

# Implementation of Innovative e-Health Services and Digital Healthcare Ecosystem – Cross4all Project Summary

Andrijana Bocevska <sup>1</sup>, Snezana Savoska <sup>1</sup>, Ilija Jolevski <sup>1</sup>,  
Natasha Blazheska-Tabakovska <sup>1</sup> and Blagoj Ristevski <sup>1</sup>

<sup>1</sup> University “St. Kliment Ohridski” University – Bitola, ul. Partizanska bb, Bitola, 7000  
R. N. Macedonia

## Abstract

The project Cross4all was intended to be a cross-border initiative towards the establishment of inclusive e-health and social services, free of accessibility barriers and with a specific focus on improving the health and medical services and data of high-risk citizens. In addition, the project plan was to increase the number of people that access high-quality health and social services in the cross-border area, promoting safe aging, early prevention, and independent living for all. For achieving these objectives and intentions, the planned activities were focused on creating deliverables arising from activities in the Cross4all project, with a focus on using IT. This paper summarizes the Cross4all project results from implementing innovative techniques for e-health services and creating an innovative digital ecosystem. This eco-system contains a cloud-based webPHR system, mobile applications for professionals and remote citizens working according to IoT principles, e-prescriptions and e-referrals system, e-learning platform, accessible web portal and help-desk devices for accessible help, all created to be fully accessible in accordance with the WCAG 2.0 (AA) principles.

## Keywords

e-health services, digital ecosystem, WCAG 2.0 (AA) principles, Internet of Medical Things, personal health records.

## 1. Introduction

The Cross4all project took place in the cross-border area between Greece and the Republic of North Macedonia, with six partner participants in the project with different expertise needed for the realization of the project activities. A big part of the population living in the cross-border had just poor access to health and social services. This was obvious in the rural areas without infrastructure for healthcare

---

Information Systems & Grid Technologies: Fifteenth International Conference ISGT'2022, May 27–28, 2022, Sofia, Bulgaria



© 2022 Copyright for this paper by its authors.  
Use permitted under Creative Commons License Attribution 4.0 International (CC BY 4.0).  
CEUR Workshop Proceedings (CEUR-WS.org)

and social service, with long-lasting poverty, lack of inclusive services, poor living conditions, and low level of access to available eHealth services. There is a lack of other digital services in educational, healthcare and social services, especially for a focus group of the Cross4all (poor people, persons with disabilities, chronic conditions, elderly people and children). For all these mentioned reasons, Cross4all project [1] objectives were:

- to foster the process of gaining health literacy and digital health literacy for cross border population;
- to design innovative practices for tackling health inequalities and improving access for all;
- to establish new mechanisms focused on the conditions of poverty, and services of comfort at home, including rural and isolated areas;
- to unblock the potential of healthcare professionals in offering care services to those most in need;
- to promote joint strategies for developing integrated health and social care sans frontiers.

The specifics of the two health systems on both sides of the border (Greece and Macedonia), especially the standards established in health, medicine and social protection were studied by the project partners. The technical partners examined the standards for inclusion of citizens with special needs, disabilities, the elderly and children. These standards were related to their involvement in the use of digital tools, legislation on personal data protection, and current software solutions in both countries, the conditions of citizens with disabilities, senior citizens and children in terms of accessibility and use of digital tools.

For the project, the HL7 (FHIR) standards, classification systems used in healthcare and medicine in both countries and in the world, in general, were studied (ICD10, SNOMED, pharmaceutical systems and other standards and code systems needed to create digital tools).

Ongoing health strategies in the two participating countries were analyzed and a strategy for improving digital health literacy, e-literacy and raising health self-management was proposed. An action plan to improve health care for vulnerable populations on both sides of the border was also proposed including activities and measures to be implemented.

## **2. Background of Cross4all project**

The entry-level activities for the project started with the surveys on the two sides of the border for creating a Joint study for the gaps and inequity of the citizens to access to health and social services. According to this study, made by the professional assessors and telephone surveys, the joint study for gaps and inequity to access to healthcare and social services on the two sides of the border was made.

In addition, according to these insights, within the Cross4all project, a draft of the strategy and the action plan for the cross-border area for the focus groups was created (Joint Strategy & Action Plan with emphasis on inclusive social/health care practices for elderly and disabled citizens). Guide for special, accessible healthcare and social services available in the cross-border area was also created in 3 languages (English, Macedonian, Greek) and accessible alternative formats. The joint guide is also printed and disseminated in the area in 5 000 items in 3 languages.

For arising awareness for healthcare self-management, increasing healthcare and digital healthcare literacy, 4 workshops were organized, online in the pandemic circumstances, each for 80 people. The workshops had a very strong influence on the participants and their families, producing a high interest in the project results.

