Remote Patient Monitoring Station

Ángel Jiménez, Richard Weber, Francisco Díaz , Cristian Retamal

Instituto Sistemas Complejos de Ingeniería (ISCI)

Ingeniería Industrial, FCFM – U.de Chile.

INTRODUCTION

Understanding the context

Given the current health emergency, a remote monitoring system for patients diagnosed with Covid-19 has been considered.

▶ The original idea corresponds to **monitoring the patient at home**, from a device with biosensors connected to the internet (IoT).

Due to the high requirement of medical personnel in health facilities, this solution can also be adapted for support in clinical settings (intermediate care, triage, etc.).

What will we see in this presentation?

The challenge

The general idea

Indicators

Biosensors and Operation

Future Uses and Adaptations

UNDERSTANDING THE CHALLENGE AND THE SOLUTION

Hospital availability

The pandemic caused by COVID19 generates considerable strain on hospital bed capacity. When this Is surpassed, the negative effects of the virus multiply. But how can hospital capacity be increased? One way is to free up beds. However, it is often complex to release patients whose symptoms may worsen at home.

Remote monitoring

One alternative that does allow us to free up beds and control the patient properly is that of remote monitoring. This project aims to enable such monitoring:

1. By allowing patients to read their own relevant vital signs.

2. Having the data and alerts so remote but simple for medical equipment.

Financial and operational feasibility

Some monitoring alternatives are currently available on the market. However,

i) discharging a patient with such alternatives is extremely expensive, and
ii) it is not always the same medical staff that discharges the patient then does the monitoring, which complicates the coordination of home visits by hospital staff.

REQUIREMENTS
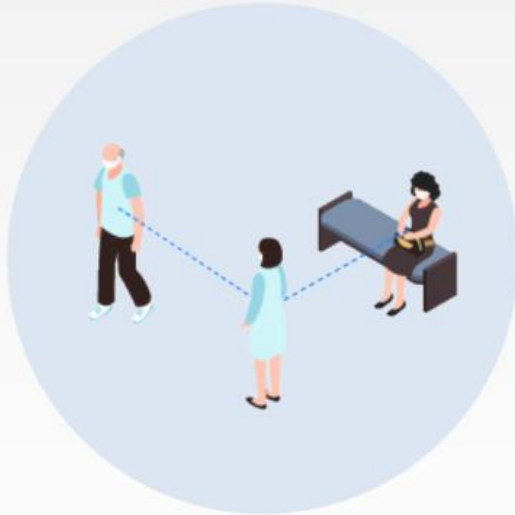
Avoid contact with infected patients and optimize the visits of clinical staff.
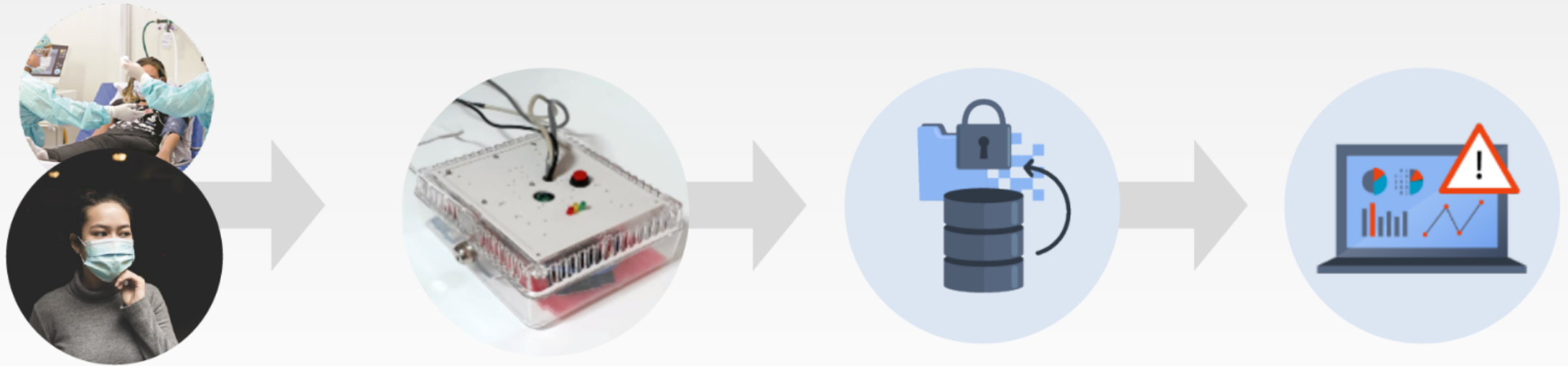
Assure the patient that even while they are at home, they are being monitored and will be taken to hospital if necessary.

Free up space for the treatment of new patients.

GENERAL IDEA OF THE MONITORING STATION

Patients detected are placed in quarantine in their homes or in observation rooms

The device developed makes it possible to read the patient's vital signs and the clinical environment, in accordance with adaptive measurement protocols.

