# MEPRO - Smart mobile phone application for self-assessment of mental distress

***Improving patients' safety by assessing mental distress after surgery.***

Surgical Hospital Rožna dolina, Ljubljana, Slovenija is a small surgical hospital, privately own but public financed, with approximately 7000 surgical procedures performed per year. Surgery is mainly oriented to orthopaedic and general surgery.

## Challenge description

Mental distress - in this context-levels of mental, physical, and emotional stress can be high before and after surgery (common causes of stress include anything that results in pain, including illness and surgery)- can be alert or sign that patient has medical problems after discharge from hospital and he or she for various reasons does not want to speak about them with family, relatives, or physician. Detecting mental distress in individuals can be challenging because it often involves subjective experiences and emotions. However, there are several signs and indicators that may suggest someone is experiencing mental distress. It's important to note that these signs can vary from person to person, and some individuals may hide their distress, so it's not always easy to detect. There are some pre-screening systems for mental health distress designed to identify individuals who may be at risk for mental health issues or distress. These systems are often used in various settings, including healthcare, education, workplaces, and community organisations, to help assess and support individuals who may need mental health intervention.

According to research conducted by Surgical hospital Rožna dolina, there is no user-friendly mental distress self-assessment mobile phone application in the market that satisfies the demands of hospital (we call patient-oriented view): tailored to be connected with possible medical conditions and in Slovene language.

Although mental distress assessments are typically complex and require detailed evaluation by medical healthcare professionals, mobile version for self-assessment may be the first important step to alert family, relatives, or physicians that patient has medical problems (he or she is not willing to talk about).

Main group of patients: all adult patients discharged from hospital after general or orthopaedic surgery.

An indicator of the quality of life perceived by the patient is the VR-12 (see resources), validated method to measure general perception of quality of life.

## Challenge main objectives

The main objective is to improve patient self-assessment and safety after discharge from hospital (and quality of life). As a secondary objective the Challenger also wants to learn the acceptance of tailored medical mobile solutions in elderly and to learn how to easily integrate 3rd party mobile solutions through its corporate IT system. After assessing the mental distress, the application should put the patient in contact with physician or member of family.

# Solution functional requirements

### Compulsory functional requirements

- The solution shall be user friendly for low digital literacy levels. The content shall be easy to digest by the patients, for example, using pictograms rather than text that captures patient's perspective on their mental condition after surgery.
- The solution shall allow Information exchange between patients and their surgeon.
  - Patient would choose from several templates to create the message, depending on the message type.
  - Doctors should be able to send the same message to patient.
- Calendar management: so, patients and physician can easily add or review patients' medical condition.
- Alert surgeon and family physician and family member that a change in mental condition needs their attention configurable through their channels of communication (smart phone, e-mail, etc.)
- Usable and intuitive for patients.
- When the user starts there will be available an application for local patients developed by Solver that incorporates, among others, user authentication. The new medical application must be called through authentication application, so user identification takes place under maximal safety conditions.
- The Solver application will be available for Android and iOS.

### Desirable functional requirements

- Use of AI to recognize facial expression.
- Facilitate access to informative resources for self-empowerment, like documents, and videos. Including on a survey to assess quality of life indicator.
- Medication management. Possibility that doctors incorporate and modify prescriptions.
- Connection with 3rd party devices like smart bands or watches to track day activity and sleep patterns.
- Information summaries and analytics on the available data to empower patients and facilitate better disease management by the patients themselves, in collaboration with their doctor.
- Optimised for multi-device access.
- Including on a survey to assess quality of life indicator (VR-12) and to request and collect the patient outcomes over time.

# Pilot scope

After beta version of application is prepared, 30 patients who underwent general or orthopaedic surgery will enrol in the pilot together with two physicians.

### Language

- The application must be available in English and in Slovene language as the targeted population is not fluent in English.

### Other aspects

- Patient must be owner of smart mobile device (smart phone).