To increase the quality of healthcare services, the Guide for professionals was created, printed in 2 languages (Macedonian and Greek in 2 000 items), in an alternative format [2]. It was disseminated in and out of cross-border area for healthcare and social professionals.

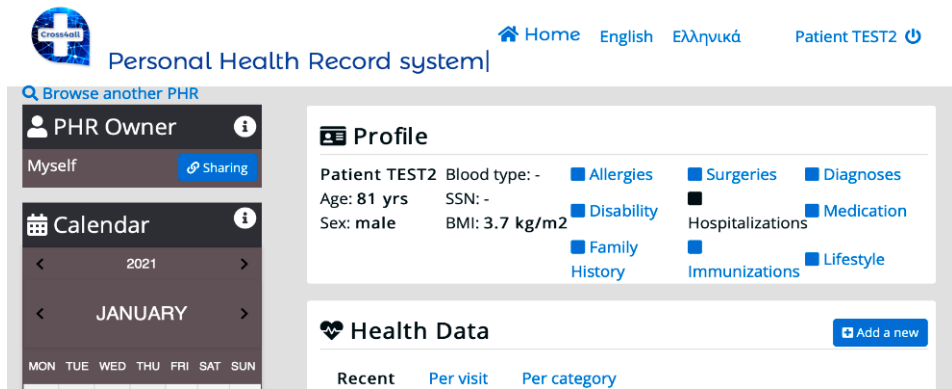
According to the project plan, 6 three-day local seminars were organized (online in the condition of Covid-19 pandemic) for 50 people in the project partners' municipalities in order to make an influence on the increase of health and digital health literacy of the focus groups of the project. For this purpose, educational materials for increasing health and digital health literacy were produced, stored in the accessible e-learning platform in 3 languages. Due to the need of the focus groups and citizens of the area, there were also materials for raising awareness for healthcare self-management of the population of the focus groups. The impact of these seminars was assessed through an online survey where the participants answer questions about their health, digital health and digital literacy.

### **3. Practical implementation of Cross4all project**

#### **3.1. Cross4all ecosystem and its digital tools**

The legal regulations for the protection of the privacy of patients and doctors, for the levels of protection of the private and health data of patients and citizens in the two participating countries, were studied. According to them, the architecture of the Cross4all cloud webPHR system was developed as an integrated project ecosystem that intends to store patient data on both sides of the border. This broad architecture, which is an integral part of the entire Cross4all ecosystem, has appropriate Authorization, Authentication and Accounting (AAA) services with the help of Keycloak servers on both sides of the border [3, 4]. With the start of the activities for creating the central cloud web PHR application, Figure 1 and the system analysis that was done for this purpose, an inadequate level of knowledge

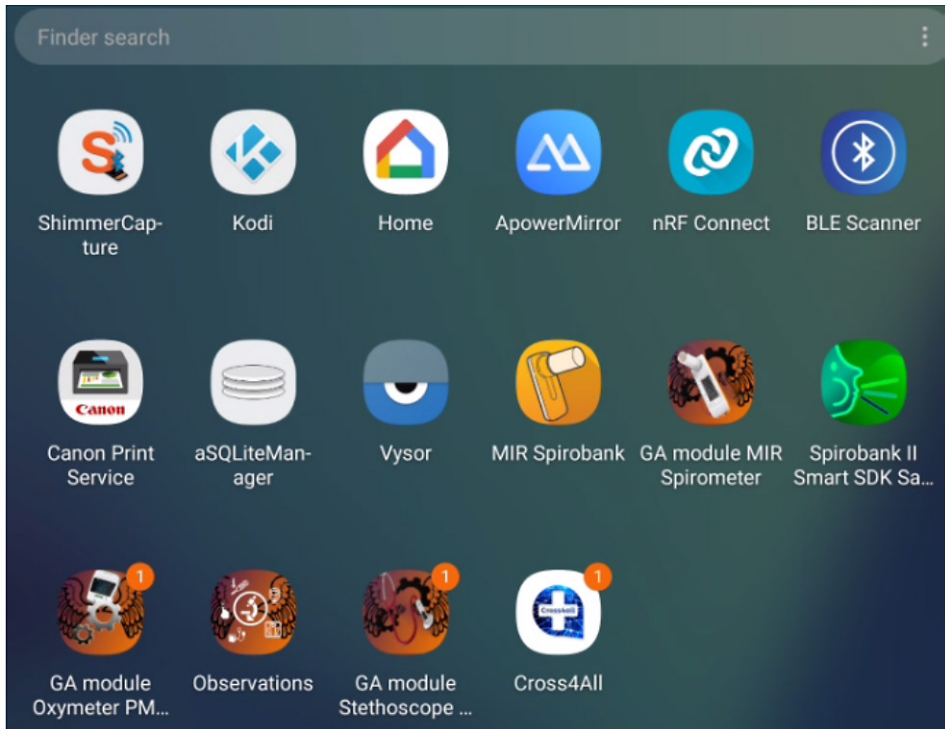
of the concept of personal health file (PHR) from the medical staff was detected. In addition, the patients' health and digital health literacy, on both sides of the border were assessed as insufficient. Initially, the patient who owns the PHR of the webPHR system chooses to which country he belongs and accordingly receives a screen in the appropriate language that can be changed to one of the 3 languages of the project. The system works with one-time authentication codes initially when creating PHR for the patient and the doctor, then uses its own authentication and identification data [5].