The signals are cleaned and processed by algorithms developed specifically and sent securely to servers with end-to-end encryption.

The signs are transformed into indicators, with which tables of indicators and alarms can be generated.

WHAT TYPE OF INDICATORS?

The following indicators were identified as the most relevant with the help of medical experts and medical literature.
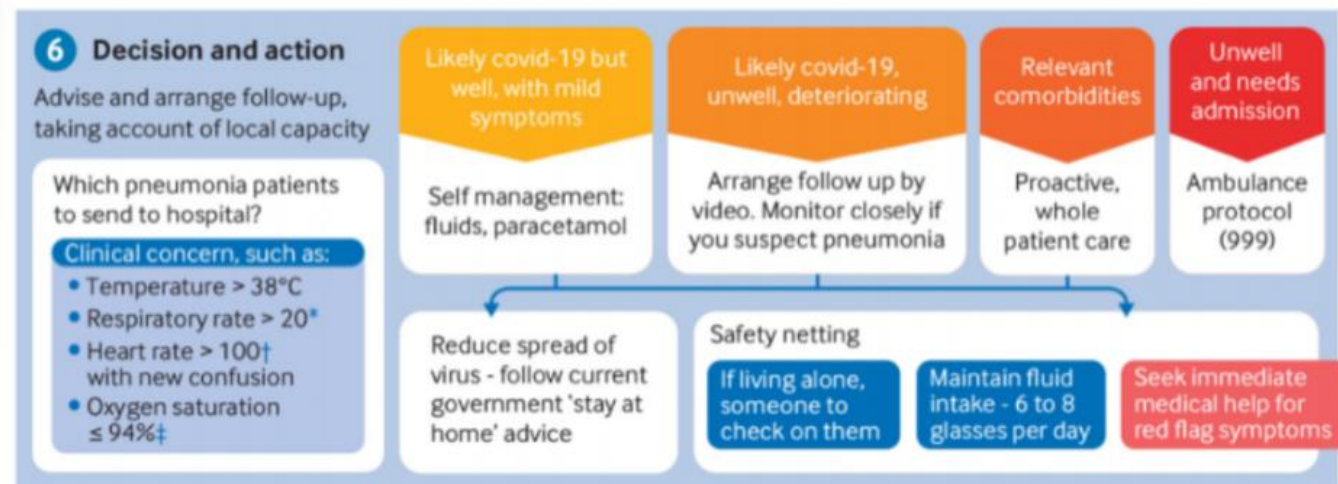
PATIENT

Heart rate
Oxygen saturation
Body temperature
Respiratory rate

CLINICAL ENVIRONMENT

Temperature
Humidity

Greenhalgh, T., Koh, G. C. H., & Car, J. (2020). Covid-19: a remote assessment in primary care. Bmj, 368

CONNECTING THE SENSORS

The **PPG sensor** (photoplethysmography) connects to the index finger, permitting the calculation of the heart rate and oxygen saturation vital signs.

The **accelerometer** is connected by a belt located at navel level. It reads a signal used to calculate the respiratory rate.
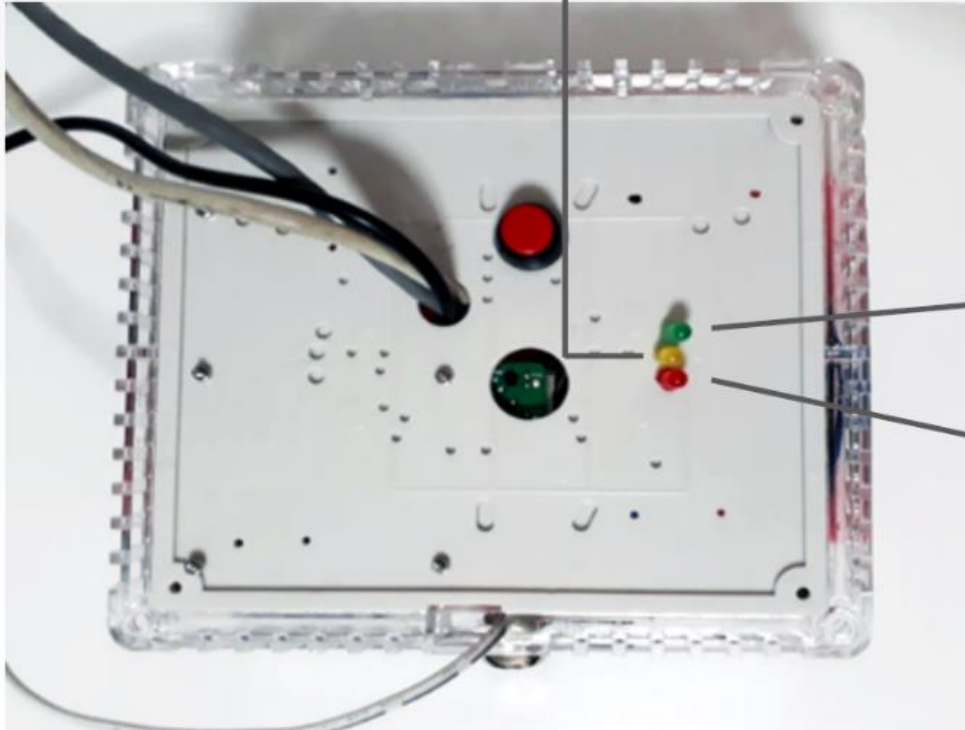
The **thermometer** should be placed under the armpit. This reads the body temperature of the patient.