# Pilot set-up conditions

### Ethical, legal, or regulatory

The approach of the pilot must be previously validated by an Ethics Committee of Medical faculty or National medical ethical board. The Committee will pay special attention to the collection of informed consents of patients by the Solver and the protection of personal data, observing the requirements established by the European data protection Regulation and Slovenian law.

If considered necessary, the Solver will be asked to anonymise the data according to mechanism established by the Challenger. At any case, the Solver cannot exploit or make the data for different purposes than the ones agreed with the Challenger and after pilot end, all copies of the data must be transferred back to the Challenger or deleted.

### Technological

The systems and servers needed for running the piloted application will be hosted by the Solver. For safety reasons and data protection the Solver should have back up servers. Technological requirements will be established in a technical session at the beginning of the project.

### Data access

No initial data will be provided for pre-load. All participants will have to register for free and fill their own data.

# Expected impact and KPIs.

- Reduction in the number of physical visits of patients: a) to the doctor office at least 10% and b) to emergency room at least 20%.
- Quality of life indicator VR-12 (see resources). Increase of an average one point per month of usage, with a maximum 10 points during the total survey period.

# Business opportunity

### Market size

At the level of hospital organisation this project will be available in two hospitals with more than 20000 surgical discharges per year. At the national level there are more than 20 hospitals with the surgical units.

Presented application can be extended in a standard way with the same technology to many other pathologies, inside and outside starting hospital, with great possibility of growth.

### Adoption plans

We plan to procure and scale up the solution in our organisation if the pilot is successful.

# Leading SME

| GENERAL INFORMATION | |
|---|---|
| **NAME OF THE SME** | DITA d.o.o. |
| **DESCRIPTION OF THE SME** | DITA was established in 2024 as a spin-off company, by dr. Izidor Mlakar and dr. Bojan Musil with the goal of developing health care solutions that will support a digital transformation of healthcare organizations and the healthcare sector. |
| **WEBSITE URL** | www.dita.si |

**Table 1. Leading SME general information**

## Solution proposed:

***COMPASS: Comprehensive Monitoring and Post-surgical Support System for Physical and Mental Wellbeing.***

COMPASS is a comprehensive framework designed to collect digital biomarkers non-intrusively and assess individuals for the risk of mental distress. This innovative system comprises three key components: the mPatient App for patients, the Risk Assessment Model, and the mClinician App for healthcare providers. Real-world data is sourced from diary recordings, physiological biomarkers obtained from smart wearables, and validated instruments like PHQ-9, GAD7, EQ5D 3L, and VR-12. The Risk Assessment Model, serving as the central component, employs (X)AI techniques and traditional AI approaches to analyse data patterns and create personalized risk profiles. Machine learning-based predictive models for mental health will be developed and statistically validated by clinicians.

The mPatient App, brought from TRL4 to TRL7, offers a user-friendly mobile interface presenting data in easily digestible visualizations. It tracks mood swings, well-being, rehabilitation progress, upcoming appointments, and aids in managing physical and mental states. The app includes features such as eConsent, Diary & Care Plan, Message for patient-doctor communication, Knowledge Bank for mental health information, and a Virtual Assistant providing personalized support.

The mClinician App, a web-based solution, aids clinicians in decision-making and optimizing physical visits by providing a back-end interface as a decision support tool. It integrates real-world data collected by the mPatient App, enhancing overall patient care and communication.

The micro-service-based infrastructure supporting these components consists of Apache Camel and Apache ActiveMQ Artemis. Apache Camel facilitates external access to AI and data services, serving as a connection between components, while Apache ActiveMQ Artemis, an MQTT broker, handles internal and external communication. The architecture, verified at TRL7, incorporates REST API implemented with Java and Swagger UI for documentation and testing.

