PRECISE4Q

PREDICTIVE MODELLING IN STROKE

DELIVERABLE - SUBMISSION

Project Acronym: **Precise4Q**
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Project Title: **Personalised Medicine by Predictive Modelling in Stroke for better Quality of Life**

D1.4 Set of functional requirements and architecture

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Revision History, Status, Abstract, Keywords, Statement of Originality

Revision History

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Abstract (for dissemination)	Using the predefined use cases (T1.2), with the Stroke Service Blueprint, an analysis will be applied to define functional specifications and a concept will be introduced. Besides the user-centered perspective of PACT, the "designer-centric" components related to system use will be added using functions and events, interactions and usability issues, content and structure, style and aesthetics (FICS).
Keywords	Data survey, UX/UI, stakeholders, Service Blueprint

Statement of originality
This deliverable contains original unpublished work except where clearly indicated otherwise. Acknowledgement of previously published material and of the work of others has been made through appropriate citation, quotation or both.

Table of Content

Executive Summary

Within Precise4Q multiple AI-based models will be developed to be integrated in solutions guiding prevention, treatment, rehab and reintegration measures.
The main medical concept of PRECISE4Q is to target four different stages of stroke in the life trajectory in a novel precision medicine approach. Precision medicine is defined as a concept to tailor prevention, diagnostics and therapeutics individually to any given patient. Thus, we are developing a set of models for each of the four clinical stages of stroke - prevention, stroke therapy, stroke rehabilitation and stroke reintegration - and combine these in a digital stroke patient platform.
To provide the digital stroke patient platform and its respective AI-based models to the respective healthcare professionals in the different phases, we have been designing use case scenarios and are subsequently developing user-centered services such as mobile applications (apps) and decision support systems.

1 Introduction

Within Precise4Q multiple AI-based models will be developed to be integrated in solutions guiding prevention, treatment, rehab and reintegration measures.
The main medical concept of PRECISE4Q is to target four different stages of stroke in the life trajectory in a novel precision medicine approach. Precision medicine is defined as a concept to tailor prevention, diagnostics and therapeutics individually to any given patient. Thus, we are developing a set of models for each of the four clinical stages of stroke - prevention, stroke therapy, stroke rehabilitation and stroke reintegration - and combine these in a digital stroke patient platform. To provide the digital stroke patient platform and its respective AI-based models to the healthcare professional, we have been designing use case scenarios and are subsequently developing user-centered services such as mobile applications (apps) and decision support systems. The objective of this report is take the results from identification of the most relevant user needs for each patient journey phases, concentrating on the most common and complex questions (D1.2 and D1.3) and translate these into a service blueprint for the different stages enabling the development of user-centric services and product prototypes.

2 Description of the service blueprint

To have the maximum impact on improvement of patient care and patient outcome, it is essential to provide the developed AI-based models in user-friendly and seamlessly integrated services.
We designed and developed the *Stroke Service Blueprint* in an iterative process regarding the 4 phases of the patient journey:
1. Prevention: One of the most promising approaches to reduce the effects of stroke on individual health and healthcare systems is to prevent stroke. More than 77% of stroke events are first time events.
2. Acute Treatment: There have been advances in the therapy of ischemic stroke in the past decades. Overall therapy success, however, is still poor. For thromboembolic stroke, the most favourable current treatment paradigm is the time-based dissolution of the obstructing blood clot by a drug or its mechanical retrieval. Unfortunately, up to 20% of patients arrive with an unknown time from stroke onset, and most patients present too late in the hospital to receive treatment.
3. Rehabilitation: A multitude of different stroke rehabilitation concepts and methods has been developed to date. However, from an evidence-based perspective only very few general proven recommendations exist: a) Specialized rehabilitation is useful, b) early rehabilitation and mobilization is useful and c) higher intensities of therapy are useful. Beyond this, it is unclear which therapy
options lead to better rehabilitation outcome, i.e. which therapies are best suited for the individual patient.
4. Reintegration: Reintegration is the long-term outcome after stroke. After acute treatment and rehabilitation, reintegration success is measured by the patients' reintegration into their family, communities and workplaces.

