient flow is key in this project, with the final aim to maximize safety, quality and efficiency in the diagnosis and treatment phase. By using the implementation Real-Time Location System Technologies and through the implementation of an emergency unit care model we will be able to closely follow patients and implement the tracking system in the Emergency Department and the Stroke Unit.



MYOCARDIAL INFARCTION EMERGENCY CARE PATHWAY

Use case at Centro Hospitalar e Universitário de Coimbra, CHUC

The use case will focus on the myocardial infarction emergency care pathway. Currently, the central region of Portugal is suffering the highest mortality from ST elevation myocardial infarction. Timely access to reperfusion therapy is a key variable for favorable prognosis but angioplasty requires a specialized trained care team available 24/7 and resources are limited.



The goal is to identify which regions are experiencing the highest-time-to-reperfusion and which regions a suffering the highest mortality. Analyzing the registries with Interactive process mining data-driven model will allow to assess the impact of setting a new PCI facility in the region. Through simulation based on the models, it would be possible to assess the improvement in reducing time-to-reperfusion in those regions that need it most. By allocating resources to the right region, improvement in patient prognosis is expected.

ACUTE BRAIN INFARCTION

Use case at Erasmus University Medical Center, EMC
The use case at EMC focuses on the acute ischemic brain infarction care pathway. Case prognosis significantly depends on prompt diagnosis and time to treatment, what is known as time-to-needle. The current care pathway contains numerous and critical dependencies that influence the actual time for the patient to get the right treatment. Emergency Triage, bed occupancy and level of workload at the Stroke Unit are factors that definitely influence the time-to-needle. We hypothesize that by reducing the length of stay on the Stroke Unit, bed occupancy and staff workload will be also reduced producing a process improvement which will impact time-to-needle and eventually patient outcome. Interactive Process Mining will be applied to produce an in-depth analysis of the current Stroke Care Path, aiming at identifying dependencies and consequences that are relevant for patient outcome and patients in general and specifically those which are relevant for the length of stay of the patient.



ELDERLY FRAIL PATIENTS

Use case at Karolinska University Hospital, KUH
The use case is focused on the emergency department (ED) at the Huddinge site at the Karolinska University hospital. The ED is having issues with crowding and extended length of stay for elderly frail patients. The ED is not a good location of care for elderly frail patients that have a higher need of basic care and assistance that is difficult to provide in an ED that is under pressure. This leads to an increased risk of complications and poor patient outcomes for this group. We will use process mining to better understand how the real process looks like for this group of patients and how it differs from other patient groups. We will use the findings to identify improvement initiatives. Initiatives will be aimed at reducing ED length of stay and will be followed up and analyzed using process mining techniques to drive improvement initiatives and to evaluate results.



Value Technical Approach

Current Machine Learning-based Process Mining tools, Celonis or Disco, are 1-fit-all solutions for general Process Mining applications, not being specifically made for healthcare. The interconnection with databases cannot be tailored and they cannot create interconnections with legacy systems. Moreover, only data specialists can operate them, keeping the clinician completely outside the ML and mining process. Also, discovery algorithms of those tools do not keep the traceability to the individual. This limits both, their acceptance and application, in the healthcare domain. Previously validated in several healthcare settings as reflected in literature, VALUE is specially conceived to cope with those issues.

VALUE solution is a software tool for applying IPM analysis in clinical and health care settings. This tool can be used directly as a standalone tool or as a complete solution, including CDR and RTLS, being integrated within the organization's facilities.

This interoperable solution will allow hospitals and service providers to analyze clinical pathways and processes with patients. The analysis of processes, where process mining techniques are used, allows the participation of clinical professionals. This synergy increases not only the understanding of the pathways and processes being studied, but also the understanding of what machine learning techniques can offer. This deeper understanding facilitates acceptance of these techniques by clinicians and managers.

The VALUE solution will offer both an IPM toolkit that will allow data analysis and visualization, as well as a complete version designed to be integrated into a Hospital Information System and that will have all the necessary interoperability tools and extensions to be applicable to all Hospital.

Partners



<http://www.valueproject.eu>

VALUE is supported by EIT Health

DISSEMINATION ACTIVITIES

VALUE will present its first results at the 2nd International Conference on Process Mining, 4-9 October, 2020.



The first editions of dissemination materials have been developed and are available for consultation and download:

- Videos
 1. VALUE introduction.
<https://www.youtube.com/watch?v=TuzJLI9M26s>
 2. VALUE methodology.
<https://www.youtube.com/watch?v=x58YoeJdrLA>
 3. What is a datarodeo?
<https://www.youtube.com/watch?v=PgdDXSisjCM>
 4. What does VALUE dashboard offer?
<https://www.youtube.com/watch?v=NST9foGEqGc>
- Infographics
- Brochure

43rd Annual International Conference of the IEEE Engineering in Medicine and Biology Society, July 26-30, 2021, Guadalajara, Mexico



The 8th European Medical and Biomedical Conference, 29-Nov-3Dec., Portoroz, Slovenia.



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