**Figure 1:** WebPHR cloud-based system of the Cross4all eco-system

Data protection and privacy on both sides of the border were also among the priorities of the technical teams of the project due to different legal regulations in both countries, as well as the law on health care and the law on personal data protection of citizens. Because of this, the teams worked with legal entities that defined the limits of the use of personal data and their storage in electronic form. The next step was a translation of the analysis into requirements for digital data privacy protection, which was the basis for selecting and deploying a privacy and security system for the entire ecosystem. The selected Keycloak servers on both sides of the border provided separate data servers for both country participants [6]. According to these criteria and standards set in the project and implemented in the Cross4all ecosystem, the personal data of the owners of the electronic personal health records and the health and medical data created by the patients were stored on the appropriate side of the border. As data owners, patients and their temporarily selected doctors can enter data manually or with the help of the instruments available to them. Data acquired in the project, with medical devices/sensors, which measure vital signs of life, related to mobile applications, and connected to the project ecosystem on the principle of telemedicine were stored according to law for privacy data protection, on the suitable side of the border.

The next part of the Cross4all eco-system included all necessary activities for developing appropriate mobile applications for citizens and professionals as well as for medical tourists in the area, as shown in Figure 2 [7]. The technical partners developed mobile ICT tools for supporting the operation of data collection and supporting the concept of “evidence-based medicine” for the patients. Mobile applications for professionals and citizens were used in the project’s Centers of reference for health issues. As a central point of the system, the PHR system was used as the center of all connected help possibilities for patients. The experts from Centers of reference, from healthcare services and Mobile units from two municipalities on two sides of the border, were equipped with mobile applications for professionals. They also have devices for preventive health services, pre-diagnostic and guidance of the patients, and mobile applications for citizens with smart devices, connected with sensors for vital signs of life measuring. Mobile applications were used to perform preventive health onsite as well as help at home. Mobile application for citizens was used also by Mobile Units from municipalities, equipped with mobile kits for remote citizens that, after a first visit, are identified as the candidate for short-period tele monitoring. In the frame of the project, 10 complete sets of equipment were provided for the medical professionals in the cross-border area with tablets, wireless sensors for vital sign recording (Littman stethoscope, heart rate sensor, heart pressure, spirometer, cardiograph, weight scale, body temperature, and arterial oxyhemoglobin saturation (SpO<sub>2</sub>), glucometer, etc.). The healthcare professionals as staff of the Centers of reference for health issues and Mobile units were trained appropriately in order to be able to deliver a large part of their services at the patients’ homes for the focus groups of the project (people with disability and/or reduced mobility, elderly, children, patients with chronic diseases) [8].



**Figure 2:** Cross4all mobile application for citizens' main menu

The mobile application for citizens was developed as a completely accessible mobile platform with WCAG 2.0 (AAA) compliance for accessible remote help based on the tele monitoring principles, as shown in Figure 3. 25 completes sets of equipment (with tablet/mobile, the wireless sensor for vital sign monitoring and recording of heart rate, heart pressure, breath rating, glucometer, SPO2, tracker, etc.) were on disposal to the Centers of reference for health issues and their Mobile units in two sides of the border. The mobile application for citizens was a part of the Cross4all eco-system and collected patient data in their PHR in a secure and accessible way, in accordance with the country of living of the patients. It was also developed in 3 languages and assessed according to WCAG compliance with a high score of compliance.

