

Patient centric solution for smart and sustainable healthcare

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ABBREVIATIONS

AAL	Active Assisted Living
AMSPPR	Romanian Association of Dentists with Private Practice
ACESO	Patient centric solution for smart and sustainable healthcare
EuGMS	European Geriatric Medicine Society
ICT	Information and communication technology
AI	Artificial Intelligence
WHO	World Health Organization
GUS	Central Statistical Office
TD	Teledentistry

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1. Abstract

The aim of this deliverable is to present the scientific dissemination activities of the ACESO project, be they journal papers or conference articles and presentations. During the life of the project, three journal articles were written; two of them concerned telemedicine and teledentistry in seniors, and the other one discussed federated learning on health and wellbeing data. Four conference articles and presentations were also done by the ACESO consortium, one of them being a dissemination of the project at the largest annual medical conference dedicated to geriatrics in Europe (Congress of the EuGMS). Another important international conference where the project was disseminated was the EduLearn 2021; the last two presentations of the ACESO project were conducted in the Conference of the Romanian Association of Dentists with Private Practice by Ligia Muntianu.

2. Introduction

The scientific dissemination within ACESO project is grouped in the following sections as journal papers and conference papers and presentations.

3. Journal Papers

3.1 TITLE: Teledentistry and oral health in older adults - aspects for implementation of the "Patient centric solution for smart and sustainable healthcare (ACESO)" project

Reference: Gryglewska B, Perera I, Klimek E, Fedyk-Łukasik M, Piotrowicz K, Mocanu I, Muntianu L, Gąsowski J. Teledentistry and oral health in older adults - aspects for implementation of the "Patient centric solution for smart and sustainable healthcare (ACESO)" project. *Folia Med Cracov.* 2022;62(2):5-16. doi: 10.24425/fmc.2022.141697. PMID: 36256891.

Impact on the project: Dissemination of the rationale and main ideas behind the project nationally and internationally through publication in the PubMed(R) indexed journal.

Short description: Oral health and diseases are significant components of general health. However, oral health-care remains at the lowest of older patients' priorities. The inability to obtain dental care can result in progression of dental disease, leading to a diminished quality of life and overall health. Teledentistry (TD) provides an opportunity to improve the quality of oral health services. The aim of our narrative review was to analyze the usefulness of teledentistry as a part of telemedicine to improve oral health in the elderly. **Materials/Methods:** The PubMed database search was done for: teledentistry, oral health, oral- health related diseases, elderly, older adults. The applicability of TD has been demonstrated from children to older adults. Older adults have many obstacles in getting oral health care, including low income, lack health insurance, frailty, anxiety, depression, mobility problems or other handicaps. Available data suggests that the usefulness of TD in the provision of oral care in elderly people living in residential aged care facilities. Moreover, TD procedures were found to be as accurate as traditional face-to-face dental examinations, they were cost-effective and well accepted among patients and caregivers. TD might be a very useful tool for professional education, improving access and patient satisfaction of dental care. However, such TD modes would be difficult to widely implementation in community-dwelling older people who cannot access dental care. The ongoing "Patient centric solution for smart and sustainable healthcare (ACESO)" project will add to the intelligent oral health solutions.

3.2 TITLE: Directions of the telemedicine in geriatrics

Reference: Rudzińska A., Kupis R., Piotrowicz K, Malicki Ł, Mocanu I, Cramariuc O, Perera I, Gryglewska B, Gąsowski J. Kierunki rozwoju telemedycyny w geriatricii. [Directions of the telemedicine

in geriatrics] (in): *Oczekiwania wobec nauk biomedycznych – trendy, wyzwania i perspektywy. Tygiel, 2023: 147-159; ISBN: 978-83-67104-73-9.*

Impact on the project: Dissemination of the ideas promoting telemedicine in older adults in a collection of papers concerning the emerging issues in medical research in Poland.