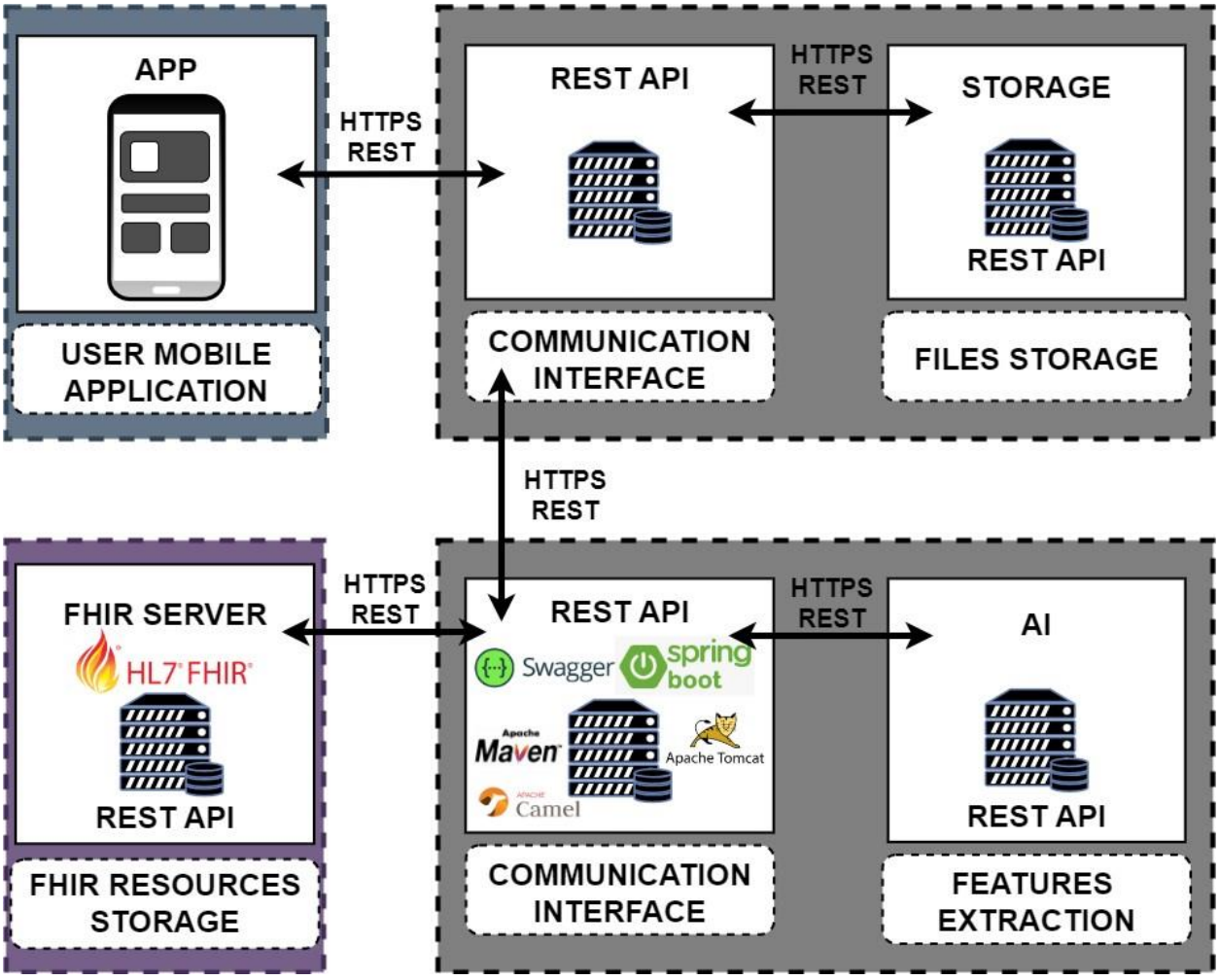


**Figure 1. Solution overview diagram**

In summary, COMPASS combines advanced technologies, including AI and machine learning, with user-friendly interfaces in the mPatient and mClinician Apps. This holistic approach aims to transform mental health monitoring, empowering both patients and clinicians with real-time data, personalized support, and efficient decision-making tools. The micro-service infrastructure ensures seamless communication and data operations across the entire system.

## Work to be done by the leading SME

**WP1. Project management and Awareness and Impact building** focuses on crucial project management objectives: effective monitoring, adherence to plans, interfacing with EU services, ensuring quality, and risk management. WP1 ensures coordinated efforts, quality assurance, and strategic communication, crucial for successful project implementation.