As shown in figure 1, the service blueprint is divided into the four different stages of the patient journey. In the beginning, in the prevention phase, the patient's actions are visualized: The patient is notified about necessary check-ups, the patient visits the doctor, and checks for his/her current risk. This might lead to behavior change and reduction of stroke risk. The touch points are: information by letter, email or insurance app; the medical check-up, the mobile technology in an app and a medical check-up.

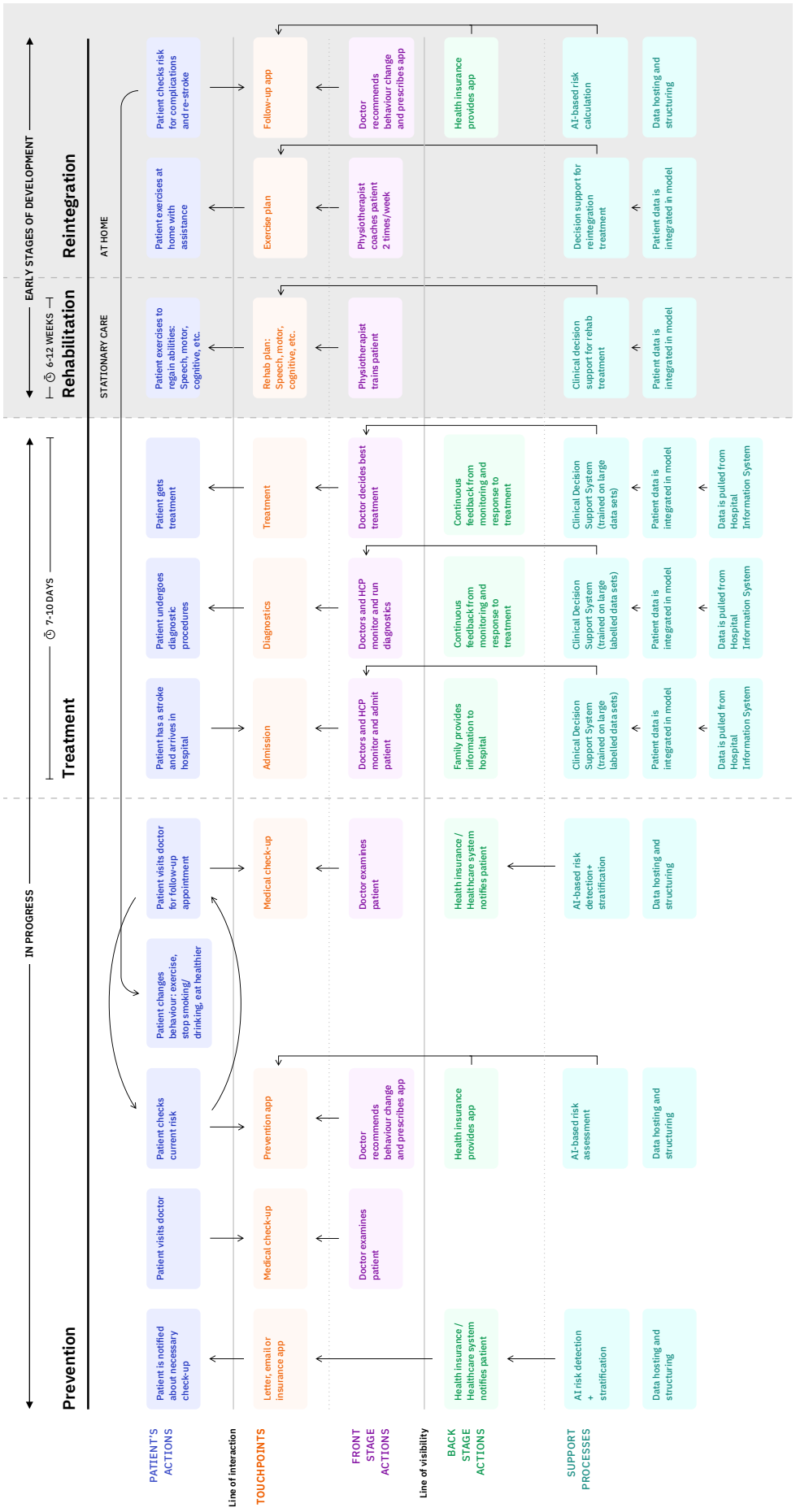

Fig 1: Service Blueprint for the stroke patient journey

The front stage actions are: Examination by the doctor, recommendation of behavior change and prescription of the app. Backstage, there is health data that informs for notification purposes and support processes. Technologically, at the core there are dedicated machine learning models for the different purposes.
In the second phase, the acute stroke treatment phase, the patient with a stroke arrives at the hospital, is admitted, undergoes diagnostics, and is treated according to the doctors decision. Supporting the decision of the doctor are models that are provided by a clinical decision support systems. Backstage, seamless integration into the hospital information system is essential. The models the decision support systems are based on, I have been trained on large data sets of past patients. In 3. The rehabilitation phase, patients are trained and coached to regain abilities that have been lost due to a stroke. The touch points are: The rehab plan for speech, motor, cognitive, physical exercises. The provider, the physiotherapist, acts in the front stage. Backstage for this phase, like in the treatment phase, decision support for rehab professionals is provided. The patient data is fed in to the models and recommended treatment regimens are visualized.
In 4. Reintegration there are 2 aims: first, further improvement of lost abilities and second prevention of a second stroke. This is in the front stage both done by the physiotherapist and by the patient him or herself via an app.

3 Application scenarios

As described, the application scenarios and the respective technology vehicles are dependent on the different stages of the patient journey and the approaches to be taken: In 1. Prevention: a mobile application (app) for the primary use of the patient at risk for stroke. In 2. Treatment: A clinical decision support system integrated in the Hospital Information System (HIS) supporting the doctors treating acute stroke patients. In 3. Rehabilitation: A decision support system helping healthcare professionals in allocating resources and personalizing rehab procedures. And, finally to close the loop, in 4. Reintegration: a mobile application for the use of patients to prevent complications after stroke and re-stroke (i.e. second stroke).