Short description: Forecasts by the World Health Organization (WHO) and the Central Statistical Office (GUS) indicate that by 2050 the elderly will constitute 22% of the population. With the passage of years and the increase in the average life expectancy, not only the way of looking at the elderly changes, but also the needs and expectations of members of this social group. With the passage of time, an increase in interest in new technologies could be observed among seniors. What is more, their fluent use at work and in everyday life in the previous stages of life determines greater efficiency and independence in the use of mobile devices. The COVID-19 pandemic has contributed to the spread of many telemedicine solutions. Their use, including further popularization of visits to doctors and other medical professionals via videoconferencing, can positively affect the availability of health services, reduce the waiting time for contact with a specialist and reduce the financial outlays related to the organization of stationary check-ups. The multimorbidity of the elderly, which is common among the elderly, poses further challenges for telemedicine in the field of development of devices for ongoing health monitoring. Diseases of the musculoskeletal system that limit mobility and increase the risk of falling, cardiac comorbidities, carbohydrate and lipid metabolism disorders are some of the most common health problems affecting elderly people, whose adequate treatment depends to a large extent on regular control of parameters such as glycemic level or blood pressure. Another, no less important, area in which there is an increase in demand for intelligent technological solutions is the area of disease prevention and promotion of a healthy lifestyle, including care for oral hygiene and health that is often overlooked in old age.

Key word: geriatrics, telemedicine, modern technologies

3.3 TITLE: Testing Federated Learning on Health and Wellbeing Data

Reference: Irina Mocanu, Razvan Smadu, Marius Dragoi, Andrei Mocanu, Oana Cramariuc: Testing Federated Learning on Health and Wellbeing Data, EHB 2021, 18-19 November 2021, Iasi (ISI Proceedings).

Impact on the project: The paper is presenting and testing various approaches to data processing which are GDPR compliant.

Short description: Nowadays artificial intelligence is used in healthcare applications, too. Based on current research personalized medicine could transform the healthcare domain. Thus, medical data from users must be collected and used for training models. In order to preserve the privacy of data, federated learning represents a good candidate. This paper proposes an extension of the federated learning model that is evaluated for learning over a distributed dataset. The proposed architecture is a client-server, where the clients are clustered by the server, according to their data similarity (without exposing data to the server). The server stores the clusters models and manages the clients. Different tests were performed on three datasets: CIFAR-10, MNIST and a non-standard one - a sleep dataset. Results show that an increase of the convergence rate was obtained (in case of the MNIST dataset was 50 times faster). Also, the method has the ability to learn patterns from the data, by keeping data locally.

4. Conference papers and presentations

4.1 TITLE: The “Patient centric solution for smart and sustainable healthcare” (ACESO) project, rationale and protocol

Reference: Ian Perera, Ligia Muntianu, Irina Mocanu, Ewa Klimek, Małgorzata Fedyk-Łukasik, Łukasz Malicki, Angelo Consoli, Barbara Gryglewska, Karolina Piotrowicz, Jerzy Gąsowski. The “Patient centric solution for smart and sustainable healthcare” (ACESO) project, rationale and protocol. *Eur Geriatr Med* (2021) 12 (Suppl 1): S1–S387

Event size: approx. 2000 participants

Impact on the project: Project dissemination at the largest annual medical conference dedicated to geriatrics in Europe.

Short description: The “Patient centric solution for smart and sustainable healthcare” (ACESO) project aims to leverage the use of artificial intelligence (AI) to create an integrated health and oral-care platform through the use of intelligent devices and data analytics, with the focus on oral hygiene and xerostomia. Methods: Sixty participants, including with xerostomia, aged 60 years, with varying states of dentition will be recruited in the pilot study, following classification based on a Comprehensive Geriatric Assessment. Participants’ salivary status at rest as well as in function will be assessed using citric acid challenge test to differentiate between patients with and without xerostomia. The individual components to assess the end-user’s oral hygiene (smart toothbrush) and oral-hygienic behaviour will be tested together with devices measuring general health status (sphygmomanometer, thermometer, oximeter, weighing scale, activity and sleep bracelet, and glucometer). Further, the platform integrating these components will be set-up and tested in all individuals giving input to the underlying AI engine. Results: The AI models will help to associate the seemingly disparate health and oral hygiene phenomena possibly indicating rapid changes in patients’ health and wellbeing. The hitherto performed feasibility pilot, demonstrated that the adopted salivary secretion challenge is capable of differentiating patients into those with and without salivation problems. Conclusion: Preliminary tests performed revealed that most cases responded well to chemical stimulation. However, some participants displayed decreased salivary flow due to a decrease in parotid secretions. Further research is required to establish the basis of these findings.

4.2 TITLE: Oral Health Education for Elderly Through ICT Technology

Reference: N. Samar Brencic, L.A. Stanca Muntianu, K. Piotrowicz, I. Mocanu, D. Rudel, I.G. Lupu, ORAL HEALTH EDUCATION FOR ELDERLY THROUGH ICT TECHNOLOGY, in *Proc. EduLearn 2021*, Mallorca, Spain 2021.