The use of sensors to measure vital signs of life according to the Internet of Things – IoT principle was another area explored in the project. Namely, the devices planned to be used in the project (wearables – sensors), were selected according to quality standards and according to the reliability and availability of sensors that were associated with mobile applications for the needs of medical staff and patients. The equipment selected by the Joint Technical Committee

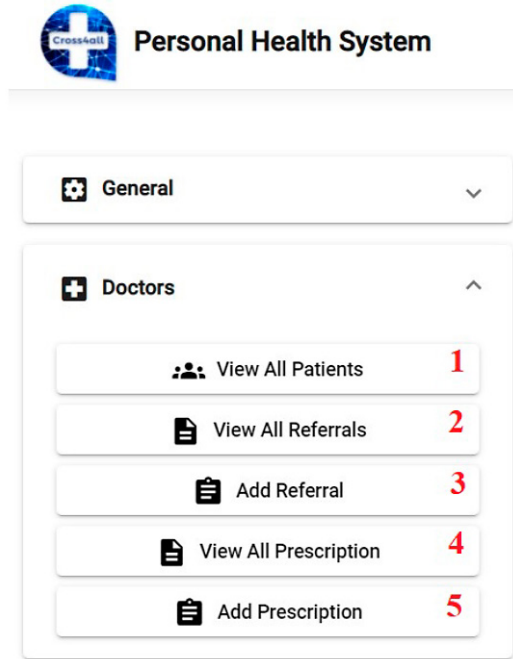
provided a range of features needed for the project. In order to meet the Procurement Procedures for the project and to link to applications for citizens and medical professionals, the technical partner studied their Bluetooth connectivity. The technical teams, after the purchase of the equipment for measuring vital signs of life, worked on security preferences regarding the use of devices connected to the mobile application, without using the cloud service of manufacturers and detecting Bluetooth secure communication with each of the devices. They transfer data to tablets or mobile phones in a secure way, encrypted and in a format defined by FHIR standards, according to ontologies that were set as a standard in health and medicine. This data were stored in the mobile applications and were transferred to the patient's PHR. Data from measured vital signs of life on the cloud service are stored in a safe way, protected, encrypted, and thus entered in the database on the appropriate side of the border to which the patient belongs, no matter where he is in the moment. The whole complex procedure, with all devices, brought new knowledge of communication of measuring sensors connected with the mobile application, user friendly, into web PHR system and transferred data over the network in a secure way, encrypted and with a secure transmission.



**Figure 3:** Devices that can be selected from the screen of the mobile application for remote citizens

The development of the service for e-prescriptions and e-referrals, Figure 4 intended to enable the citizens who are outside the place of residence, either across the border or outside the state health system to be able to receive medicines or referral to an appropriate specialist. It is a part of the web PHR ecosystem and allows the doctor temporarily selected by the patient to have access to his/her health record, to monitor his/her health condition (remotely or in his/her clinic, hospital) [9]. Depending on the need, the selected medical practitioner can prescribe medication and authorize a pharmacist from whom the patient can pick up the medicine, giving temporary access to the part of the patient's medical file, which contains the medicines that are registered with the module e-prescriptions. The specialist, to whom the e-referral was intended in PHR, can receive temporary access to the patient's file, and the patient can receive health care from the selected specialist. The specialist has the opportunity to see the data from his PHR and according to that data and results to make a decision about the patient's future treatment and give recommendations to the doctor who sent the patient to him. All these features are available in the project ecosystem part e-prescription and e-referral system. It can also be considered as a learned lesson, that despite these possibilities of the system, the requirements for connection to the national health care system are still impossible, both due to the concept of PHR ownership by the patient and due to the concept of different protection law of national systems. The Ministry of Health is the owner of data gained for patients in the national systems and data protection is at the level of providers of health and medical services. The lesson learned is that physicians can reap the benefits of both systems, the national continuum and the web PHR system while the project is in progress. The partners attempted to obtain patient data by the national health software "MojTermin", but that attempt failed due to different security preferences of the two independent systems.

