

# FallPredict

## *Real-time patient monitoring during independent movements in the Hospital.*

KBC Rijeka is one of five clinical hospital centres in Croatia. It is a regional hospital centre covering three counties, providing medical care for approximately 600,000 inhabitants. Consists of 18 clinics, 6 clinical institutes, 6 independent institutes, 2 independent departments and the hospital pharmacy. KBC Rijeka employs more than 3.400 employees, 312 biomedical, and health researchers. The hospital performs activities of health care and diagnostic activities in the field of medicine with more than 3 mill. medical services. KBC Rijeka is a clinical partner for several higher education institutions (HEIs) such as The Faculty of Medicine Rijeka, The Faculty of Health Studies, and The Faculty of Dental Medicine.

### Challenge description

Currently, prevention efforts rely heavily on manual supervision by healthcare staff. However, taking into account the number of medical staff (74 nurses working in shifts and 8 caregivers) in the Clinic for cardiovascular diseases and number of beds 53 and 8 special chairs for one day hospital stay (therapy and diagnostic procedures), it's not feasible that each patient is monitored all the time. Although tenders are announced and scholarships are approved, we are faced with an insufficient number of nurses.

To provide continuous and better supervision or assistance for patients who need to go for a walk, use the restroom, etc. implementing a solution that allows for remote monitoring of patients during unassisted movements during hospital stay can bring several significant benefits. It enhances patient safety, reduces the risk of falls and injuries, optimizes staff resources, and improves overall operational efficiency. The hospital benefits from increased patient satisfaction, reduced incidents of adverse events, and a more proactive approach to patient care.

Additionally, the solution contributes to a positive impact on key performance indicators, such as fall incidence rates, patient engagement in physical activities, and overall healthcare quality measures.

In the Clinic for Cardiovascular Diseases of KBCRI, around 20 falls of patients occur in a year. Of all these falls about 15% are serious one with severe injures like bone fractures. With this solution, this number can be reduced, but also if a fall happens nurses will be immediately alerted which can reduce the pain and suffering of the patients as the reaction of medical staff can be quick.

The solution would improve patient hospital experience as their mobility and independence within the hospital environment wouldn't be limited only to their room and bed. It should be noted that only patients who will give approval will wear wearable sensors for fall detection.

Furthermore, in recent years, fall risk assessment has gained prominence with the realization that falls require significant medical attention and can pose significant financial burdens.

### Challenge main objectives

The main objective of the challenge is to enhance patient safety by providing a solution that can detect potential falls in real-time. The solution aims to minimize the risk of injuries



resulting from falls and improve the response time of healthcare providers, while at the same time, patients can preserve their mobility and independence within the hospital environment.

## Solution functional requirements

### Compulsory functional requirements

- The solution shall support and include patient held devices, for example, wearable sensors on the patient or their clothing (e.g. wrist, leg, slippers) to accurately detect changes in posture and movement.
- Wearable sensor for fall detection should be designed with careful consideration of various factors to ensure optimal usability, effectiveness, and user comfort. Following requirements must be achieved:
  - Compact design and lightweight - allowing patients to wear it comfortably without hindering their movements.
  - Comfort and Skin-Friendly Materials: Use soft and hypoallergenic materials to prevent irritation and ensure comfort during prolonged wear.
  - Water Resistance: Sensor should be water-resistant.
  - Battery Life: Sensor should be able to work normally without re-charging or changing batteries for 30 days.
  - Sensor should support wireless connectivity (e.g., Bluetooth) with monitoring system that will be placed in the room for nurses or smartphones of nurses.
  - Language mode: the software should have a possibility to choose the Croatian language.
- The system must have an immediate alerting mechanism that notifies healthcare providers when a potential fall is detected in real-time. Also, it must show the exact location of the patient at the time of alert.
- The system should provide a user-friendly interface for healthcare providers to view real-time data, alerts, and patient information related to fall detection.
- The system should be able to monitor several patients at the same time.

### Desirable functional requirements

- It would be good if the sensor can also track number of the steps in certain time interval (6 minutes intervals) by the patients as this data can be used to determine if the patient is feeling healthier and can be discharged from the hospital ("6-minute walk test").

## Pilot scope

End-user type	Role	Number
Medical staff (Cardiologists and nurses)	They have to provide requirements, recruit patients, use and validate the solution.	10
Patients	Participate in the pilot and validate the solution.	30

**Table 1. Targeted users**

### Language

- Solution and the whole pilot, including the communication with the end-users will be conducted in Croatian language.

### Other aspects

- Solver needs to provide KBCRI with the wearable sensors for fall detection of patients. KBCRI estimates that 5 wearable sensors would be sufficient to conduct the pilots, but other agreements could be reached.

## Pilot set-up conditions

### Ethical, legal, or regulatory

An Ethics Committee of the KBCRI must previously validate the approach of the pilot. The solution shall be fully GDPR compliant. Solver should familiarize with the Croatian national law and all relevant legal or other documents that regulate healthcare system and IT sector in Croatia as well as European union. The hospital will not take the responsibility or obligation to perform legal/administrative/technical corrections or advises to selected Solvers or options. Solver will be responsible for the innovative solution/product that is not in line with all legal conditions that arrange the healthcare system in EU and/or Croatia.