Event size: over 800 delegates from 80 different countries

Impact on the project: Project dissemination at one of the most important international education conferences for lecturers, researchers, technologists and professionals from the educational sector.

Short description: Leading oral-care manufacturers are envisioning a world where daily oral health routine can be used to educate consumers to take care of their health comprehensively. State of the art research and ongoing European projects are striving towards extracting health knowledge from daily oral routine and using this knowledge for optimizing care and for leading a longer and healthier life. In this context, the “Patient centric solution for smart and sustainable healthcare” (ACESO) project is aiming to exploit modern Artificial Intelligence (AI) technologies in order to build an integrated health and oral-care platform in which intelligent devices use data analytics to learn about users’ oral and general health and wellbeing. Our approach will enhance oral health education and will spur the ability of patients to play a more active role in managing their health. Thus, we will help supporting the current

trend in sustainable care which aims at shifting care delivery from a patient-centered to a patient-centric approach.

ACESO's ambitious goals are pursued by a multinational consortium involving both academic and industrial partners from Poland, Romania, Switzerland, Slovenia and Hungary. Several differences are known to exist among the targeted users in these countries. Consequently, cross-national cooperation within ACESO will be able to take into account differences in national backgrounds during the development of the platform and in training and educating the users.

4.3 TITLE: The electronic e-care dental platform in the European ACESO project

Reference: Ligia Muntianu, Platforma electronica dental e-care in proiectul European ACESO [The electronic e-care dental platform in the European ACESO project], Conferinta de paro-protetica a AMSPPR 2022, 3-5 March, online presentation.

Event size: approx. 300 participants

Impact on the project: ACESO Project dissemination to Romanian dental specialists and researchers.

Short description: This article is presenting a general view of the ACESO project, including objectives and expected impact. The ACESO architecture is presented along with the first prototypes of the smart ACESO toothbrush.

4.4 TITLE: Artificial intelligence in oral and general health care

Reference: Ligia Muntianu, Inteligenta artificiala in ingrijirea sanatatii orale si generale [Artificial intelligence in oral and general health care], Conferinta de paro-protetica a AMSPPR 2022, 3-5 March, online presentation.

Event size: approx. 300 participants

Impact on the project: ACESO Project AI applications and approaches for oral and general health dissemination to Romanian dental specialists and researchers.

Short description: AI applications and approaches for oral and general health are presented in the context of the ACESO project.

4.5 TITLE: The discrepancy between the rating of the individual health devices and the tablet interface of a technology-rich health system for home use. The ACESO project

Reference: Abstracts of the 18th Congress of the European Geriatric Medicine Society. Eur Geriatr Med 13 (Suppl 1), 1–439 (2022). <https://doi.org/10.1007/s41999-022-00711-8>

Event size: over 1500 participants

Impact on the project: Project dissemination at the largest annual medical conference dedicated to geriatrics in Europe.

Short description: Technology-rich personalised health systems are being used in the care for older patients. However, the reception of such techniques may limit their use. Methods: In the Krakow (Poland) centre of the ACESO project, we profiled participants > 60 years of age. After the equipment have been used on at least one occasion, we administered structured and semi-structured questionnaires concerning the ease of use of the components that included sphygmomanometer, thermometer, intelligent toothbrush and the use of a tablet-based interface. Additionally, we tested the perceived improvement of salivation with the use of Salipen salivation stimulating device.

5. Conclusions

During the course of the project, the consortium partners have published 3 scientific journal articles and have participated with articles, presentations or posters to 5 scientific conferences. The articles and presentations had the aim of disseminating the ACESO project and its most interesting discoveries and innovations to the scientific community. The scientific dissemination activities during conferences and congresses were a success, reaching more than 3000 lecturers, researchers, technologists and professionals from a variety of sectors.

6. Document History

Date	Changes	Version	Author
1.12.2020	Definition of the deliverable template	1	All partners
1.12.2021	Contributions from 2021	2	CITST, JUMC, MKS, LSDM, DCMTC
1.12.2022	Contributions from 2022	3	CITST, JUMC, MKS, LSDM, DCMTC
1.10.2023	Contributions from 2023	4	CITST, JUMC, MKS, LSDM, DCMTC
2.10.2023	Internal review	5	JUMC