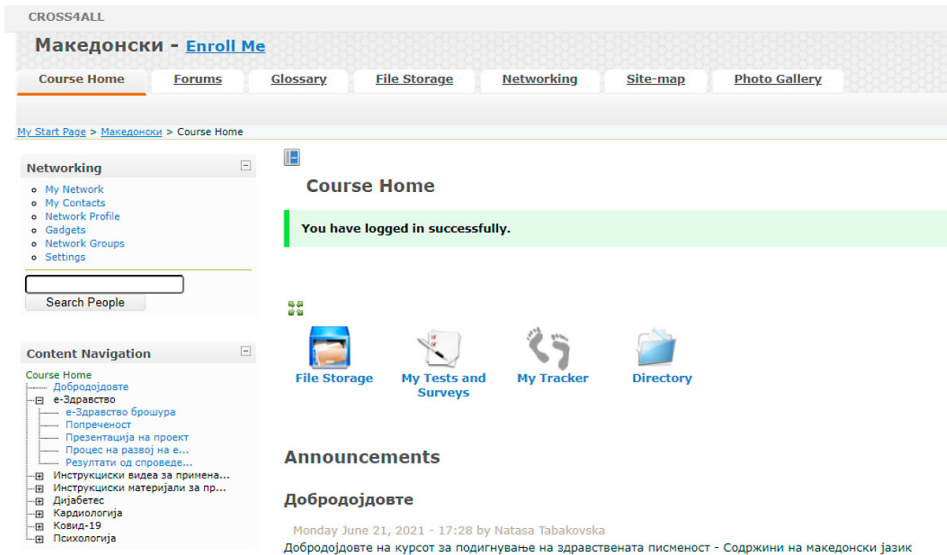




**Figure 4:** e-prescriptions and e-referrals service

Support table and public information points through the access kiosks set up in the municipalities in which the Pilot Project took place enable citizens to access the information on how and where they can get health and social services from the project. They also can find information on how to get their own health card and all health and social services that go with them. Like all other project tools, these digital tools are accessible to citizens with disabilities and are located in places that are easily accessible to them.

In order to select an appropriate e-learning platform, Figure 5 and to increase digital health literacy and awareness of the possibilities for health self-management, the most used 8 e-learning platforms were analyzed, from which ATutor platform was selected.



**Figure 5:** e-learning platform for Cross4all

Five platforms, according to the WCAG compliance criteria (Accessibility standards for digital tools for people with disabilities, senior citizens and children), were selected in the first phase. These five best-placed e-learning platforms were analyzed according to the criteria for WCAG2.0 and WCAG 2.1 for AA and AAA compliance (Moodle, Elademy, Docebo, Sakai, ATutor) [10, 11]; according to the properties related to assistive technologies (for citizens with visual, auditory and motor impairments) for all three levels of compliance A (must have), AA (should have) and AAA (may have). These properties must, should and may possess in order to be suitable for use by the indicated persons. These analyzes distinguished ATutor as the highest-rated e-learning platform with the highest performance for working citizens with disabilities (visual, auditory and motor impairments). Here we should emphasize that the consents of the selected five e-learning platforms for citizens with Autistic disorders were also considered. These proved to be included in the ATutor; the ways in which they are presented and the opportunities offered by ATutor are completely appropriate for children and citizens facing any of the Autistic Disorders [12]. The entire content was translated in the 3 languages of the project and accessible at [13].

#### **4. Pilot projects activities, capitalization and sustainability of the project's outcomes**

This part of the project considers activities and their impact, including practical Pilot implementation according to the concept of e-health and with the usage of Cross4all digital tools offers to citizens of the target groups preventive services and support to digitalize their personal health records. They achieved these aims according to the patients' needs, with help of the staff of pilots Centers of reference for healthcare services as well as reaching out to individuals at remote and isolated areas by the Mobile Units.

These activities of Pilot projects provided implementation of two Pilots in two municipalities together with the Clinic for prevention, treatment and rehabilitation of cardiovascular diseases "St. Stefan" from Ohrid. In the Pilot program, they succeeded to improve and extend their healthcare and social care services to better address the special needs of the target groups. The improved part was provided through improved primary healthcare and social care services (preventive health services, diagnostic pre-assessment, guidance, prescription services.).

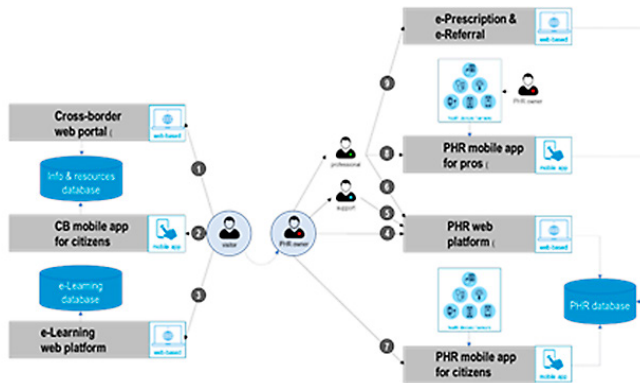
These services were fully accessible, in 3 languages and fully friendly for the citizens with chronic conditions and citizens with disabilities, children with disabilities. With the usage of e-health concept with web PHR, e-prescription and e-referral system, equipped with mobile sets (wireless sensors and smart devices), the staff members of the Centers of reference for healthcare services was able to provide medical help in the site and in the patients' home. They have trained appropriately in order to be able to deliver a large part of their services at the homes of people from target groups and in the rural and distant areas. In this way, the citizens obtained e-health services from home by the selected medical staff to which they give grand permission to access their medical dossier (PHR) through web-based cloud webPHR service. In this way, they also used mobile applications for monitoring vital signs of life for the patients at home, saved and transferred in their PHR and e-prescription and e-referral system. From their homes, they used a completely accessible e-learning platform for increasing health and digital health literacy, awareness for self-healthcare management and accessed the web portal [cross4all.eu](http://cross4all.eu) for accessible healthcare information. They can also use the services by the healthcare professionals with mobile apps for professionals at Centers of reference for healthcare service.