### Technological

The technical solutions are focused on the use of wearables like sensors in smart watch or bracelet devices, to help determine if fall has occurred, and if that statement is true, alert medical personnel about the incident, location of the fall and identification of the patient. Every patient wears a device identified to his/her name, the device is via WIFI connected to the hospital network and registered in the database. On the central console computer, hospital personnel watch the status of every patient in real time. If the fall occurs the smart watch registers the changes in values in its gyroscope and acceleration sensors and sends the alert of possible incident and location of the fall to the central console computer, as well as to the mobile version of the monitoring application on the phone of selected personnel. As the device is registered to the exact patient, in monitoring application we also know the identification of the patient that is subjected to the possible fall incident. Every device is in local hospital network (central console monitoring stations, smart watches, mobile phones, central database server) so the communication between the devices is ensured. As for requirements for this project there are hardware and software parts of the development. As for hardware, central computer monitoring station, mobile phones, smart watches, wireless access points and server is required. For software part, the development of monitoring applications, API (application programming interface) for communication with smart watch sensors, and database management system is needed. Many commercial smart watches (Samsung, Huawei, Apple watch, etc.) already have fall detection functionality built in as feature, as well as functionality of sending fall detection alarm to predefined locations, so there is no need for developing complex algorithm for measuring data from the sensors, but it is needed to develop monitoring applications that can receive data from communication protocols used by smart watches.

The system doesn't need to be interoperable with our current IS, but if applicable than it should have the possibility to communicate to our HIS over HL7 (Health layer 7) protocol. As for technical solution, we need device on patient that monitors the possible fall in real time, and if fall occurs alarms the personnel of the possible fall. Specified system should be standalone application on local network, but with built in mechanism for communication with other systems in the future over HL7 protocol (sending and receiving HL7 messages).

### Data access

Solution will work as a separate system and no data will be extracted from organisational systems, or any other for this solution. The Confidentiality Agreement will be signed between KBCRI and the chosen supplier/solver (SME) of the innovative solution.



## Expected impact and KPIs.

To provide continuous and better supervision or assistance for patients who needs to go for a walk, use the restroom, etc. implementing a solution that allows for remote monitoring of patients during unassisted movements during hospital stay at Clinic for cardiovascular diseases can bring several significant benefits. It enhances patient safety, reduces the risk of falls and injuries, optimizes staff resources, and improves overall operational efficiency. The hospital benefits from increased patient satisfaction, reduced incidents of adverse events, and a more proactive approach to patient care.

Additionally, the solution contributes to a positive impact on key performance indicators, such as fall incidence rates, patient engagement in physical activities, and overall healthcare quality measures.

- **Reduce number of fall incidence rate by 10%.** In the Clinic for Cardiovascular Diseases of KBCRI, around 20 falls of patients occur in a year. The goal is to compare patients who will have wearable sensor with group of patients who won't (both groups will be of similar age/health condition) in certain period of time.
- **Reduction in Fall-Related Injuries:** Compare the severity and types of injuries in falls of the patients who have wearable sensor and patients who don't. Goal is to compare if the quick reaction of the medical staff (they receive alert by the solution) can reduce severity of injuries.
- **Patient Satisfaction:** Administer patient satisfaction surveys on the patients who participated in testing (e.g. if they feel better and safer wearing it, does it impact their comfort during the stay, did they feel that the system respected their privacy, did the fall monitoring system impact their ability to engage in daily activities, etc.). Goal is to analyse scores and feedback to assess satisfaction levels. The aim is to have at least 20 patient surveys received and have 60% of positive answers. Likert scale will be used for rating.<sup>1</sup> The satisfaction of the medical staff who will participate in the pilot will be also measured by the survey. The aim is to have 60% of positive answers (Likert scale will be used for rating).

## Business opportunity

### Market size

- *Internally, the KBCRI is a regional hospital centre covering three counties, providing medical care for approximately 600,000 inhabitants. Consists of 18 clinics, 6 clinical institutes, 6 independent institutes, 2 independent departments and has the total capacity is 1069 patient beds. More than 45,000 patients are hospitalized annually at the Rijeka Clinical Hospital Center and about 300,000 patient days are realized. This solution can be replicated in other clinics in the KBCRI who have hospitalized patients that are the target group (elderly or frail patients).*
- *At the national level in Croatia there are thirteen (13) Clinical institutions which include five (5) main Clinical Hospital Centres, there are twenty-two (22) General Hospitals and twenty-eight (28) Special hospitals. There are also a number of private hospitals which are not included in this calculation. According to the last available data (2022.), there were 22.717 beds in Croatian hospitals and 658.189 patients were treated. The market size estimates indicate the potential for substantial revenue and positive impact on*

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<sup>1</sup> <https://www.questionpro.com/blog/what-is-likert-scale/#:~:text=Definition%3A%20Likert%20scale%20is,%2C%20product%2C%20or%20target%20market>

patient safety across the Croatian healthcare landscape if the solution proves to be efficient and effective.

### Adoption plans

If the pilot project will be successful, our internal decision-making body will decide about the acquisition of the innovative solutions. There is no commitment for KBCRI to adopt or purchase the innovation if successful.

## Resources

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inDemand. (2020). [inDemand stories](#).

inDemand (2018). [EPICO Challenge](#) - inDemand Call for Companies Murcia Region.

inDemand (2019). [GRAVIDITY Challenge](#). inDemand Call for Companies Murcia Region.

InnoBuyer. (2023). [InnoBuyer Webinar](#): How to master innovation needs identification.