OUTPUT

Tools

Project index number and acronym	niCE-life CE1581
Output number and title	Output O.T3.1 Pilot testing of the intelligent monitoring platform in Brno
Responsible partner (PP name and number)	BUT – PP2
Project website	https://www.interreg-central.eu/Content.Node/niCE-life.html
Delivery date	31/12/2021

Summary description of the key features of the tool (developed and/or implemented) and of its transnational added value

Elderly people may experience any form of healthcare in a variety of settings, such as hospitals, assisted living facilities, or in some cases, they can be treated at home. The proper healthcare setting and management can affect the physical as well as mental health of older adults in a great way, and therefore, it requires careful and well-planned operation to ensure proper, in-time, and targeted help aiming at improving or at least maintaining the highest quality of life for as long as possible. The fact that the population is growing faster than ever before will very likely result in immense health issues with an increasing economic burden to health care systems worldwide. For this purpose, various in-home remote systems dedicated to the analysis, monitoring and treatment of various age-related diseases such as Parkinson's disease (PD), Alzheimer's disease (AD), dementia, etc., are being developed all around the world. The hope the entire world has is that in near future, we will be able to create and establish modern digital tools that will allow doctors to get early and precise identification of such diseases, apply effective treatment as soon as possible, slow down the process of neurodegeneration, and in general, save human lives.

In the scope of the niCE-life project, we have developed the online sleep monitoring system that leverages the use of smart wearables (specifically, an actigraph bracelet), digital signal processing, and state-of-the-art machine learning, to analyse sleep remotely in an objective, fast and low-cost mode. It is designed as a client-server web application that enables remote assessment and monitoring of sleep disorders. Nowadays, sleep disorders are diagnosed mainly based on screening in a sleep laboratory where the video-polysomnography (vPSG) is employed. Such an approach is expensive, not comfortable and does not offer a longitudinal assessment. In addition, in the current period of the pandemic, it is a big obstacle, because hospitals are overwhelmed with covid-positive patients and regular screenings (e.g. those held in sleep laboratories) are significantly reduced. The intelligent monitoring tool offers a cheap (€150/device that can be reused) and affordable (diagnosis in the comfort of home with minimal impact on a person daily life) alternative.

Since the system enables remote diagnosis of sleep disorders, which are the early markers of α-synucleopathies, it could be used during the prodromal diagnosis of e.g., PD. This disorder remains in the prodromal stage (i.e., in a stage when the typical symptoms are not visible) for up to 10 years. After those 10 years when the symptoms start to be more pronounced (e.g., resting tremor, rigidity, bradykinesia, postural instability), there are already significant brain damages. Treatment is significantly more effective when administered early. Thus, the Intelligent monitoring tool could be used for timely intervention which could have a positive impact on patients' quality of life.

The system is not limited to a specific country as PD is the most common neurodegenerative condition after AD affecting an estimated 1.2 million people in Europe alone with the incidence of PD being forecasted to double by 2050 primarily as a result of the ageing population. Therefore, an actigraphy-based sleep monitoring tool has a high potential to be used in the entire EU, to make the acquisition, analysis, assessment, and monitoring of sleep data more accessible and easier to deploy aiming at day-to-day use in clinical practice. In addition, as mentioned below, the tool goes beyond the borders of neurodegenerative disorders and establish its potential in the field of sleep apnea as well.

NUTS region(s) where the tool has been developed and/or implemented (relevant NUTS level)

The Intelligent monitoring tool was developed at the Brno University of Technology (CZ064 NUTS level 3).

It was tested and implemented at the following sites:
- Samariterbund Burgenland (AT111 NUTS level 3)
- University Hospital Olomouc (CZ071 NUTS level 3)
- St Anne's University Hospital Brno (CZ064 NUTS level 3)

Expected impact and benefits of the tool for the concerned territories and target groups

Primary endpoint

Improved quality of life of patients with sleep disorders - Thanks to the remote, easy-to-use and early diagnosis of sleep disorders, the Intelligent monitoring tool could be used to identify the early marker of $\acute{o}$Ī-synucleopathies, support their prodromal diagnosis and thus enabling timely intervention (treatment) that will have a positive impacts on patients' quality of life.

Secondary endpoints

The Intelligent monitoring tool has the following secondary endpoints
- Effective work of experts - Thanks to the remote mode of sleep analysis, the experts will not have to invite patients to hospitals frequently. Also, due to the 7-day monitoring, they will have much better and complete picture of a pathology.
- Reduced costs related to the management of diseases associated with sleep alterations - Thanks to the remote monitoring, the Intelligent monitoring tool will reduce number of patients in hospitals, examination time of experts, and costs related to traveling to hospitals.

Beside the impact for patients and healthcare providers, and economic impact, the Intelligent monitoring tool has a societal impact as well. Neurodegenerative disorders creates new costs to patients, their families and friends, but also they create the need for increased social care. Thus the early diagnosis and timely intervention could significantly alleviate its consequences.

Sustainability of the tool and its transferability to other territories and stakeholders

The Intelligent monitoring tool is currently deployed and extensively used at the St Anne's University Hospital Brno (https://www.fnusa.cz/en/hp/, CZ064 NUTS level 3) and the Central European Institute of Technology (www.ceitec.eu, CZ064 NUTS level 3). More than 90 subjects already used it. Neurologists of these institutions employ it in clinical studies for prodromal diagnosis of Lewy body diseases, i.e. PD and dementia with Lewy bodies. We believe that in the next few years after the system is sufficiently published in scientific journals, it will be adopted by other teams in other territories.

In the frame of the niCE-life project, we already proved the transferability of the tool. In 2021 the University Hospital Olomouc (CZ071 NUTS level 3) expressed a strong interest in the tool, more specifically, local experts started to use it for the assessment of sleep apnea. Apnea is a potentially serious sleep disorder in which breathing repeatedly stops and starts. Breathing pauses can last from a few seconds to minutes. Complications can include daytime fatigue, high blood pressure or heart problems, type 2 diabetes, metabolic syndrome, complications with medications and surgery and possibly also liver problems. A side effect could be also sleep-deprived partners. People struggling with sleep apnea are often prescribed a continuous positive airway pressure (CPAP) machine to mitigate their symptoms. The hospital uses the Intelligent monitoring tool to remotely assess the effect of CPAP-based treatment.

As soon as the niCE-life project approaches its end, we plan to apply for another reprojects where the Intelligent monitoring tool will be further improved/developed and provided to other stakeholders.

References to relevant deliverables and web-links
If applicable, pictures or images to be provided as annex

The main deliverables related to the tool are the following ones:

- O.T2.1 – Intelligent monitoring tool
- D.T3.1.1 - Implementation plan of the pilot actions in the partner regions
- D.T3.2.4 - Summary report from the pilot action in Brno

The tool is deployed at: https://linda.utko.feec.vutbr.cz/