This digital eco-system gave many possibilities to healthcare services at home to the project's focus groups and improved their healthcare and wellbeing in the cross-border region. The spreading of the concept was by the Pilot project that raised the awareness for available healthcare and e-health services accessible for the citizens of cross-border areas in two municipalities, participants in the Cross4all project.

The activities of capitalization of project's results, the feasibility of the project's outcomes as well as the possibility for results' transferability were ran in the pandemic of Covid-19 and, unfortunately, were changed with online events activities.

## 5. Scenarios provided in the Cross4all project for citizens and patients

The implementation of the project enabled the realization of the following 9 scenarios shown in Figure 6, which were provided by the project [14]:



**Figure 6:** Scenarios provided by the Cross4all project for enabled services for citizens

- a) A Visitor (citizen or health professional or volunteer) who can access through his own device or through a public project info-kiosk the public web portal to find information on healthcare services. Including information about access and accessibility, maps, inspections' data, transportation info, educational resources produced in the project, information on survey results as well as other key project outcomes guidance about existing tools, services and resources (project Help desk), how to get involved in volunteering into the volunteer program.
- b) The role of Visitor (citizen or volunteer) may also use information for tourist on his/her own mobile device and use for accessible information about available services, in order to create a travel plan that is georeferenced and get information from the Help desk. The planned application unfortunately was not developed due to the Covid-19 pandemic and the inability to travel across the border, i.e. tourists could not travel for a long time. They can still access web portal cross4all.eu to retrieve information about available health and social services in the cross border region.

c) A Visitor (citizen) may also be informed of the existence of a special e-Learning platform to register to special courses related to health literacy (the ability to obtain, read, understand, and use healthcare information in order to make appropriate health decisions and follow instructions for treatment, e.g., for addressing or solving various health problems. A visitor may also register to special courses related to digital health literacy (set of skills, knowledge, and attitudes that a person needs to seek, find and appraise health information and services from electronic sources, and to find, select and make effective use of available tools (PHRs, devices, mobile apps, etc.)

These entire three visitor roles that are enabled by the project do not imply using the project's cloud webPHR platform until the visitor decides to create his/her own electronic health personal card (e-PHR or PHR) as owner. Once a Visitor decides to create his own PHR on the project cloud, he/she becomes a PHR owner, which is a new role in the Cross4all digital ecosystem.

d) A PHR owner (citizen) can use the webPHR platform through his/her own device or a public project info-kiosk to store/view his/her own health profile and history, own medication plan, visits to health service providers and upload related medical documents (per visit) as well as vital signals collected with his/her own (not connected) medical devices. A PHR owner can find, select and export data of his/her PHR in various formats and share data of his/her PHR in various ways, e.g., with health professionals within or across the borders.

e) A PHR owner (citizen) may visit any Local support expert (in special centers of reference in the municipalities, established in the project) to receive assistance. Or to learn how to use/manage his/her own PHR, how to initiate/configure his/her own PHR as well as receive service for digitizing paper-based records; and/or grant access for uploading them appropriately on his/her own PHR on his/her behalf.

f) A PHR owner (citizen) may visit any Health service professional (who has no access to a connected third-party system) and grant him/her access (temporary or not) to view parts or whole of his PHR, using the PHR web platform, access (visit-related) to add/upload data to his/her own PHR, using the PHR web platform. A PHR owner can be informed of data viewed by the professionals and to approve or not, as well as for data edited/entered by the professional.

g) A PHR owner (citizen) can download on his/her own mobile device the PHR mobile app for citizens or use a mobile set of devices provided by Cross4all. To store new data to view his/her own PHR, schedule and receive notifications related to his medical plan, doctor visits, store/view his/her vital signals collected with his/her own or provided (connected/supported) health devices/sensors and find, select and share data of his/her PHR, e.g., with health professional within or across the borders.

- h) A PHR owner (citizen) may visit any Health service professional who has access to a connected third-party system and:
  - [precondition: has granted the professional access rights (temporary or not) to view parts or whole of his/her PHR data] view parts or whole of the patient's PHR data through his/her PHR mobile app for pros.
  - [precondition: has granted the professional access rights to add/upload data (visit-related) to his/her PHR data] add/upload data (visit-related) to the patient's PHR through his/her PHR mobile app for pros,
  - [precondition: has granted the professional access rights to add/upload data (visit-related) to his/her PHR data] add vital signals to the patient's PHR (visit-related), which are collected through his/her health devices/sensors connected to his/her PHR mobile app for pros.
- i) A PHR owner (citizen) may visit any Health service professional who has access to a connected third-party system, and:
  - [precondition: has granted the professional access rights (temporary or not) to view parts or whole of his/her PHR data] view parts or whole of the patient's PHR data, through his/her e-prescription & e-referral systems
  - [precondition: has granted the professional access rights (temporary or not) to add/upload new data to his/her PHR data] add / upload data to the patient's PHR through his/her e-prescription & e-referral systems.