The objective of this report is to identify the most relevant scenarios and use cases for each of the patient journey phases. Service blueprint and swim lane processing mapping techniques are applied, in which processes and involved participants are grouped visually by placing them in lanes, with one lane for each person, group or relevant subprocess.
To this aim, in this work we address each phase individually. The Prevention phase focuses on use cases in the out-patient prevention setting and distinguishes between primary and secondary prevention. Naturally, the occurrence of stroke changes the input data as well as the tests which will be performed. In the acute phase, we outline the scenario of acute stroke treatment. Here, the focus is on the acute setting within the hospital. Use cases in rehabilitation treatment are presented in this work focusing on cognitive impairments. Post-stroke cognitive impairment occurs frequently in ischemic stroke patients. While most stroke survivors return to live in the community, re-integration may be an enormous challenge. The ability to return to an acceptable lifestyle, participating in both social and domestic activities is important for perceived quality of life. Therefore, in this phase we address use cases arising following discharge from hospital care or rehabilitation into the community. These include social support, impact of caregiving on informal care-givers, family functioning, provision of information and education, leisure activities and return to work.

4 Iterative development and releases

With our synchronized set-up of developing models for the different use cases and designing frameworks and user interfaces for the implementation of these models in the real world, we adhere to iterative development principles. We seek user feedback and integrate the incoming results in the sequential releases. The continuous development is and over the course of the

project will be informed by D1.3 Use cases and their inputs/outputs specifications, D1.4 Set of functional requirements and architecture, D1.5 Empirical study on attitudes towards personalized medicine, D1.6 Ethical framework and oversight mechanisms for big data health research, D1.7 Ethics of personalized medicine and data-driven modeling, D1.8 Release of the deliberative dashboard, D4.3 Data Schema Designs for Each Model, D6.2 Innovation management plan and exploitation report; and will inform D2.7 Reliable interfaces implemented as service connectors, D2.8 Pilot for clinical decision support system, D4.10 An integrated digital stroke patient platform spanning the entire patient life-cycle, D7.6 Launch of European Modelling Platform for Open Stroke Research.