Once all sensors have been fitted, the patient should press the red button. The yellow light flickers and the green light indicates the end of the process.

USING THE DEVICE

The device has three lights that guide the patient through the process.

The yellow light comes on to indicate that the patient must connect the sensors, remain in a rested state, and give the signal that they are prepared by pressing the red button. The yellow flashing light indicates that the process of signal reading being carried out correctly.

The green light indicates that the process has been carried out to completion correctly.

The red light informs the patient of the status of internet connectivity, a crucial element in IoT devices.

VALIDATION, ADAPTATION, AND SCALABILITY

- The phase of technical feasibility has been successfully completed.
- We are seeking an alliance and a clinical environment to carry out a concept test and a clinical validation study.

- The development has taken easy use for the patient into account, therefore facilitating the self-reporting of vital signs and the clinical environment.
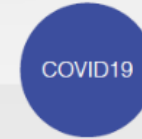
COVID19

- The system has been developed with the specific requirements of a patient diagnosed with Covid-19 in mind.
- It allows easy adaptation of monitoring times and types of alarm according to the state of health of a specific patient and clinical criteria of a doctor.
- The collected data makes it possible to progressively develop clinical research on the disease.

This development can be scaled to the treatment of other diseases or postoperative care, thus reducing the number of bed-days for each patient. Its application has a direct impact during winter campaigns, when respiratory diseases are at their peak.

CONCLUSIONS

A **reliable and economical** solution.

We are looking for a solution that is **scalable** to a large number of patients.

We use **data science tools** to connect **cost reduction in hardware development**, **communications and software**, with high confidence levels in the measurements recorded from secure and efficient signal processing algorithms.
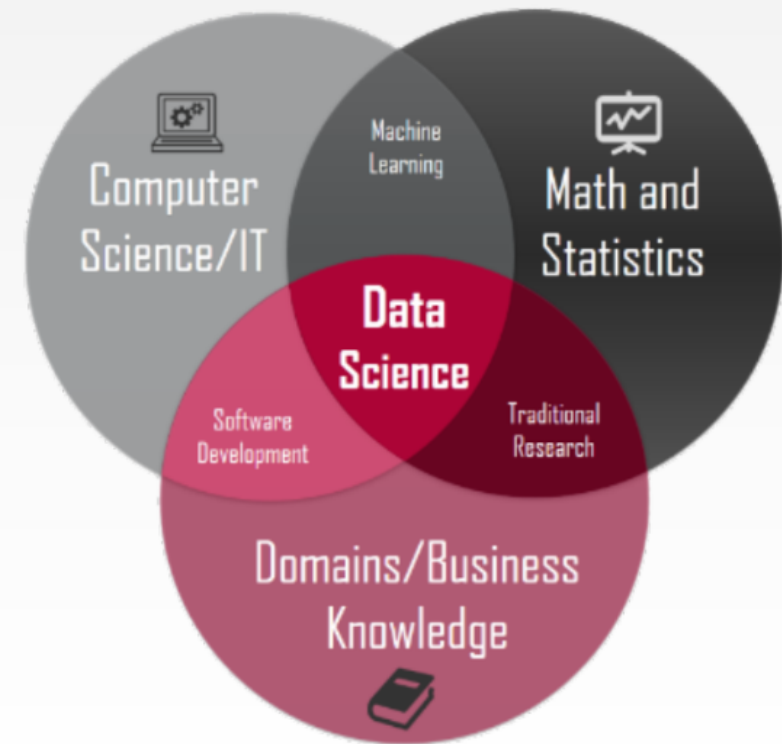
We seek an alliance for **clinical validation**.

FUTURE WORK

By using data science, this technological system will pave the way for the implementation of new improvements such as:

- Prediction models of risk events.

- Prediction and/or classification of the evolution of each patient.

- Progressive clinical research on coronavirus.

CONTACTS

Web Science and Smart Technology Lab
wesstlab.dii.uchile.cl

Researchers:
Ángel Jiménez - ajimenez@dii.uchile.cl
Richard Weber - rweber@dii.uchile.cl

Complex Engineering Systems Institute (ISCI)
contacto@isci.cl
www.isci.cl

ISCI INSTITUTO
SISTEMAS COMPLEJOS
DE INGENIERÍA