## 6. Conclusions

The Cross4all project made a huge impact on the citizens in cross-border areas of the two country participants in the municipalities that were partners in the project.

For the healthcare and social staff, the impact was obvious in unblocking their capabilities to give help to citizens of target groups using e-health and telehealth, telemedicine services. In addition, the medical staff is increasing their capability to help citizens from the target groups in centers of reference ambulance or at home, using webPHR, e-prescription and e-referral services, as well as mobile applications for citizens and professionals. They were empowered with a wide range of e-health and telemedicine services and devices and can give preventive healthcare and guidelines and in this way to decrease the gap between healthcare and social services and citizens of the focus groups of the project, providing online help. They also benefit from the project's training and workshops for increasing digital healthcare literacy and e-health literacy using healthcare sensors (such as the Internet of Medical Things) connected with mobile devices and mobile applications for professionals and citizens. They are also educated to give instructions to the patients who own their PHR in the web PHR system on how to increase their health and digital health literacy through Cross4all acces-

sible e-learning platform and how to increase their awareness for the need of self-HealthCare management. They can also monitor the patient's home and obtain data for evidence-based medicine.

For the target groups of citizens, the project Cross4all offers accessible healthcare services using the whole e-health and telemedicine Cross4all eco-system that provides creating a PHR on cloud webPHR eco-system. This allows the patient to have their digitalized PHR everywhere and select doctors to whom they can grant permission to access their medical dossier. In this way, the patients from target groups (citizens with chronic diseases, disabled peoples, elderly and children, poor citizens in distance and rural areas) can have e-health services at home and guidelines from their selected medical practitioners to cope with their medical problems, including tele monitoring kits for citizens at home and using the concept of evidence-based medicine.

For the municipalities, the project Cross4all provides Pilot Centers of reference of accessible e-health and mobile services to help their citizens and provide healthcare services at home and in the Centers of reference.

For the Cross4all project cross border area medical tourist, the project provides available data for accessible healthcare services in the cross-border regions. They can have their own PHR and give access to medical staff to have medical and healthcare services on the two sides of the border.

For the two participant-countries, the joint study for gaps and inequity in the accessible healthcare and social services provides information as well as a joint action plan and strategy on how to overcome the problems of inequity of accessible health and social services in the mentioned regions for the target groups of citizens. The Pilot project was also a good practice example that can be taken into consideration in solving detected problems.

For all countries in the region, the Project Cross4all (where Academic dissemination of the results are presented in international conferences and published in Academic digital libraries Scopus and Springer, etc.) can be taken as an example of good practice for the integration of e-health services cross-border, through patient's PHR. The webPHR and patient's PHR are accessible to the patients and their cross-border selected medical persons, taking into consideration the country of living of the patient, security and privacy issues and healthcare and medical standards and coding systems used in healthcare systems in all countries. The Cross4all eco-system is a practical cross border patient-centric healthcare system.

For the project partners, the experience and expertise that they had collected are obvious, especially for technical partners by gaining knowledge in advanced e-health services, healthcare and medical standards, and security and privacy services. They also obtained knowledge of using Internet of Things (IoT) and Internet of Medical Things (IoMT) services, as the base for creating demanded telemedicine and healthcare services with mobile applications. For the other partners,

the project provided enhancement of their awareness and ability to give advanced accessible help to the citizens of the target groups. The project also increased the ability of healthcare professionals through Centers of reference and Mobile units to give accessible help to the citizens of target groups using e-health services.

The huge Academic dissemination of the results with many published papers in the international conferences, published in the conferences' proceedings influence overall world's community and can be used as the example of good practices how this concept of PHR-patient centric system can be implemented cross-border.

Recommendations for further work:

- Connection of digital assets of the Cross4all project – webPHR with “Mo-jTermin”, a state application used by Secondary/Primary and Tertiary Health in the Republic of North Macedonia. Connecting as a third-party tool would provide citizens with the ability to own and access their medical files (PHR) via mobile application. This mobile application should enable monitoring of vital signs of life and transfer of measured data in PHR to the patient. By using these carrying sensors (sensors connected to smart device and mobile application for citizens), medicine based on evidence for medical staff as planned in the Cross4all border project should be provided. All physicians selected by patients may have access to medical records and provide medical assistance to patients i.e., e-prescription and e-referral services.
- Implementation of the concept in the entire Balkan region and beyond, which would provide an accessible assistance to the health and social services to a huge number of citizens.