**WP2. Requirements elicitation and design of the study protocols** focuses on providing initial understanding on mental health monitoring, post-surgery well-being, and digital intervention practices. Employing the PRISMA methodology, T2.1 analyses existing knowledge, while T2.2 defines use cases with a Patient and Public Involvement (PPI) approach. T2.3 identifies technical requirements and ensures compliance with privacy and security regulations. Outputs include D1 – Requirements, Use Cases, and Studies (M6), encapsulating stakeholders' needs, COMPASS users, use cases, technical requirements, the initial

architecture, and the study initiation package. This comprehensive approach aligns the project with real-world needs and regulatory standards.

**WP3. COMPASS Platform Development** aims to establish an advanced multimodal sensor network and data model. The goal is to capture features essential for monitoring mental health parameters, empowering patients through educational materials and direct patient-doctor communication. T3.1 focuses on Reference Platform Architecture and Open APIs Specifications, aligning with relevant models (Rest, ReEIF & FIWARE). T3.2 concentrates on developing mHealth & mClinician Apps, emphasizing user interfaces and integrating third-party devices. T3.3, the Risk Assessment Model, delves into knowledge discovery using AI/ML models and comprises of: (i) feature extraction using graph similarity techniques; (ii) feature enrichment, (iii) linking mental health risk prediction and proposing interventions (from the educational library), by employing diverse ML. T3.4 ensures Integration, Data & Security assurance, delivering the COMPASS platform with major releases. Outputs include Technical Architecture (M9), Prototype version for Living Labs (M10), and Beta version (M15) for validation in clinical studies, summarized in D2, at M15.

**WP4. Co-creation, Evaluation and Demonstration in Real-World Conditions** focuses on Co-creation, Evaluation, and Demonstration in Real-World Conditions. It aims to organize, deploy, and operate living labs, and evaluating the feasibility of the COMPASS solution based on predefined KPIs in real-world pilots. T4.1 ensures Actor & Community Engagement, fostering recruitment success through community-building activities. T4.2 deploys COMPASS Living Labs & Proof-of-Concept, refining technologies through co-creation, leading to a Beta Version. T4.3 coordinates Pilot Roll-out, following study initiation package guidelines, and T4.4 evaluates Pilot Outcome, monitoring technical suitability, GDPR compliance, and KPI results. Outcomes include a Public Engagement Strategy (M10), Evaluation of Living Labs outcomes (M15), and COMPASS Framework and sustainability assessment (M18), summarized in D3.

# Follower SME

## Scope of work performed by the follower SME

We propose that the Follower SME gets involved in the next tasks:

**WP1. Project management and Awareness and Impact building**

In collaboration with the leading SME, the follower SME should concentrate effort in:

a) Quality assurance, administrative coordination and ethical monitoring.

b) Implementation of the dissemination and communication strategy.

**WP2. Requirements elicitation and design of the study protocols**

Technical requirements analyse for the Application (resources needed):

a) Focus on requirements and participatory design.

b) Functional requirements and conceptual architecture.

c) Requirements for IoS and Adroid marketplace distribution.

**WP3. COMPASS Platform Development**

While the system of the solution will be developed by DITA, we propose that the follower SME will concentrate their effort in:

a) Development of the Application for physicians; backend portal, personalization and automation of care workflow: messages, alerts, activities, privacy control.

b) Development of the patient application, based on the multimodal sensor network and data model system developed by the leading SME.

c) Integration with third-party devices.

d) Ios and Android application store distribution.

e) Joint integration, Data & Security assurance.

**WP4. Co-creation, Evaluation, and Demonstration in Real-World Conditions**

With the main effort dedicated to:

a) Setting up a co-creation methodology.

b) Support the organisation, deployment and operation of living labs.

c) Community Engagement.

d) Coordinate the pilot Roll-out.

e) Evaluating Pilot Outcomes, monitoring technical suitability, GDPR compliance, and KPI results.