## 7. References

- [1] Cross-border initiative for integrated health and social services promoting safe ageing, early prevention and independent living for all, Interreg – IPA CBC Cross4all, <https://cross4all.eu/en>.
- [2] Digital Guide for Professionals – Expertise on Accessibility for People with Disabilities and Service for Vulnerable Groups, Interreg – IPA CBC Cross4all, <https://cross4all.guide>.
- [3] S. Savoska, I. Jolevski, Architectural Model of e-health PHR to Support the Integrated Cross-border Services, Proceedings of the Information Systems and Grid Technologies conference 2018, 16–17 November 2018, Sofia, pp. 42–49, ISSN 1613-0073.
- [4] S. Savoska, I. Jolevski, B. Ristevski, N. B. Tabakovska, A. Bocevaska, B. Jakimovski, I. Chorbev, and V. Kilintzis, Design of Cross Border Healthcare Integrated System and its Privacy and Security Issues, Computer and Communications Engineering, (2019), 13 (2). pp. 58–63. ISSN 1314-2291.
- [5] Central Authentication Service, Cross4all webPHR system, Interreg – IPA CBC Cross4all <https://phr.cross4all.eu>.



- [6] A. Bocevska, S. Savoska, B. Ristevski, N. B. Tabakovska, I. Jolevski, V. Trajkovik, Cross4all Project Model of Integration of Healthcare Data Using the Concepts of EHR and PHR in the Era of IoT, The 14<sup>th</sup> conference on Information Systems and Grid Technologies, May 28–29, 2021, Sofia, Bulgaria, pp. 165–177. ISSN 1613-0073.
- [7] N. B. Tabakovska, A. Bocevska, I. Jolevski, B. Ristevski, N. Beredimas, V. Kilintzis, N. Maglaveras, S. Savoska, Implementation of Cloud-Based Personal Health Record Integrated with IoMT, The 14<sup>th</sup> conference on Information Systems and Grid Technologies, May 28–29, 2021, Sofia, Bulgaria, pp.182-202. ISSN 1613-0073.
- [8] S. Savoska, N. B. Tabakovska, I. Jolevski, A. Bocevska, B. Ristevski, V. Kilintzis, V. Chatzis, N. Beredimas, N. Maglaveras, V. Trajkovik, Integration of IoMT Sensors' Data from Mobile Applications into Cloud based Personal Health Record, 13<sup>th</sup> ICT Innovations Conference 2021, Skopje, Republic of North Macedonia.
- [9] D. Kitanovski, A. Stojmenski, I. Chorbev, B. Jakimovski, S. Savoska, B. Ristevski, I. Jolevski, N. B. Tabakovska, A. Bocevska, "Implementation of a Cloud-Based Personal Health System for Cross-Border Collaboration", 13<sup>th</sup> ICT Innovations Conference 2021, Skopje, Republic of North Macedonia.
- [10] A. Bocevska, S. Savoska, B. Ristevski, N. Tabakovska-Blazheska, Analysis of Accessibility of the e-Learning Platforms According to the WCAG 2.0 Standard Compliance, VIII International Conference on Applied Internet and Information Technologies, (ICAII 2018), 5 October 2018, Bitola, R. Macedonia, pp. 26–31, ISBN 978-9989-870-80-4.
- [11] A. Bocevska, S. Savoska, B. Ristevski, N. Blazheska-Tabakovska, I. Nedelkovski, A Comparison of Accessible e-Learning Projects for Improving of Digital Health Literacy, 12<sup>th</sup> Information Systems and Grid Technologies (ISGT2018) Conference, 16–17 November, 2018, Sofia, Bulgaria, pp. 50–60, ISBN: 1613-0073.
- [12] N. Tabakovska-Blazheska, B. Ristevski, S. Savoska, A. Bocevska, Learning Management Systems as Platforms for Increasing the Digital and Health Literacy, 3rd International Conference on E-Education, E-Business and E-Technology (ICEBT 2019), 02.08-04.08.2019, Madrid, Spain, pp. 33–37, ISBN: 978-1-4503-7256-5.
- [13] Cross4all E-learning platform, Interreg – IPA CBC Cross4all, <http://atutor.cross4all.uklo.edu.mk/browse.php>
- [14] S. Savoska, V. Kilintzis, B. Jakimovski, I. Jolevski, N. Beredimas, A. Mourouzis, I. Corbev, I. Chouvarda, N. Maglaveras, V. Trajkovik, Cloud Based Personal Health Records Data Exchange in the Age of IoT: The Cross4all Project, ICT Innovations 2020, pp 28–41.